



Pulmonary hypertension in chronic lung diseases: a hospital-based cross-sectional observational study using echocardiographic assessment.

Dr. S Sunil Kumar¹, Dr. V Sai Savya^{2}*

¹*Divisional Medical Officer, South Central Railway Hospital, Lalaguda, Hyderabad, Telangana, India.*

²*Assistant Professor, Department of Pulmonary Medicine, ESIC Medical College and Hospital, Sanath Nagar, Hyderabad, Telangana, India.*

Abstract

Background:

Pulmonary hypertension in chronic lung diseases reflects pulmonary vascular remodeling and chronic hypoxic vasoconstriction, and it worsens exercise tolerance and clinical outcomes.

Objectives:

To estimate the prevalence and severity of pulmonary hypertension using echocardiographic assessment in chronic lung disease patients and to describe accompanying right heart changes.

Methods:

This hospital-based cross-sectional observational study was conducted at South Central Hospital, Lalaguda, South Central Railways, India, from January 2025 to October 2025. Adults with established chronic lung disease underwent standardized transthoracic echocardiography for estimation of pulmonary artery systolic pressure and evaluation of right heart structure and function.

Results:

Among 100 participants (mean age 58.6 ± 11.4 years; 62% males), pulmonary hypertension was detected in 46%. Mild pulmonary hypertension constituted the largest subgroup, while 8% had severe pressure elevation. Participants with pulmonary hypertension had a longer duration of respiratory illness, lower resting oxygen saturation, and a higher frequency of right ventricular dilatation and reduced tricuspid annular plane systolic excursion compared with those without pulmonary hypertension.

Conclusion:

Echocardiographic pulmonary hypertension was common in chronic lung diseases and was associated with right heart involvement and markers of advanced respiratory impairment.

Recommendations:

Echocardiographic screening in symptomatic chronic lung disease patients, particularly those with prolonged illness and resting desaturation, can enable early risk stratification and timely referral for comprehensive pulmonary hypertension evaluation.

Keywords: *Chronic lung disease; Echocardiography; Pulmonary artery systolic pressure; Pulmonary hypertension; Right ventricular dysfunction.*

Submitted: December 22, 2025 **Accepted:** February 20, 2026 **Published:** March 30, 2026

Corresponding Author: *Dr. V Sai Savya*

Email: savyavemula@gmail.com

Assistant Professor, Department of Pulmonary Medicine, ESIC Medical College and Hospital, Sanath Nagar, Hyderabad, Telangana, India.



Introduction

Chronic lung diseases are a leading cause of disability and premature death worldwide. COPD contributes a substantial share of the global respiratory burden and remains closely linked to preventable exposures such as tobacco smoke and air pollution [1]. As the prevalence of chronic respiratory illness increases, long-term complications that extend beyond ventilatory impairment have gained increasing attention, particularly cardiovascular comorbidity and pulmonary vascular disease [2].

Pulmonary hypertension (PH) in the setting of chronic lung disease represents an adverse pulmonary vascular phenotype characterized by elevated pulmonary pressures and progressive right ventricular (RV) afterload. In group 3 PH, key mechanisms include hypoxic vasoconstriction, loss of pulmonary capillary bed, endothelial dysfunction, and vascular remodeling. Recent syntheses underscore that PH associated with lung disease is frequently under-recognized because its symptoms overlap with chronic respiratory failure and deconditioning [3,4]. When present, PH is consistently linked with reduced functional capacity, higher exacerbation burden, and poorer survival.

Definitive diagnosis of PH requires right heart catheterization; however, contemporary guidelines endorse transthoracic echocardiography as the principal noninvasive tool for early detection, probability assessment, and evaluation of cardiac impact [4]. Updated hemodynamic definitions and classification frameworks have refined the diagnostic approach and have emphasized careful phenotyping in lung disease-associated PH [5]. Echocardiography allows estimation of pulmonary artery systolic pressure (PASP) and provides actionable information regarding RV size, RV systolic function, right atrial dimensions, and tricuspid regurgitation severity—variables that inform risk and referral decisions [6,7].

The burden of PH differs across chronic lung diseases. COPD-related PH is often mild, yet a clinically important subset develops moderate-to-severe PH with overt right heart dysfunction and high mortality risk [10,11]. Similarly, interstitial lung diseases (ILDs) can develop PH as fibrosis advances, and pooled evidence confirms that PH complicating ILD is common and clinically consequential [12]. In high-tuberculosis settings, post-TB structural lung disease represents another important substrate for chronic respiratory impairment; systematic evidence has shown a measurable PH burden in post-TB lung disease, supporting routine clinical vigilance [9].

Despite these insights, institution-level observational data remain limited in many tertiary-care settings, where patients often present late with longstanding symptoms and resting

hypoxemia. Estimating the echocardiographic PH burden and defining associated right heart changes in such populations can support local screening strategies and referral pathways.

Objectives: (1) To determine the prevalence and severity of pulmonary hypertension among patients with chronic lung diseases using echocardiographic assessment; (2) To evaluate right heart structural and functional changes associated with pulmonary hypertension; and (3) To examine associations of pulmonary hypertension with disease duration and resting oxygen saturation.

Materials and Methods

Study design and setting

This was a hospital-based observational cross-sectional study conducted in the Department of Pulmonary Medicine at South Central Railway Hospital, Lalaguda, Hyderabad, Telangana, India, from January 2025 to October 2025. The hospital is a tertiary-care healthcare institution that provides outpatient, inpatient, emergency, diagnostic, radiological, and cardiopulmonary evaluation services for patients from Hyderabad and surrounding regions. Patients with chronic respiratory diseases attending pulmonology outpatient and inpatient services were evaluated during the study period.

Participants and sampling

Consecutive adult patients with established chronic lung disease were screened for eligibility. Patients fulfilling the inclusion criteria were enrolled until the required sample size was achieved. This consecutive sampling approach was used to reduce selection bias and to ensure that the study population represented routine hospital-based chronic lung disease patients.

Eligibility criteria

Inclusion criteria were age ≥ 18 years, documented chronic lung disease of at least 6 months' duration, and clinical stability at the time of echocardiographic assessment. Patients were excluded if they had congenital heart disease, significant left-sided valvular heart disease, left ventricular systolic dysfunction, suspected chronic thromboembolic pulmonary hypertension, or inadequate echocardiographic windows. These exclusions were applied to minimize non-respiratory causes of elevated pulmonary artery pressure and improve internal validity.

Sample size determination

The sample size was estimated using the single-proportion formula for cross-sectional studies:



$$n = Z^2pq / d^2$$

where $Z = 1.96$ at 95% confidence level, p = anticipated prevalence of pulmonary hypertension among chronic lung disease patients, $q = 1 - p$, and d = absolute precision. Based on previous evidence suggesting that pulmonary hypertension may occur in approximately 40% of chronic lung disease patients, p was taken as 0.40, q as 0.60, and d as 0.10. The calculated sample size was:

$$n = 1.96^2 \times 0.40 \times 0.60 / 0.10^2 = 92.2$$

The minimum required sample size was therefore 93. After allowing for possible incomplete clinical records or technically inadequate echocardiographic assessment, the final sample size was rounded to 100 patients.

Clinical data collection

Data were collected using a structured proforma. Information regarding age, sex, smoking history, primary respiratory diagnosis, and duration of lung disease was recorded. Resting peripheral oxygen saturation was measured by pulse oximetry after at least 5 minutes of seated rest. Based on available clinical records and physician diagnosis, patients were classified as having chronic obstructive pulmonary disease, interstitial lung disease, bronchial asthma, or post-tuberculosis sequelae.

Echocardiographic assessment

All participants underwent standardized transthoracic echocardiography performed by trained personnel. Transesophageal echocardiography was not used. Pulmonary artery systolic pressure was estimated from peak tricuspid regurgitation velocity using the modified Bernoulli equation, with the addition of estimated right atrial pressure. Right ventricular size, right atrial enlargement, tricuspid regurgitation severity, and right ventricular systolic function were assessed using standard echocardiographic parameters. Tricuspid annular plane systolic excursion below 17 mm was considered suggestive of reduced right ventricular systolic function.

Operational definitions

Echocardiography-detected pulmonary hypertension was defined as pulmonary artery systolic pressure ≥ 35 mmHg. Severity was categorized as mild pulmonary hypertension when PASP was 35–44 mmHg, moderate when PASP was 45–59 mmHg, and severe when PASP was ≥ 60 mmHg. Right heart involvement was recorded when right ventricular dilatation, right atrial enlargement, reduced TAPSE, or moderate-to-severe tricuspid regurgitation was present.

Bias control

Potential sources of bias were identified during study planning and addressed at different stages. Selection bias was minimized by enrolling consecutive eligible patients rather than selectively recruiting severe or clinically obvious cases. Measurement bias was reduced by using a uniform clinical proforma, standardized pulse oximetry procedure, and predefined echocardiographic criteria for pulmonary hypertension and right heart assessment. Misclassification bias was minimized by classifying chronic lung disease based on documented clinical records and the treating physician's diagnosis. Confounding by other cardiac or vascular causes of pulmonary hypertension was reduced by excluding patients with left ventricular systolic dysfunction, significant left-sided valvular disease, congenital heart disease, and suspected chronic thromboembolic disease.

Statistical analysis

Data were analyzed using descriptive and inferential statistics. Continuous variables were expressed as mean \pm standard deviation or median with interquartile range, depending on distribution. Categorical variables were summarized as frequencies and percentages. Patients with and without pulmonary hypertension were compared using the independent samples t-test for continuous variables and the chi-square test or Fisher's exact test for categorical variables, as appropriate. Potential confounders such as age, sex, smoking status, primary lung disease type, duration of illness, and resting oxygen saturation were considered during analysis. Where applicable, stratified analysis and multivariable logistic regression were used to examine whether pulmonary hypertension remained associated with clinical and echocardiographic variables after adjustment for relevant confounders. Missing data were checked before final analysis. Participants with incomplete key echocardiographic data were excluded, while any minor missing values in secondary variables were handled using complete-case analysis without imputation. A p -value < 0.05 was considered statistically significant.

Ethical considerations

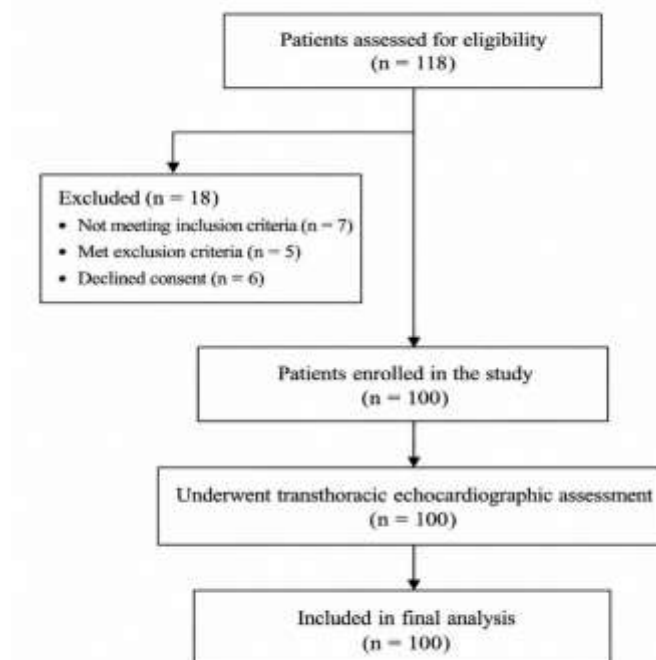
The study protocol was reviewed and approved by the Institutional Ethics Committee/competent institutional authority of South Central Railway Hospital, Lalaguda, Hyderabad, Telangana, India. Written informed consent was obtained from all participants before enrollment.

Results

A total of 100 patients with chronic lung diseases were included in the final analysis. All participants underwent

standardized transthoracic echocardiographic evaluation for estimation of pulmonary arterial pressure and assessment of right heart structure and function.

Figure 1. Participant Flow Diagram



The mean age of the cohort was 58.6 ± 11.4 years, with male predominance (62%). COPD represented the largest diagnostic subgroup (48%), followed by ILD (26%), bronchial asthma (16%), and post-tuberculosis sequelae

(10%). The median duration of chronic respiratory illness was 7 years (IQR: 4–12), and 54% were ever-smokers (Table 1).

Table 1. Baseline demographic and clinical characteristics (N = 100)

Variable	Value
Age (years), mean \pm SD	58.6 ± 11.4
Sex, n (%)	Male: 62 (62.0); Female: 38 (38.0)
Duration of lung disease (years), median (IQR)	7 (4–12)
Primary lung disease, n (%)	COPD: 48 (48.0); ILD: 26 (26.0); Asthma: 16 (16.0); Post-TB sequelae: 10 (10.0)
Ever smokers, n (%)	54 (54.0)

Overall, 46 participants had echocardiographic evidence of pulmonary hypertension. Mild PH (35–44 mmHg) was the most frequent category (24%), while severe PH (≥ 60 mmHg) was observed in 8% of the total cohort (Table 2).

The mean PASP among PH patients was 46.8 ± 11.9 mmHg, significantly higher than in participants without PH (28.4 ± 4.6 mmHg; $p < 0.001$).

Table 2. Prevalence and severity of pulmonary hypertension based on PASP (N = 100)

PH category	Number (%)
No PH (PASP <35 mmHg)	54 (54.0)
Mild PH (35–44 mmHg)	24 (24.0)
Moderate PH (45–59 mmHg)	14 (14.0)
Severe PH (\geq 60 mmHg)	8 (8.0)
Total with PH	46 (46.0)

Across diagnostic subtypes, PH prevalence was highest in ILD (61.5%) and post-tuberculosis sequelae (60.0%), followed by COPD (41.7%) and asthma (25.0%) (Table 3).

Table 3. Pulmonary hypertension according to underlying lung disease

Lung disease	Total (n)	PH present, n (%)
COPD	48	20 (41.7)
ILD	26	16 (61.5)
Asthma	16	4 (25.0)
Post-TB sequelae	10	6 (60.0)
Overall	100	46 (46.0)

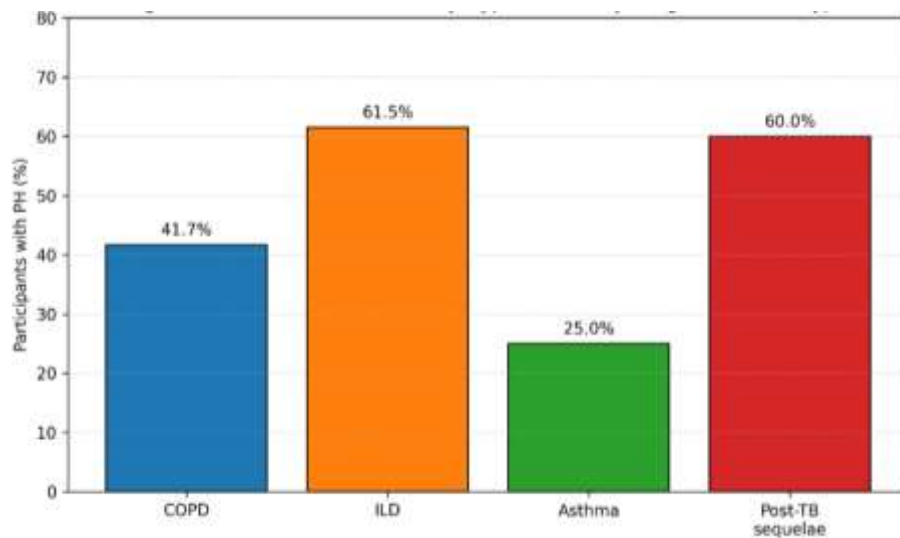


Figure 1: Prevalence of Pulmonary Hypertension by Lung Disease Subtype

Right heart structural and functional involvement was common among those with PH. RV dilatation was present in 60.9% of PH patients versus 7.4% of those without PH, and reduced TAPSE (<17 mm) was observed in 52.2% versus 7.4%, respectively (both $p < 0.001$). Right atrial

enlargement was also more frequent in PH patients (43.5% vs 3.7%; $p < 0.001$) (Table 4).

Patients with PH had a longer duration of lung disease (9.8 ± 4.6 vs 5.6 ± 3.2 years; $p < 0.001$) and lower resting SpO_2 ($88.2 \pm 4.1\%$ vs $92.6 \pm 3.8\%$; $p < 0.001$) compared with the no-PH group (Table 4).



Table 4. Echocardiographic right heart findings and clinical associations

Parameter	PH present (n=46)	No PH (n=54)	p value
PASP (mmHg), mean \pm SD	46.8 \pm 11.9	28.4 \pm 4.6	<0.001
RV dilatation, n (%)	28 (60.9)	4 (7.4)	<0.001
TAPSE <17 mm, n (%)	24 (52.2)	4 (7.4)	<0.001
Right atrial enlargement, n (%)	20 (43.5)	2 (3.7)	<0.001
Duration of lung disease (years), mean \pm SD	9.8 \pm 4.6	5.6 \pm 3.2	<0.001
Resting SpO ₂ (%), mean \pm SD	88.2 \pm 4.1	92.6 \pm 3.8	<0.001

Discussion

In this cohort of patients with chronic lung diseases evaluated using standardized transthoracic echocardiography, pulmonary hypertension was detected in 46% of participants. This observation highlights that lung disease-associated PH is frequent in routine clinical practice and is often accompanied by structural and functional right heart involvement. Modern reviews emphasize that PH in chronic lung disease is heterogeneous, frequently overlaps symptomatically with advanced ventilatory impairment, and therefore tends to be under-detected without targeted cardiovascular evaluation [2,3].

The prevalence observed in the present study is consistent with reports that demonstrate a substantial PH burden in advanced respiratory populations. In COPD specifically, pooled evidence indicates that approximately two-fifths of patients can have echocardiographic or hemodynamic PH, with mild PH representing the majority and severe PH forming a smaller but high-risk subgroup [10]. Our severity pattern similarly showed predominance of mild PH, while 8% had severe PH, a distribution that aligns with existing syntheses and underscores the need for screening beyond spirometric grading alone [10,11].

PH proportions were highest in ILD and post-tuberculosis sequelae in this study. For ILD, systematic review data confirm that PH is common and has tangible prognostic implications, particularly when pulmonary pressure elevation is moderate to severe [12]. Post-TB lung disease is increasingly recognized as a chronic respiratory condition with vascular consequences; meta-analytic evidence has documented a measurable PH prevalence, reinforcing the need to evaluate dyspnea and desaturation in such patients with a cardiovascular lens [12].

Right heart involvement was prominent among PH patients, with significantly higher rates of RV dilatation, reduced TAPSE, and right atrial enlargement. These findings are

physiologically coherent because sustained pulmonary pressure elevation increases RV afterload, leading to chamber remodeling and reduced longitudinal systolic function. Echocardiography guidance supports integrated assessment of pulmonary pressures and right heart parameters, and TAPSE remains a reproducible bedside marker of RV systolic performance that can help stratify risk in resource-constrained settings [8,13].

From a clinical standpoint, the observed associations between PH, longer disease duration, and lower resting SpO₂ provide actionable cues for targeted screening. International guidelines prioritize echocardiography as a key detection modality in the diagnostic pathway and recommend confirmatory right heart catheterization for patients with high echocardiographic probability and clinical suspicion of significant PH [4,5]. Within chronic lung disease services, early recognition of PH and RV dysfunction can guide optimization of lung disease therapy, reinforce the importance of oxygen supplementation in hypoxemic individuals, and facilitate timely referral to specialized centers for comprehensive evaluation and multidisciplinary management [14].

Generalizability

These results are most applicable to tertiary-care populations where chronic lung diseases often present at an advanced stage with prolonged symptoms and resting hypoxemia. The echocardiographic distribution of PH severity and the right heart correlates are likely transferable to similar hospital-based cohorts that rely on noninvasive screening. Generalization to community cohorts with early or mild respiratory disease requires caution because referral patterns and clinical stability differ substantially.



Conclusion

In this observational study, echocardiographic pulmonary hypertension was identified in 46% of patients with chronic lung diseases. Mild pressure elevation accounted for most cases, while a clinically important subset exhibited moderate-to-severe pulmonary hypertension accompanied by right ventricular dilatation and reduced TAPSE. Pulmonary hypertension was more frequent in interstitial lung disease and post-tuberculosis sequelae, and it was associated with longer respiratory illness duration and lower resting oxygen saturation. These findings support structured echocardiographic screening to improve detection of pulmonary vascular involvement, guide risk-based referral, and reinforce integrated cardiopulmonary care in routine practice. Regular reassessment can support timely escalation of oxygen and rehabilitation.

Limitations

This single-centre study relied on echocardiographic estimates of pulmonary pressures without routine confirmation using right heart catheterization. The cohort represented a tertiary-care population and included heterogeneous lung disease subtypes, which limits subtype-specific inference. Pulmonary function indices, imaging-based disease severity scoring, and biomarkers were not collected, restricting mechanistic interpretation. Longitudinal outcomes such as exacerbations, hospitalization, and mortality were not assessed.

Recommendations

Patients with chronic lung diseases who have disproportionate dyspnea, prolonged illness duration, or resting desaturation should undergo screening echocardiography for early detection of pulmonary hypertension and right heart dysfunction. Clinical pathways integrating SpO₂ assessment, standardized echocardiographic PASP estimation, and right heart functional metrics such as TAPSE can strengthen risk stratification. Optimization of disease-specific therapy, smoking cessation support, pulmonary rehabilitation, and long-term oxygen therapy in eligible hypoxemic patients should be prioritized. Individuals with suspected moderate-to-severe pulmonary hypertension require prompt referral to specialized centres for confirmatory evaluation and multidisciplinary management, with periodic follow-up to track RV function.

Acknowledgement

The authors thank all study participants for their cooperation. We acknowledge the Central Hospital, Lalaguda, South Central Railways, India, for facilitating patient enrollment and clinical assessment. We also recognize the echocardiography technicians and nursing staff for assistance in standardized transthoracic imaging and oxygen saturation measurements. Guidance and support from departmental faculty and the hospital administration during the study period are gratefully appreciated.

Abbreviations

CPD – Chronic obstructive pulmonary disease
ILD – Interstitial lung disease
PH – Pulmonary hypertension
PASP – Pulmonary artery systolic pressure
RV – Right ventricle / Right ventricular
RA – Right atrium / Right atrial
TAPSE – Tricuspid annular plane systolic excursion
TR – Tricuspid regurgitation
TTE – Transthoracic echocardiography
SpO₂ – Peripheral oxygen saturation
IQR – Interquartile range
SD – Standard deviation

Source of funding

The study has no funding

Conflict of interest

The author declares no conflict of interest.

Author contributions

VSS-Concept and design of the study, results interpretation, review of literature, and preparation of the first draft of the manuscript. Statistical analysis and interpretation, revision of manuscript. **SSK**- Design of the study, results interpretation, review of literature, preparation of the first draft of the manuscript, and revision of the manuscript.

Data availability

Data available on request

Author Biography

Dr. S. Sunil Kumar is a Divisional Medical Officer at the South Central Railway Hospital, Lalaguda, Hyderabad, Telangana, India. He completed his MBBS from MNR Medical College in 2011 and pursued his postgraduate training in Pulmonary Medicine, obtaining his MD from



Kakatiya Medical College in 2017. His clinical expertise includes the evaluation and management of chronic respiratory disorders, pulmonary hypertension, and respiratory care delivery in hospital-based settings. He is actively involved in patient-centered clinical practice and institutional healthcare services, and contributes to academic and research activities focused on improving respiratory outcomes through early diagnosis and evidence-based treatment strategies. **ORCID iD:** <https://orcid.org/0009-0006-5052-7689>

Dr. V. Sai Savya is an Assistant Professor in the Department of Pulmonary Medicine at ESIC Medical College and Hospital, Sanath Nagar, Hyderabad, Telangana, India. She completed her MBBS from Gandhi Medical College in 2010 and subsequently obtained her MD in Pulmonary Medicine from Kakatiya Medical College in 2014. Her academic and clinical interests focus on chronic respiratory diseases, pulmonary hypertension, and the application of echocardiographic assessment in respiratory medicine. She is actively involved in teaching undergraduate and postgraduate students and contributes to clinical research aimed at improving diagnosis and outcomes in patients with chronic lung disorders. **ORCID iD:** <https://orcid.org/0009-0004-3647-976X>

References

1. Safiri S, Carson-Chahhoud K, Noori M, et al. Burden of chronic obstructive pulmonary disease and its attributable risk factors in 204 countries and territories, 1990-2019: results from the Global Burden of Disease Study 2019. *BMJ*. 2022;378:e069679. doi:10.1136/bmj-2021-069679. PMID:35896191. <https://doi.org/10.1136/bmj-2021-069679>
2. Olsson KM, Corte TJ, Kamp JC, Montani D, Nathan SD, Neubert L, Price LC, Kiely DG. Pulmonary hypertension associated with lung disease: new insights into pathomechanisms, diagnosis, and management. *Lancet Respir Med*. 2023;11(9):820-835. doi:10.1016/S2213-2600(23)00259-X. PMID:37591300. [https://doi.org/10.1016/S2213-2600\(23\)00259-X](https://doi.org/10.1016/S2213-2600(23)00259-X)
3. Shlobin OA, Adir Y, Barbera JA, Cottin V, Harari S, Jutant EM, Pepke-Zaba J, Ghofrani HA, Channick R. Pulmonary hypertension associated with lung diseases. *Eur Respir J*. 2024 Aug 29;2401200. doi:10.1183/13993003.01200-2024. PMID:39209469. <https://doi.org/10.1183/13993003.01200-2024>
4. Humbert M, Kovacs G, Hoeper MM, et al. 2022 ESC/ERS Guidelines for the diagnosis and treatment of pulmonary hypertension. *Eur Heart J*. 2022 Oct 11;43(38):3618-3731. doi:10.1093/eurheartj/ehac237. PMID:36017548. <https://doi.org/10.1093/eurheartj/ehac237>
5. Simonneau G, Montani D, Celermajer DS, et al. Haemodynamic definitions and updated clinical classification of pulmonary hypertension. *Eur Respir J*. 2019;53(1):1801913. doi:10.1183/13993003.01913-2018. PMID:30545968. <https://doi.org/10.1183/13993003.01913-2018>
6. Augustine DX, Coates-Bradshaw LD, Willis J, et al. Echocardiographic assessment of pulmonary hypertension: a guideline protocol from the British Society of Echocardiography. *Echo Res Pract*. 2018;5(3):G11-G24. doi:10.1530/ERP-17-0071. PMID:30012832. <https://doi.org/10.1530/ERP-17-0071>
7. Parasuraman S, Walker S, Loudon BL, et al. Assessment of pulmonary artery pressure by echocardiography: A comprehensive review. *Int J Cardiol Heart Vasc*. 2016;12:45-51. doi:10.1016/j.ijcha.2016.05.011. PMID:28616542. <https://doi.org/10.1016/j.ijcha.2016.05.011>
8. Zaidi A, Knight DS, Augustine DX, et al. Echocardiographic assessment of the right heart in adults: a practical guideline from the British Society of Echocardiography. *Echo Res Pract*. 2020;7(1):G19-G41. doi:10.1530/ERP-19-0051. PMID:32105053. <https://doi.org/10.1530/ERP-19-0051>
9. Van Heerden JK, Louw EH, Thienemann F, Engel ME, Allwood BW. The prevalence of pulmonary hypertension in post-tuberculosis and active tuberculosis populations: a systematic review and meta-analysis. *Eur Respir Rev*. 2024 Jan 17;33(171):230154. doi: 10.1183/16000617.0154-



Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.7 No. 3 (2026): March 2026 Issue
<https://doi.org/10.51168/sjhrafrica.v7i3.2514>
Original Article

2023. PMID: 38232991; PMCID: PMC10792440. <https://doi.org/10.1183/16000617.0154-2023>
10. Zhang L, Liu Y, Zhao S, Wang Z, Zhang M, Zhang S, 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 Jun 10;17:1365-1379. doi: 10.2147/COPD.S359873. PMID: 35711174; PMCID: PMC9196913. <https://doi.org/10.2147/COPD.S359873>
11. Blanco I, Tura-Ceide O, Peinado VI, Barberà JA. Updated Perspectives on Pulmonary Hypertension in COPD. *Int J Chron Obstruct Pulmon Dis.* 2020 Jun 9;15:1315-1324. doi: 10.2147/COPD.S211841. PMID: 32606641; PMCID: PMC7293405. <https://doi.org/10.2147/COPD.S211841>
12. Ang HL, Schulte M, Chan RK, Tan HH, Harrison A, Ryerson CJ, et al. Pulmonary Hypertension in Interstitial Lung Disease: A Systematic Review and Meta-Analysis. *Chest.* 2024 Oct;166(4):778-792. doi: 10.1016/j.chest.2024.04.025. Epub 2024 May 29. PMID: 38821182. <https://doi.org/10.1016/j.chest.2024.04.025>
13. Zangiabadi A, De Pasquale CG, Sajkov D. Pulmonary hypertension and right heart dysfunction in chronic lung disease. *Biomed Res Int.* 2014;2014:739674. doi:10.1155/2014/739674. PMID:25165714. <https://doi.org/10.1155/2014/739674>
14. Aguirre-Franco C, Torres-Duque CA, Salazar G, Casas A, Jaramillo C, Gonzalez-Garcia M. Prevalence of pulmonary hypertension in COPD patients living at high altitude. *Pulmonology.* 2024 May-Jun;30(3):247-253. doi: 10.1016/j.pulmoe.2021.12.006. Epub 2022 Feb 10. PMID: 35151623. <https://doi.org/10.1016/j.pulmoe.2021.12.006>

PUBLISHER DETAILS:

Student's Journal of Health Research (SJHR)

(ISSN 2709-9997) Online

(ISSN 3006-1059) Print

Category: Non-Governmental & Non-profit Organization

Email: studentsjournal2020@gmail.com

WhatsApp: +256 775 434 261

**Location: Scholar's Summit Nakigalala, P. O. Box 701432,
Entebbe Uganda, East Africa**

