Pak. J. Chest Med. 2024;30(03)

Original Article

journal homepage: https:/www.pjcm.net/

Pakistan Journal of Chest Medicine

Official journal of Pakistan Chest Society

Epidemiology and Clinical Outcomes of Pulmonary Hypertension: A Cross-Sectional Study at Lady Reading Hospital, Peshawar

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Article History:

Received:	Apr 28, 2024
Revised:	Aug 04, 2024
Accepted:	Aug 22, 2024
Available Online:	Sep 02, 2024

Author Contributions:
SZ conceived idea, LA ZM drafted the study, SZ LA collected data, SZ AB did statistical analysis and interpretation of data, SZ ZM critically reviewed the manuscript. All approved final version to be published.

Declaration of conflicting interests:
The authors declare that there is no conflict of interest.

How to cite this article:
Zeb S, Aurangzeb L, Mehmood Z, Basit A, Ikhtiar Z. Epidemiology and Clirtical outcomes of Pulmonary Hypertension: A Cross-Sectional Study at Lady Reading Hospital, Peshawar. Pak J Chest Med. 2024; 30(03):155-164.

A B S T R A C T

Background: Pulmonary hypertension (PH) is a life-threatening condition characterized by elevated pulmonary arterial pressure, leading to right heart failure and significant morbidity and mortality. Its epidemiology and clinical outcomes are influenced by various factors, including underlying etiologies, comorbidities, and treatment modalities.

Objective: To assess the epidemiology, clinical features, treatment strategies, and outcomes of PH patients at Lady Reading Hospital, Peshawar.

Methodology: This cross-sectional study was conducted at Lady Reading Hospital, Peshawar, from January to December 2023. A total of 250 PH patients were included, and data on demographics, clinical features, comorbidities, etiologies, treatment modalities, and clinical outcomes were collected. Data were analyzed using descriptive statistics by using SPSS (version 27).

Results: The mean age of the participants was 52 ± 15 years, with a higher proportion of females (56%). The most common etiology of PH was Group 2 (PH due to left heart disease), accounting for 32% of cases, followed by Group 1 (pulmonary arterial hypertension) at 28%. and 8% experienced deterioration. Hospitalization occurred in 36% of patients, with 14% mortality during the study period. Treatment modalities included diuretics (72%), anticoagulation (44%), and PH-targeted therapies such as endothelin receptor antagonists (18%) and phosphodiesterase inhibitors (14%).

Conclusion: The findings of the present study highlight the high burden of PH in low-income populations, with significant comorbidities and limited access to advanced therapies. While some patients experienced clinical improvement, a large proportion of patients remained stable or deteriorated, underscoring the need for early diagnosis, comprehensive treatment strategies, and increased access to advanced therapies.

Keywords: Pulmonary Hypertension; Epidemiology; Clinical Outcomes; Treatment Modalities

Introduction

Pulmonary hypertension (PH) is a progressive condition characterized by high pulmonary arterial pressure, which causes serious morbidity and mortality as well as right heart malfunction.[1] It includes a diverse group of disorders that share common hemodynamic abnormalities but vary considerably in their underlying etiology, pathophysiology, and clinical manifestations.[2,3]

According to the World Health Organization (WHO), this condition includes a range of clinical entities that are categorized into five main groups based on common pathophysiological and clinical features which are, pulmonary arterial hypertension (PAH), PH due to left heart disease, PH associated with lung diseases and hypoxia, chronic thromboembolic pulmonary hypertension (CTEPH), and PH with unclear or multifactorial mechanisms.[4] Because of its heterogeneity and the difficulty of treating its underlying causes, PH is still a difficult issue to manage, even with advancements in diagnostic techniques and therapeutic approaches.[2]

Globally, the prevalence and incidence of PH are influenced by factors such as geographic location, socioeconomic status, and access to healthcare. Studies have reported that PH affects approximately 1% of the global population, with the prevalence rising to 10% in individuals over 65 years of age.[5] The burden of PH is particularly high in developing countries, where delayed diagnosis and limited access to specialized care often result in poor outcomes. In Pakistan, the epidemiology of PH remains underexplored, with most data derived from tertiary care centers. Understanding the local patterns of PH is critical for improving early detection, optimizing treatment, and ultimately enhancing patient outcomes.[6] Untreated congenital heart disorders and schistosomiasis are two other factors that increase the burden of PH in developing nations. The lack of regional epidemiological data from South Asia, especially Pakistan, restricts our knowledge of the condition's prevalence, risk factors, and consequences in this segment of the population.[7]

The clinical presentation of PH varies widely depending on the underlying etiology and stage of the disease. Early symptoms are often nonspecific, such as fatigue, dyspnea on exertion, and generalized weakness, which can delay diagnosis. As the disease progresses, patients may develop more severe symptoms, including chest pain, syncope, and signs of right heart failure, such as peripheral edema and jugular venous distension. These clinical features are often compounded by comorbidities such as chronic obstructive pulmonary disease (COPD), interstitial lung disease, and congenital heart defects, which further complicate the diagnostic process.

The management of PH is made more difficult by the distinct diagnostic and treatment difficulties that each group poses. The spectrum of PH in LMICs is dominated by secondary causes, including chronic lung disorders and left heart disease, which are frequently made worse by a lack of access to healthcare and environmental variables.[8] Management of PH requires a multidisciplinary approach involving cardiologists, pulmonologists, and other healthcare professionals. Treatment strategies are guided by the underlying etiology of PH and may include pharmacological interventions such as endothelin receptor antagonists, phosphodiesterase-5 inhibitors, and prostacyclin analogs. In cases of CTEPH, surgical options like pulmonary thromboendarterectomy may be considered. Despite these advancements, treatment outcomes in PH patients remain suboptimal, especially in low-resource settings where the availability of specialized medications and interventions is limited.

The objective of this study is to assess the epidemiology, clinical features, treatment strategies, and outcomes of PH patients at Lady Reading Hospital, Peshawar. By identifying key patterns and challenges in the local context, this research aims to provide valuable insights that could inform future healthcare policies and improve patient care. The findings of this study have the potential to bridge existing gaps in knowledge and contribute to the development of region-specific guidelines for the management of PH.

This study is particularly significant given the unique socio-economic and healthcare challenges in the Khyber Pakhtunkhwa province. Factors such as low health literacy, delayed healthcare-seeking behavior, and limited access to advanced diagnostic modalities exacerbate the burden of PH in this region. Furthermore, the high prevalence of risk factors such as tuberculosis, chronic lung diseases, and rheumatic heart disease underscores the need for targeted interventions. Through a comprehensive analysis of epidemiological data and clinical outcomes, this study seeks to address these gaps and lay the foundation for improving the care of PH patients in Pakistan.

Objective

To assess the epidemiology, clinical features, treatment strategies, and outcomes of Pulmonary Hypertension patients at Lady Reading Hospital, Peshawar.

Methodology

A cross-sectional study was conducted at Lady Reading Hospital, Peshawar, a tertiary care facility serving the population from Khyber Pakhtunkhwa, tribal region, neighboring regions of Punjab and also different areas of Afghanistan. The study was carried out between January to December 2023. The study comprised patients with Pulmonary Hypertension who had been diagnosed by right heart catheterization (RHC) or transthoracic echocardiography (TTE). Adult patients (≥18 years) having a PH

Table 1. Demographic Characteristics of study cases

Characteristic	Participants	Percentage (%)
Age Distribution		
<30 years	40	16%
30–50 years	90	36%
>50 years	120	48%
Mean Age (± SD, years)	52 ± 15	
Gender		
Male	110	44%
Female	140	56%
Residence		
Urban	150	60%
Rural	100	40%
Socioeconomic Status		
Low	180	72%
Middle	60	24%
High	10	4%
Education Level		
No Formal Education	120	48%
Primary	50	20%
Secondary	60	24%
Higher Education	20	8%

diagnosis and those getting treatment at Lady Reading Hospital during the study period met the inclusion criteria whereas patients with incomplete medical records and those who chose not to participate met the exclusion criteria.

Using a standardized questionnaire, information was gathered from patient interviews and hospital medical records, which included variables like age, gender, and residence location (rural vs. urban) make up the demographics. Clinical features include symptoms, sickness duration, and WHO functional class. Etiology and Comorbidities underlying causes (like lung disease and left heart disease) and comorbidities (like diabetes and high blood pressure). Pulmonary artery pressure, echocardiogram results, and other pertinent tests are diagnostic parameters. Medication, treatments (such as oxygen therapy and anticoagulation), hospitalizations, and survival status are all examples of treatment and outcomes.

Data were analyzed using SPSS (Version 27). Descriptive

Table 2. Etiology of Pulmonary Hypertension among study cases

Etiology	Frequency	Percentage (%)
Group 1: Pulmonary Arterial Hypertension (PAH)	70	28%
Idiopathic PAH	30	12%
Connective tissue disease-associated PAH	20	8%
Congenital heart disease-associated PAH	15	6%
Drug/toxin-induced PAH	5	2%
Group 2: PH due to Left Heart Disease	60	24%
Heart failure with preserved ejection fraction (HFpEF)	35	14%
Heart failure with reduced ejection fraction (HFrEF)	15	6%
Valvular heart disease	10	4%
Group 3: PH due to lung diseases or Hypoxia	80	32%
Chronic obstructive pulmonary disease (COPD)	40	16%
Interstitial lung disease (ILD)	30	12%
Obstructive sleep apnea (OSA)	10	4%
Group 4: Chronic Thromboembolic PH (CTEPH)	25	10%
Recurrent pulmonary embolism	25	10%
Group 5: PH with Multifactorial or Unclear Mechanisms	15	6%
Sarcoidosis	5	2%
Other (e.g., hematological disorders, systemic diseases)	10	4%

statistics were used to summarize patient characteristics, comorbidities, and outcomes and a logistic regression model was used to identify predictors of adverse outcomes, such as hospitalization or mortality.

Results

A total 250 patients are enrolled during the study period. The mean age of the study population was 52 ± 15 years, with a majority of patients (48.0%) aged above 50 years. Younger patients (<30 years) constituted only 16.0% of the cohort. Females comprised a slightly larger proportion of the study population (56.0%) compared to males (44.0%), suggesting a higher prevalence of PH or healthcare-seeking behavior among women. Most patients resided in urban areas (60.0%), potentially due to better access to healthcare facilities in cities. However, a significant rural representation (40.0%) highlights the hospital's role as a referral center for the region. A vast majority of the patients (72.0%) belonged to the low socioeconomic group. Almost half of the patients (48.0%) had no formal education, which may influence their health literacy and ability to manage chronic conditions like PH (Table 1).

Pulmonary Arterial Hypertension (Group 1) was observed in 28.0% of patients. PH due to lung diseases or Hypoxia (Group 3) PH associated with chronic lung conditions accounted for 32.0% of cases. COPD was the

Table 3. Comorbidities found among study cases

Comorbidities	Frequency	Percentage
Hypertension	130	52%
Diabetes mellitus	75	30%
Chronic obstructive pulmonary disease (COPD)	55	22%
Obesity	40	16%
Rheumatic heart disease	35	14%

predominant lung disease (16%), followed by interstitial lung disease (12.0%) and obstructive sleep apnea (4%). Chronic Thromboembolic PH (CTEPH) (Group 4) was diagnosed in 10% of patients, all attributed to recurrent pulmonary embolism. This underscores the need for early diagnosis and preventive management in at-risk populations (Table 2).

Different comorbidities found among stud cases. Hypertension was the most prevalent comorbidity (52%), followed by diabetes mellitus (30%), COPD (22%) and obesity (16%) (Table 3).

Dyspnea was universally present in all patients, with fatigue (80%), chest pain (38%), Palpitations of (30%) and Syncope of 16% (Table 4).

Among study cases, 8.0% were asymptomatic or experienced no significant limitations in physical activity, indicating early-stage or well-managed disease. About 30.0% of patients reported mild symptoms during ordinary physical activity, suggesting a moderate disease burden with manageable daily functionality. The largest group, 40.0% of patients, experienced marked limitation of physical activity, with symptoms such as dyspnea and fatigue during less-than-ordinary activities. This highlights a substantial disease impact on their quality of life.

A significant proportion (22.0%) of patients were in the most severe functional class, characterized by symptoms at rest and an inability to perform any physical activity without discomfort. These patients are at high risk of adverse outcomes and require intensive management (Table 5).

Treatment Modalities: Diuretics were the most widely used therapy (72.0%), reflecting their critical role in managing volume overload. Anticoagulation (44.0%) was frequently prescribed, particularly in patients with chronic thromboembolic PH (CTEPH) or those at risk of thromboembolism. Oxygen therapy (20.0%) was reserved for those with hypoxemia, especially in PH related to lung diseases.

PH-Targeted Therapy: Endothelin receptor antagonists (18.0%) and phosphodiesterase-5 inhibitors (14.0%) were common in PAH management. Prostacyclin analogs (6.0%) and combination therapy (4.0%) were used in more severe cases, reflecting limited access to these advanced treatments.

Advanced/Interventional Therapies: Pulmonary thromboendarterectomy (2.0%) was performed in select cases of CTEPH. Atrial septostomy (1.2%) and lung transplantation (0.4%) were rarely performed, possibly due to resource constraints.

Supportive Therapies: Iron supplementation (16.0%) was used to manage anemia. Digoxin (12.0%) addressed

Table 4. Clinical features of study cases

Clinical Features	Frequency	Percentage
Dyspnea (all WHO functional classes)	250	100%
Chest pain	95	38%
Fatigue	200	80%
Palpitations	75	30%
Syncope	40	16%

Table 5. Distribution of WHO Functional Class (N=250)

WHO Functional Class	Frequency	Percentage
Class I	20	8.0%
Class II	75	30.0%
Class III	100	40.0%
Class IV	55	22.0%

right heart failure symptoms, and exercise rehabilitation programs (10.0%) targeted functional improvement (Table 6).

Functional Improvement: Among study cases, 32.0% of patients experienced improvement in their WHO functional class, indicating treatment effectiveness in some cases. 60.0% remained stable, reflecting disease control or slow progression, while 8.0% deteriorated, requiring further evaluation of advanced therapies.

Hospitalizations: Among study cases, 36.0% of patients were hospitalized at least once during the preceding six months, highlighting the disease burden and potential complications. The remaining 64.0% avoided hospitalization, suggesting effective outpatient management.

Mortality: Among study cases, 14.0% of patients died during the study, emphasizing the high-risk nature of PH and the need for aggressive management in advanced stages. The majority (86.0%) survived, with a focus on improving quality of life and slowing disease progression (Table 7).

Discussion

Pulmonary Hypertension (PH) is a progressive and debilitating condition characterized by increased pulmonary arterial pressure, leading to right heart failure and significant morbidity and mortality. Regional variations in etiology, healthcare infrastructure, and population factors result in a wide range of PH burdens. The epidemiology and clinical consequences of PH in a tertiary care context are clarified by our cross-sectional study, which was carried out at Lady Reading Hospital in Peshawar. It also offers important insights into the regional symptoms of PH.

The demographic characteristics of the 250 pulmonary hypertension (PH) patients in our study provide significant insights into the disease's epidemiology in Peshawar. The majority of patients (48.0%) in our study were aged >50 years, with a mean age of 52 ± 15 years. Notably, 16% of the cases were individuals under 30 years old, highlighting the disease's presence in younger populations. In a study conducted by Peacock et al. (2016), conducted in the United Kingdom, the mean age of PH patients was reported to be 65 years, significantly higher than in our cohort.[9] This reflects the higher prevalence of left heart disease and comorbidities in older populations in developed countries. In contrast, a study by Bigna et al. (2020) in sub-Saharan Africa reported a mean age of 45 years, which is somewhat similar to the findings of our studies.[10] The prevalence of disease is higher in females as compared to males and this finding was also pointed out by Simonneau et al. (2019), who highlighted hormonal and genetic factors contributing to higher PH prevalence among women in developed countries.[4]

In our study, urban residents constituted 60% of the patients, while 40.0% were from rural areas. Similarly, the majority of patients in our study belonged to the low socioeconomic class (72.0%), with only 4% in the high-income group. Nearly half of the cases in our study (48.0%) had no formal education, and only 8% had higher education. Similar findings (67.0%) were also noted in Iraq by Naser et al. (2021).[11] In contrast, a study by Kumar et al. (2015) in Nepal reported a predominance of low-income patients (80%), similar to our findings, emphasizing the impact of poverty on delayed diagnosis and management.[12] A study by Gupta et al. (2019) in India reported that 55% of PH patients had no formal education, consistent with our findings.[13]

The etiology of pulmonary hypertension (PH) in the present study is categorized according to the WHO classification, revealing a spectrum of causes with distinct distributions. In our study, PAH accounted for 28.0% of cases, with idiopathic PAH (12.0%) being the most common subgroup, followed by connective tissue disease-associated PAH (8%) and congenital heart disease-associated PAH (6%). A study by Simonneau et al. (2019) reported idiopathic PAH in 15–20% of cases in Western countries, slightly higher than our findings, reflecting a better diagnostic infrastructure for PAH in high-income settings.[4] PH secondary to left heart disease was found in 32%, with heart failure with preserved ejection fraction (HFpEF) comprising 14% and heart failure with reduced ejection fraction (HFrEF) being 6% in our study. On the other hand, a study highlighted that left heart disease is the leading cause of PH globally, accounting for 50–60% in some cohorts, much higher

than in our study. This discrepancy might stem from a younger cohort in our region, with fewer age-related cardiovascular diseases.[14]

Comorbidities play a critical role in the clinical presentation and management of pulmonary hypertension (PH). In our study, hypertension was the most common comorbidity, affecting 52% of patients. A study reported hypertension in 40–60% of PH patients in Western countries, aligning closely with our findings.[14] They emphasized the role of systemic hypertension as a contributor to left heart disease and subsequent PH development. In a study conducted in India by Sharma et al. (2018), 48% of PH patients had coexisting hypertension, comparable to our cohort.[15] In our study, PH associated with lung diseases or hypoxia was observed in 32.0% of patients, predominantly due to chronic obstructive pulmonary disease (COPD) (16.0%), followed by interstitial lung disease (ILD) (12.0%) and obstructive sleep apnea (OSA) (4%). Chaouat et al. (2008) reported COPD as a leading contributor to PH in Europe, accounting for 20–30% of cases, slightly higher than our findings, possibly due to higher smoking prevalence in Western countries.[16] A study in Pakistan by Ahmad et al. (2019) reported COPD-associated PH in 18% of cases, aligning closely with our findings.[17]

Diabetes mellitus in our study was present in 30% of patients, reflecting its growing burden as a comorbidity in PH. A study by Zhang et al. (2020)[18] in China observed diabetes in 28% of PH patients, also comparable to our cohort, indicating the global nature of this metabolic disorder. Chronic Obstructive Pulmonary Disease (COPD) in our study was present in 22.0% of patients, highlighting its significant role in PH pathophysiology, while Chaouat et al. (2008) in Europe reported COPD in 20–30% of PH

Table 6. Treatment Modalities of PH Patients (N=250)

Category	Frequency	Percentage (%)
Treatment Modalities		
Diuretics	180	72%
Anticoagulation therapy	110	44%
Oxygen therapy	50	20%
PH-Targeted Therapy		
Endothelin receptor antagonists	45	18%
Phosphodiesterase-5 inhibitors	35	14%
Prostacyclin analogs	15	6%
Combination therapy (two or more drugs)	10	4%
Advanced/Interventional Therapies		
Pulmonary thromboendarterectomy (PTE)	5	2%
Atrial septostomy	3	1.2%
Lung transplantation	1	0.4%
Supportive Therapies		
Iron supplementation	40	16%
Digoxin	30	12%
Exercise rehabilitation	25	10%

Table 7. Clinical Outcomes of PH Patients (N=250)

Clinical Outcomes	Frequency	Percentage
Functional Improvement		
WHO Class improvement (≥1 class)	80	32.0%
No change in WHO Class	150	60.0%
Deterioration (≥1 WHO Class)	20	8.0%
Hospitalizations		
Hospitalized (≥1 in 6 months)	90	36.0%
No hospitalization	160	64.0%
Mortality		
Deaths during study period	35	14.0%
Survivors	215	86.0%

patients, similar to our findings. They emphasized that COPD-associated PH often leads to worse outcomes due to dual organ involvement (lungs and heart).[19] In a Pakistani cohort studied by Ahmad et al. (2019), COPD was reported in 25% of PH patients, aligning closely with our data and reflecting similar environmental risk factors such as smoking and air pollution.[17]

Obesity affected 16% of patients in our study, reflecting its rising prevalence as a metabolic comorbidity. Pugh et al. (2014) in the United States reported obesity in 20-25% of PH patients, slightly higher than our findings, which may be attributed to differences in obesity prevalence across regions.[20] A study by Gupta et al. (2019) in India documented obesity in 15% of PH patients, nearly identical to our findings, reflecting similar lifestyle and dietary patterns.[13] Rheumatic heart disease was noted in 14% of patients in our study, while Kumar et al. (2017) in India found RHD in 18% of PH patients, consistent with our findings, highlighting the continued burden of this preventable disease in developing regions.[21] In contrast, Simonneau et al. (2019) in Europe documented RHD in less than 2% of PH patients.[4]

The clinical features of pulmonary hypertension (PH) reflect the disease's progression, severity, and underlying etiology. In our study, dyspnea was universally reported, affecting 100% of patients, underscoring its hallmark role in PH. Simonneau et al. (2019) identified dyspnea as the most prevalent symptom in PH patients, reported in over 95% of cases in European cohorts, consistent with our findings.[4] A study by Sharma et al. (2018) in India also noted dyspnea in 100% of PH patients, highlighting its universal presentation regardless of geographical region.[15] They attributed this symptom to right ventricular ischemia and elevated pulmonary artery pressures. A study in Pakistan by Ahmad et al. (2019) observed chest pain in 35% of PH patients, aligning closely with our data.[17] Fatigue was present in 80% of patients, making it the second most common symptom after dyspnea in our study.

Palpitations in our study were reported in 30% of patients, often associated with arrhythmias secondary to PH-related cardiac strain. Simonneau et al. (2019) reported syncope in 10–15% of PH patients in Europe, comparable to our findings, particularly in patients with idiopathic PAH or chronic thromboembolic PH (CTEPH).[4] In contrast, a study by Gupta et al. (2019) in India found syncope in 20% of PH patients, slightly higher than in our study.[13]

The World Health Organization's (WHO) functional classification is widely used to assess the severity of symptoms in pulmonary hypertension (PH) patients. It provides a framework to evaluate exercise capacity and correlate it with disease prognosis. In our study, Class I (8%) indicated minimal symptoms and preserved physical activity. A study by Simonneau et al. (2019)[4] in Europe found Class I prevalence at 10%, consistent with our findings. On the other hand, Sharma et al. (2018) in India documented only 6% of patients in Class I, slightly lower than our cohort.[15] Class II was reported in 30% of patients, characterized by mild limitations of physical activity in our study. In contrast, Simonneau et al. (2019) documented Class III in 35% of European PH patients,

lower than in our study, possibly due to earlier interventions and better healthcare access in high-income regions. Class IV was present in 22% of patients in our study, characterized by severe symptoms, including dyspnea at rest and inability to perform physical activities without discomfort. Simonneau et al. (2019)[4] found Class IV prevalence at 15–20% in European cohorts, slightly lower than our cohort. A study by Gupta et al. (2019)[13] in India reported 25% of PH patients in Class IV, slightly higher than in our study.

The treatment landscape for pulmonary hypertension (PH) encompasses pharmacological, advanced interventional, and supportive therapies. In our study, diuretics were the most frequently used treatment, administered to 72% of patients, primarily for the symptomatic relief of fluid overload and right heart failure. McLaughlin et al. (2015)[22] reported diuretic usage in 70–75% of PH patients in the U.S., consistent with our findings, while Simonneau et al. (2019)[4] in European cohorts documented diuretic use in 65%, slightly lower than in our study. Anticoagulation was prescribed to 44% of patients in our study. Simonneau et al. (2019)[4] reported anticoagulation usage in 40–50% of PH patients in Europe, aligning closely with our cohort, especially for CTEPH cases. A study by Zhang et al. (2020) in China documented oxygen therapy usage in 22%, reflecting a similar pattern in managing hypoxic complications.[18] Combination Therapy (4%) while McLaughlin et al. (2015) observed higher rates (15–20%) in North America.[22]

In Advanced/Interventional Therapies, in our study Pulmonary Thromboendarterectomy (PTE, 2%) while Ahmad et al. (2019)[17] reported similar utilization (2%) in Pakistan due to the limited availability of specialized surgical centers. In contrast, Simonneau et al. (2019) found PTE performed in 10% of eligible patients in Europe, reflecting greater accessibility.[4] In supportive therapies, iron supplementation (16%) reflects the prevalence of anemia in PH patients. Sharma et al. (2018)[15] reported a similar prevalence (18%) in India. Digoxin (12%) is used to manage right heart failure and arrhythmias. Simonneau et al. (2019)[4] reported usage in 10-12% of European cohorts. Exercise Rehabilitation (10%) while Ahmad et al. (2019) documented rehabilitation in 8% of PH patients in Pakistan, highlighting similar trends.[17]

Clinical outcomes for pulmonary hypertension (PH) patients are critical for assessing treatment effectiveness and patient prognosis. In our study, 32% of patients experienced an improvement in at least one WHO functional class during the study period. Simonneau et al. (2019)[4] reported functional improvement in 30–35% of PH patients in Europe, reflecting similar treatment response trends. Sharma et al. (2018)[15] in India observed an improvement in 25% of patients, reflecting regional differences in treatment practices and access to specialized care.

In our study, 60% of patients showed no change in WHO functional class, indicating a stable disease state. Hoeper et al. (2013) reported that approximately 55–60% of PH patients maintained their functional status over 12 months, reflecting a challenging aspect of PH management where many patients experience limited or no significant improvement. Zhang et al. (2020) found a slightly higher rate (65%) in Chinese PH patients, possibly reflecting differences in treatment strategies and disease progression patterns, and McLaughlin et al. (2015)[22] observed a similar percentage (60%) in North American PH cohorts, underscoring a consistent clinical outcome profile across diverse regions. Only 8% of patients experienced worsening of at least one WHO functional class in our study, while Simonneau et al. (2019)[4] documented deterioration in 5–10% of PH patients, indicating a stable disease state for the majority but acknowledging the potential for adverse outcomes. Gupta et al. (2019)[13] in India observed deterioration in 12%, reflecting the impact of delayed diagnosis and treatment challenges in low-resource settings. In our study, 36% of patients were hospitalized at least once in the last six months. McLaughlin et al. (2015)[22] found hospitalization rates of approximately 35% in North America, consistent with our cohort, while a study by Simonneau et al. (2019) documented lower rates (25–30%) in European cohorts, indicating more effective outpatient management or early diagnosis and treatment.[4] In Pakistan, Ahmad et al. (2019)[17] observed higher hospitalization rates (40%), reflecting gaps in access to continuous care and medication adherence compared to more developed settings.

In our study, 14% of patients died during the study period. Simonneau et al. (2019) reported mortality rates of 10-15% in European PH patients, reflecting effective treatment outcomes but recognizing inherent risks.[4] Badesch et al. (2012)[23] documented similar mortality rates (12–16%) in North America, and Gupta et al. (2019)[13] observed a higher mortality rate (18%) in Indian PH patients.

The clinical outcomes of PH patients in the present study underscore the challenges of managing this complex condition in a resource-limited setting. Early diagnosis, comprehensive management, and multidisciplinary care are critical for improving prognosis. Regional disparities in healthcare access, socioeconomic factors, and comorbidity burdens highlight the need for targeted public health interventions to address these gaps.

Conclusion

The present study provides a comprehensive overview of the epidemiology, clinical features, and management of PH patients in Peshawar. It underscores the importance of addressing regional disparities, enhancing diagnostic capabilities, and implementing cost-effective treatment

strategies to improve patient outcomes. Further research and investment in healthcare infrastructure are essential to mitigate the burden of PH in low-resource settings.

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