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Opinion
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Prevalence of Respiratory Complications in Chronic Kidney Disease Patients

S. Bavani[1] and Dr. M. Nisarudeen[2]*

[1]*Department of Physiotherapy, Devendrar College of Physiotherapy, Tirunelveli, Tamil Nadu, India*

[2]*Principal of Devendrar College of Physiotherapy, Tirunelveli, Tamil Nadu, India*

Abstract

Background: Chronic kidney disease is a progressive condition that affects multiple organ systems, including the respiratory system. Respiratory complications ae more common in CKD. This can significantly increase mortality and morbidity. Early detection is more essential for proper management.

Objective: To evaluate the prevalence and types of respiratory complications among patients with CKD and to assess the association between CKD stage and the presence of respiratory complications.

Methods: A cross-sectional study was conducted among 150 patients diagnosed with CKD. Data on demographics, CKD stage, and respiratory complications were collected using a structured proforma. Descriptive statistics were used to evaluate the prevalence and distribution of respiratory complications, and the results were expressed as frequency and percentage. The association between CKD stage and respiratory complications were assessed using the Chi-square test. A p-value of less than 0.05 was considered statistically significant.

Results: Among 150,88 male and 62 female, the respiratory complications were found in 118 (78.7%) patients. Pulmonary edema was the most common complication (30%) followed by pneumonia (18.7). Respiratory complications were more frequent in advanced CKD stages, especially stage 5. A statistically significant association was observed between CKD stages and respiratory complications $\chi^2 = 99.070$, df = 4, $p < 0.001$).

Conclusion: Respiratory complications are highly prevalent among CKD patients, with pulmonary edema being the most common. The prevalence increases with CKD stage, highlighting the need for early detection and appropriate management to reduce morbidity and improve patient outcomes.

Keywords: Chronic Kidney Disease; Respiratory Complications; Pulmonary Edema; Pneumonia; Prevalence

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Correspondence:

S. Bavani, Department of Physiotherapy, Devendrar College of Physiotherapy, Tirunelveli, Tamil Nadu, India, Tel: +91 88073 59271; E-mail: bavaninellai@gmail.com

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Introduction

Chronic Kidney Disease (CKD) is a gradual and permanent condition that causes a loss of renal function, and kidneys' inability to maintain metabolic, fluid, and electrolyte homeostasis. It's a huge worldwide health concern that impacts millions of people. In India, the increase of CKD is attributed to the high prevalence of diabetes, hypertension and cardiovascular disease, and associated lifestyle risks. Late disease recognition, limited availability of renal care, and low disease awareness among the general population are the factors leading to the acceleration of disease progression and complications.

CKD is staged based on the estimated glomerular filtration rate (eGFR) test, and the degree of CKD complicates as renal value declines. The early stage of CKD is usually asymptomatic while the later ones cause systemic problems that reduce the function and quality of life of the individual. CKD used to be considered a kidney-specific disease, it is now considered to be multisystem.

With less efficient kidney function there is a resultant increase in the accumulation of uremic toxins, fluid overload, imbalance in electrolytes, anemia, metabolic acidosis, a decline in the immune response, and cardiovascular alterations. These increase the risk of complications not related to the kidneys and elevates morbidity, dependency, the risk of needing to be hospitalized, and mortality.

Involvement of the respiratory system is common, and is often not diagnosed and is poorly managed. There is a physiological triad of the kidneys, heart, and lungs, which makes the lungs

especially vulnerable in chronic kidney disease.

Impaired excretion leads to sodium/water retention, volume overload, and elevated pulmonary capillary pressure. This causes congestion, edema, and pleural effusion - key features of the disease. Low albumin levels drop oncotic pressure, which in turn causes fluid shift into the lung interstitium and pleura. Anemia decreases oxygen delivery and produces exertional dyspnea, fatigue, and poor exercise tolerance. Acidosis and uremic toxins weak out respiratory muscles and disrupt ventilatory control which in turn raises breathing effort, reduces lung compliance, and impair gas exchange. Respiratory symptoms present in both acute and chronic settings.

Pulmonary edema is caused by advanced CKD, or inadequate fluid management, and is characterized by breathlessness, orthopnea, and exercise intolerance. Overload, heart failure, uremic serositis, or infection lead to pleural effusions, which obstruct ventilation and cause failure.

Increased risk of pulmonary TB in India is especially concerning. Pulmonary TB frequently has atypical symptoms and often goes undiagnosed. Infections are severe and lead to increased lengths of stay and higher death rates. Obstructive sleep apnea and other sleep disorders are common. Fluid collects in the airway at night and, combined with uremic neuropathy and other metabolic factors, causes airway obstructions and irregular breathing.

This harms sleep quality, daytime function, cardiovascular health, and renal progression. CKD alters lung mechanics: reduced volumes, restrictive defects, stiff chest walls. Causes include interstitial fluid, uremic myopathy, anemia, malnutrition, and inactivity. These cut exercise capacity and independence, even without overt disease.

Dialysis patients are vulnerable. Hemodialysis provokes fluid shifts, complement activation, inflammation, hypoxemia, congestion, and effusions. Peritoneal dialysis stabilizes fluids but raises intra-abdominal pressure, restricting diaphragm motion.

Physiotherapeutically, respiratory issues limit daily activities: dyspnea, poor chest expansion, tachypnea, desaturation, low tolerance. This erodes independence, work, psychosocial health, and quality of life. Routine tests often miss functional impacts.

Physiotherapy outcome measures detect them effectively. Modified medical Research Council (mMRC) dyspnea scale quantifies daily breathlessness. Chest expansion gauges thoracic mobility. Respiratory rate and SpO2 offer objective snapshots. Six-minute Walk test (6mwt) assesses endurance; Borg scale measures perceived exertion.

These tools are simple, non-invasive, affordable-ideal for Indian settings. They enable early detection and guide interventions like breathing exercise, thoracic mobilizations, airway clearance, and graded aerobics to enhance ventilation, capacity, and quality of life.

Literature gaps persist on respiratory prevalence via physiotherapy measures, especially in India. Studies prioritize biochemical, radiological, or cardiac aspects, neglecting functional rehab needs Integrated clinical-physiotherapy research is essential for holistic burden assessment. Early respiratory detection supports timely physiotherapy, reducing symptoms, decline, and improving outcomes. This study determines respiratory manifestation prevalence in CKD and their functional impact via standardized physiotherapy measures. It advocates physiotherapy integration into comprehensive CKD care.

Need for the Study

Living with chronic kidney disease (CKD) exceeds well beyond just kidney issues - it's a whole-body struggle that frequently affects patients with breathing difficulty that suffer through quietly. Unable to perform basic ADL activities such as walking to the bathroom, or climbing stairs, dealing with continuous shortness of breath, a persistent cough, or fluid accumulation in the lungs, all while kidney care takes center ages.

Daily struggles

These respiratory problems make everyday life feel like a marathon. As kidney function dips- especially when dialysis- they get worse causing ordinary activities to become exhausting.

How common they are

They often deal with pleural effusion from fluid overload, face pulmonary edema, pneumonia, sleep apnea, lung pressure issues pile on, striking harder in advanced stages.

Real impact

It leads to frequent hospitalizations and decreases the quality of life but examining these issues across CKD stages can promote early screening, physiotherapy and interventions to improve respiratory health.

Aim of the Study

To determine the prevalence of respiratory manifestations in chronic kidney disease patients across different stages of the disease, and to highlight the need for early respiratory screening and physiotherapy interventions.

Objective of the Study

Primary objective

To determine the prevalence of respiratory complications in patients with chronic kidney disease (CKD).

Secondary objective

1. To evaluate the frequent types of respiratory manifestations, present in CKD patients (eg: pulmonary edema, pleural effusion, pneumonia, restrictive lung patterns.)

2. To determine the correlation between CKD stages and respiratory complications.

3. To assess respiratory symptoms such as dyspnea, cough, and exercise intolerance in CKD patients.

4. To evaluate respiratory function and functional capacity using clinical and physiotherapy outcome measures (6- minute walk test, mMRC Dyspnea scale, spirometer)

5. To emphasize the role of early screening and physiotherapy intervention in CKD patients with respiratory involvement.

Operational definition

Chronic kidney disease: structural or functional abnormalities of the kidneys for more than 3 months, as manifested by kidney damage, with or without decreases Glomerular filtration rate (GFR).

Respiratory complications: Any respiratory problems present in patients who are suffering from chronic kidney disease, assessed through clinical assessment or investigations.

Prevalence: The proportion of CKD who have respiratory

complications during the time of assessment

Hypothesis

Null Hypothesis (H_0)

There is no significant association between chronic kidney disease (CKD) stages and the presence of respiratory complications in CKD patients.

Alternative Hypothesis (H_1)

There is a significant association between chronic kidney disease (CKD) stages and the presence of respiratory complications in CKD patients.

Review of Literature

Investigating the Multifactorial Causes and Prevalence of Dyspnea in Chronic Kidney Disease and Predictors of Worsening Dyspnea and Left Ventricular dysfunction: A Longitudinal Observational Study

2025

Suhas Gajbhiye and et.al

This longitudinal observational study aimed to determine the prevalence and multifactorial causes of dyspnea in patients with chronic kidney disease (CKD) and to identify predictors of worsening dyspnea and left ventricular dysfunction over time. The study assessed 410 CKD patients (stage 3-5 those on dialysis) using standardized tools including the Modified Medical Research Council (mMRC) Dyspnea scale, echocardiography for LV function (LVEF and diastolic parameters). Results showed thar approximately 40 % of participants experienced dyspnea at baseline, most commonly related to anemia and baseline LV dysfunction. Limitations included a single- center design, relatively small sample size potential residual confounding from pulmonary comorbidities, and limited generalizability to early CKD or non- dialysis populations.

Clinical Profile and Spectrum of Respiratory Disorders in Patients with Chronic Kidney Disease

2025

Dr. M. Ramulu and et.al

This cross- sectional study aimed to assess the clinical profile and spectrum of respiratory disorders among patients with chronic kidney disease (CKD) and to identify the patten of pulmonary involvement across different CKD stages. The study included 50 hospitalized CKD patients (stages 3-5) who underwent detailed clinical evaluation, chest X- ray, arterial blood gas analysis and spirometry to detect respiratory abnormalities. Results showed a high prevalence of respiratory complications, with pleural effusion (44%) pulmonary edema (36%), restrictive lung disease (56%) being the most common findings. Limitations included a small sample size, single center hospital setting, and cross- sectional design, which limited generalizability and prevented assessment of casual relationships or long-term outcomes.

Prevalence of chronic respiratory disease using case-finding tools in adults living with noncommunicable disease in low- and middle-income countries: a systematic review

2025

Adriano Petrolini-Mateus and et.al

This 2025 systemic review aimed to estimate the prevalence of chronic respiratory disease (CRD) among adults with non-communicable diseases (NCDs)- including chronic kidney disease (CKD) – in low- and middle-income countries (lMICs) and to evaluate the screening or case- finding tools used. Databases such as PubMed Embase, lILACS, SciELO, and Web of science were searched up to February 2025 for studies applying questionnaires, peak-flow, micro-spirometry, or full spirometry to detect CRD in adults with NCDs. Out of 8,939 records, only three studies met inclusion criteria highlighting a major research gap. Reported CRD prevalence ranged from 1-5% in hypertensive cohorts to 11-17% in patients with cardiovascular or CKD comorbidities, were restrictive patterns and undiagnosed airflow limitation wee common findings. Limitations included the small number of eligible studies, restricted geographic representation, heterogeneity in diagnostic methods and lack of longitudinal or CKD specific- data.

Associaton of Pulmonary Hypertension and the Stages of Chronic Kidney Disease: A Cross-Sectional Study

2025

Muhammed Akhtaruzzaman and et.al

This study aimed to determine the prevalence of pulmonary hypertension across different stages of CKD and to identify its association risk factors. A total of 120 CKD patients (stages 3-5) attending a tertiary care hospital were evaluated using ECHO to estimate pulmonary artery systolic pressure along with measurements of hemoglobin levels, renal function and volume stress. A total 0f 120 CKD patients (stage3-5) attending a tertiary care hospital were evaluated using ECHO. The study found that overall prevalence of PH was 44.2%, with prevalence increasing significantly from 27.1% in stage 3 to 54.8% in stage 5 CKD. Limitations included a single- center, small sample design and use of ECHO rater hand catheterization.

Assessment of respiratory function and quality of life of chronic kidney disease after physical activity in the endodiuretic period

2025

Vincius Rodrigues and et.al

This study aimed to evaluate the effects of structured physical activity performed during the intradialytic period on respiratory function and quality of life in patients with CKD. The spirometry as a measuring tool. The results showed that patients in the continuous intradialytic exercise group demonstrated significant improvements in respiratory parameters and quality of life. Limitations included a small sample size, short duration of follow up, single center design, and possible selection bias.

Association between COPD and CKD: a systematic review and meta-analysis

2024

Zexin Liu and et.al.

This study aimed to evaluate the association between COPD and CKD, exploring prevalence, shared risk factors, and prognostic outcomes. The measuring tools included spirometry for COPD diagnosis and (eGFR) or serum creatinine for CKD. Results showed that patients with COPD had a 2.2 – fold higher risk of developing CKD, while CKD patients have reduced pulmonary function, increased hospitalizations and higher mortality. Limitations included

heterogeneity in diagnostic criteria and variability in confounder adjustment and the observational design for more studies which restricted casual inference.

Association between pulmonary function and rapid kidney function decline: a longitudinal cohort study from CHARLS

2024

Shisheng Han and et.al.

This study aimed to investigate whether impaired pulmonary function predicts rapid kidney function decline in adults without baseline chronic kidney disease. The study analyzed data over 9000 participants enrolling in long term health survey with baseline spirometry and serial estimated GFR measurements collected over a median follow up of 8 years. Results demonstrated that participants with restrictive or obstructive lung patterns had a significantly higher risk of RKFD compared to those with normal lung function. Limitations included the observational design, lack of inflammatory biomarker data and potential residual cofounding but the study emphasized the importance of integrated pulmonary and renal disease screening in high-risk populations.

Pulmonary Manifestations at Different Stages in the chronic kidney disease: An Observational Study

2023

Anbumaran Parivakkam Mani and et.al.

This study aimed to evaluate the prevalence and types of respiratory complications across stages of CKD in an Indian tertiary care setting. The investigators enrolled 70 CKD patients (aged above 18 years) from February to October 2021, and assessed them clinically and via diagnostic tools including pulmonary function tests chest radiograph and CT scans, sputum/pleural fluid analyses, ECHO for left ventricular function and in selected cases- polysomnography to detect sleep apnoea. They found that 70% of patients had pleural effusions, 52% had pulmonary oedema, about 7% developed pneumonia, and in 60% sleep apnea was present, other findings included pleural thickening (10%) and pulmonary calcification (3%). The limitations include small sample size the fact that large proportion of patients were in stage 5 end stage CKD and lack of long term follow up to assess outcomes over time.

Respiratory complications and sleep disorders in children with chronic kidney disease: A correlation often underestimated

2023

M Lelii and et.al

This study aimed to assess the prevalence and character of sleep disorders among children with CKD either on dialysis or not compared with healthy peers. The investigators enrolled 95 children (54 with CKD- 22 on hemodialysis, 32 non- dialysis, 41 healthy controls) and measured sleep quality via the Arabic version of the children's sleep habits Questionnaire (CSHQ) daytime sleepiness via the paediatric Epworth Sleepiness scale (paediatric- modified), (ESS) and symptomatic restless- legs syndrome (RLS) using a questionnaire. They found that 75.9% of children with CKD had sleep disturbances (81.8% on dialysis vs 71.8% not on dialysis), while 22% had excessive daytime sleepiness sleep- disordered breathing, behavioural insomnias and parasomnias- are very common in children with CKD and that clinicians should actively screen for them. The limitations included are small sample size, subjective questionnaire rather than objective questionnaire.

Concomitant Lung and Kidney Disorders in Critically Ill Patients: Core Curriculum 2022

2022

Sarah F Sanghavi and et.al

This article aims to provide intensivists and nephrologists with a comprehensive overview of the complex interactions between the lungs and kidneys in critically ill patients, emphasizing the management of one organ system cannot proceed in isolation of the other. They highlight how disorders such as diffuse alveolar hemorrhage, acute respiratory distress syndrome (ARDS) or (COPD) and venous thromboembolism often complicate renal dysfunction, and vice versa and they stress therapeutic trade- offs. The limitations, it is a review rather than original or outcomes the evidence base is heterogenous and largely derived from observational studies, and many of the mechanistic pathways remain incompletely defined.

Methodology

Study design

This study was conducted as a prevalence study of respiratory complications in chronic kidney disease patients: an observational, cross-sectional study.

Study setting

Kidney care center, Tirunelveli.

Study population

Patients diagnosed with chronic kidney disease. (CKD) attending OPD or admitted in the hospital.

Sample size

A total of 150 CKD patients who were include in the study.

Sampling technique

A purposive convenience sampling technique was used.

Inclusion Criteria

Patients diagnosed with CKD (stages 1 to 5)

Age > 18 years

Both male and female patients

Patient willing to participate and give informed consent

Exclusion Criteria

Patients with acute kidney injury.

Known pre - existing severe pulmonary disease unrelated to CKD

Recent thoracic surgery or trauma

Hemodynamically unstable patients

Variables

Independent variable:

Stages of chronic kidney disease (CKD stages 1-5)

Duration of CKD

Dialysis status

Age

Gender

Dependent variables:

Presence of respiratory complications

Type of respiratory complications

Respiratory symptoms

Respiratory function measures

Confounding variables:

Smoking history

Preexisting lung disease

Anemia

Fluid overload

Nutritional status

Cardiovascular comorbidities

Outcome Measures

Respiratory symptom assessment:

Modified medical research council (mMRC) Dyspnea scale.

Functional capacity

6 min Walk test (6MWT)

Oxygenation

Peripheral oxygen saturation (spo2)

Pulmonary function

(spirometry)

Radiological findings

(chest X-ray and ct scan)

Perceived exertion

(modified Borg scale)

Procedure

Following ethical approval, the need and procedure of the study were explained to all the participants, and written consent were obtained. Demographic data such as age, gender and the clinical information including stage of CKD, illness duration, dialysis status and associated comorbidities were recorded.

Participants were then assessed for the presence of respiratory symptoms such as breathlessness, cough production, chest pain and wheezing through patient interview and medical records.

A detailed respiratory system examination was assessed.

Details regarding respiratory complications was collected from clinical examination findings and review of available investigations.

All observations were accurately documented in a systematic assessment and Performa.

The collected details were prepared for statistical analysis to evaluate the prevalence of respiratory complications among chronic kidney disease patients.

Statistical Analysis

Data collected from 150 patients who were diagnosed with chronic kidney disease were stepwise entered into Microsoft Excel and later analyzed using IBM SPSS (Statistical Package for the Social Sciences). All variables were categorized appropriately prior to analysis.

Descriptive statistics were used to evaluate the demographic characteristics and clinical variables of the study population. These were presented in terms of frequency and percentage to identify the prevalence of respiratory complications among chronic kidney disease patients.

The pattern of different types of respiratory complications such as pulmonary edema, pneumonia, pleural effusion, and others was assessed using frequency tables. Graphical representations including pie charts and bar diagrams were used to present the data visually.

To assess the relationship between the stage of chronic kidney disease (Stages 1–5) and the presence of respiratory complications, the Chi-square test was used. The level of statistical significance was set at $p < 0.05$, and results with p-values lower than this were considered analytically significant.

Outcome tools (Borg dyspena scale, 6-minute walk test, SpO_2, pulmonary function test) were used only for clinical assessment and were not included in statistical analysis,as the primary objective of the study was prevalence.

Frequencies

See Table 1.

Frequency Table

Table 2 shows the gender distribution of the study participants. Out of 150 participants, 88 (58.7%) were males and 62 (41.3%) were females.

Table 3 presents the distribution of chronic kidney disease (CKD)

Table 1:

Statistics					
		Gender	Ckd_Stage	Resp_Comp	Complication_Type
N	Valid	150	150	150	150
	Missing	0	0	0	0

Table 2: Gender Distribution of the Study Participants.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	88	58.7	58.7	58.7
	Female	62	41.3	41.3	100.0
	Total	150	100.0	100.0	

Table 3:

CKD_STAGE Distribution of CKD Stages					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	STAGE 1	2	1.3	1.3	1.3
	STAGE 2	24	16.0	16.0	17.3
	STAGE 3	29	19.3	19.3	36.7
	STAGE 4	36	24.0	24.0	60.7
	STAGE 5	59	39.3	39.3	100.0
	Total	150	100.0	100.0	

Table 4:

RESP_COMP Prevalence of Respiratory Complications					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NO	32	21.3	21.3	21.3
	YES	118	78.7	78.7	100.0
	Total	150	100.0	100.0	

Table 5:

Case Processing Summary						
	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
CKD_STAGE * RESP_COMP	150	100.0%	0	0.0%	150	100.0%

Table 6:

CKD_STAGE * RESP_COMP Crosstabulation				
Count				
		RESP_COMP		Total
		NO	YES	
CKD_STAGE	STAGE 1	2	0	2
	STAGE 2	22	2	24
	STAGE 3	6	23	29
	STAGE 4	1	35	36
	STAGE 5	1	58	59
Total		32	118	150

Table 7:

Chi-Square Tests			
	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	99.070[a]	4	<.001
Likelihood Ratio	92.887	4	<.001
Linear-by-Linear Association	74.316	1	<.001
N of Valid Cases	150		
a. 2 cells (20.0%) have expected count less than 5. The minimum expected count is 43.			

stages among the participants. The majority of participants were in Stage 5 (39.3%), followed by Stage 4 (24.0%), Stage 3 (19.3%), Stage 2 (16.0%), and Stage 1 (1.3%).

Table 4 shows the prevalence of respiratory complications among the study participants. Respiratory complications were present in 118 (78.7%) participants, while 32 (21.3%) had no respiratory complications.

Crosstabs

See Tables 5-7.

GGraph

See Figure 1.

Figure 1 depicts a clustered bar chart showing the relationship between CKD stages and respiratory complications. The occurrence of respiratory complications was notably higher in advanced CKD

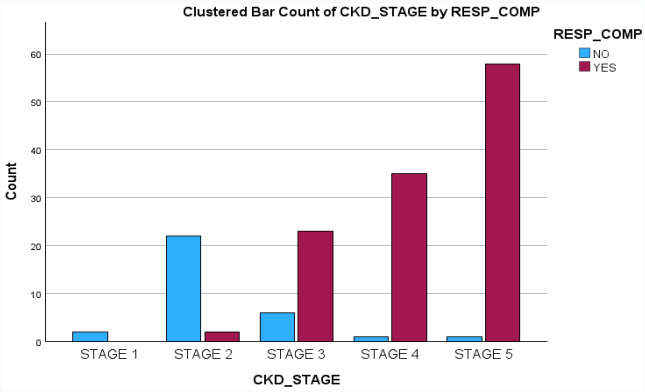

Figure 1: Graphical Representation of CKD Stage and Respiratory Complications.

Table 8:

Statistics		
COMPLICATION_TYPE		
N	Valid	150
	Missing	0

Table 9:

COMPLICATION_TYPE Types of Respiratory Complications					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NO COMPLICATION	32	21.3	21.3	21.3
	PULMONARY	45	30.0	30.0	51.3
	PNEUMONIA	28	18.7	18.7	70.0
	PLEURAL EFFUSION	25	16.7	16.7	86.7
	DYSPNEA	16	10.7	10.7	97.3
	OTHER	4	2.7	2.7	100.0
	Total	150	100.0	100.0	

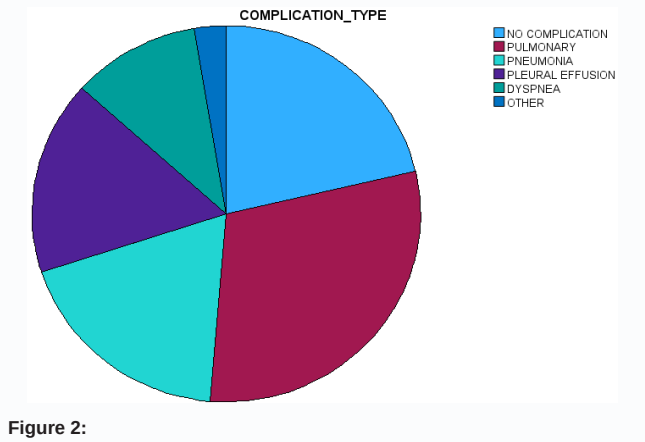

Figure 2:

stages (Stages 4 and 5).

Frequencies

See Tables 8-9.

Table 9 illustrates the distribution of different types of respiratory

complications. Pulmonary complications were the most common (30.0%), followed by pneumonia (18.7%), pleural effusion (16.7%), dyspnea (10.7%), while 21.3% had no complications.

Figure 2 shows the graphical representation of respiratory complication types among the participants.

Result

A total of 150 patients diagnosed with chronic kidney disease (CKD) across stages 1 to 5.

Demographic characteristics

Out of 150 patients, 88 (58.7%) were males and 62 (41.3%) were females, indicates a male predominance in the study population.

CKD stages distribution

Stage 5 CKD the largest group with 59 patients (39.3%) followed by stage 4 with 36 patients (24.0%), stage 3 with 29 patients (19.3%), stage 2 with 24 patients (16.0%) and stage 1 with 2 patients (1.3%).

Prevalence of respiratory complications

Out of the total 150 CKD patients, 118 patients (78.7%) presented with respiratory complications, while 32 patients (21.3%) did not have any respiratory complications. This shows that a high prevalence of respiratory complications among CKD patients

Association between CKD stage and respiratory complications

None of the patients in Stage 1 had respiratory complications. Only 2 patients in stage 2 showed respiratory involvement, whereas a marked increase was observed in stage 3 (23 patients), stage 4 (35 patients), and stage 5 (58 patients).

Statistical analysis using the Chi- square test revealed a significant association between CKD stage and the presence of respiratory complications ($\chi^2 = 99.070$, df = 4, $p < 0.001$) indicating that respiratory complications are significantly more common in advanced CKD stages.

Types of respiratory complications

Among the study population, pulmonary edema was the most common respiratory complication, affecting 45 patients (30.5%), followed by pneumonia in 28 patients (18.7%), pleural effusion in 25 patients (16.7%), and dyspnea in 16 patients (10.7%). A small proportion of patients (4 patients, 2.7% had other respiratory complications. No respiratory complications were observed in 32 patients (21.3%).

Discussion of the Study

The current study looked at the occurrence of respiratory problems among 150 individuals with chronic kidney disease (CKD). Our findings revealed that 78.7% of patients experienced respiratory problems, indicating that respiratory involvement is a widespread and clinically significant problem in CKD.

Gender Distribution

Among the study population, 88 patients were male and 62 were female. The higher prevalence among males may reflect the higher CKD burden reported in men in some studies, although respiratory complications appeared irrespective of gender.

Types of Complications

Pulmonary edema was the most common respiratory complication (30%), followed by pneumonia (18.7%). This aligns with previous studies suggesting that fluid overload and immune compromise in CKD increase the risk of pulmonary edema and infections. Other complications, including pleural effusion and COPD-like changes, were less common.

Association with CKD Stage

Respiratory complications were more frequent in advanced CKD stages, especially stage 5. The Chi-square test revealed a statistically significant association between CKD stage and respiratory complications ($\chi^2 = 99.070$, df = 4, $p < 0.001$). This finding is consistent with the pathophysiology of CKD, where progressive renal dysfunction leads to fluid retention, anemia, metabolic derangements, and reduced immunity, all of which contribute to pulmonary complications.

Comparison with Previous Literature

Our findings are in line with previous research indicating that respiratory complications are common in CKD, particularly in advanced stages. Pulmonary edema, secondary to fluid overload, remains the most frequently observed complication, while pneumonia reflects increased susceptibility to infections due to impaired immune function.

Clinical Implications

The high prevalence of respiratory complications in CKD patients emphasizes the need for routine respiratory monitoring and early intervention, especially in advanced CKD stages. Awareness of the common types of complications can guide clinicians in preventive strategies, early diagnosis, and appropriate management to reduce morbidity and improve quality of life.

Functional and Physiological Interpretation

The high burden of respiratory complications observed in this study can be explained by the close physiological relationship between renal dysfunction and pulmonary function. Progressive decline in renal function leads to fluid overload, hypoalbuminemia, anemia, metabolic acidosis, and accumulation of uremic toxins, all of which adversely affect respiratory mechanics and gas exchange. These changes result in reduced lung compliance, increased work of breathing and early onset of dyspnea, even during minimal physical activity. Such mechanisms explain the high prevalence of pulmonary edema and pleural effusion noted in the present study.

In added to this, there is a presence of impairment in immunity in CKD patients increases susceptibility to respiratory infections such as pneumonia. Frequent hospital admissions, comorbid diabetes malnutrition, and repeated exposure to invasive procedures further compound this risk. The presence of pneumonia in nearly one – fifth of the study population highlights the need for vigilant respiratory assessment and infection prevention strategies in CKD care.

Stage-wise Progression and Respiratory Burden

The strong association between advanced CKD stages and respiratory complications observed in this study reinforces the concept that respiratory involvement worsens as renal function declines. Patient in stages 4 and 5 demonstrated a markedly higher prevalence of complications, and prolonged disease duration. This stage- wise increase underscores the importance of early screening in the earlier stages of CKD to prevent progression of respiratory morbidity.

Relevance of physiotherapy perspective

From a physiotherapy point of view, respiratory complications significantly impair functional capacity, exercise tolerance, and independence in activities of daily living. Although outcome measures sch as mMRC dyspnea scale, 6-minute walk test, SPO_2 monitoring, and spirometry were not included in statistical analysis, their clinical use provided valuable insights into the functional impact of respiratory involvement. Many patients demonstrated educed endurance, increased perceived exertion, and limited chest expansion even in the absence of severe radiological findings.

Early identification of respiratory dysfunction through physiotherapy assessment allows timely initiation of interventions such as breathing exercises, thoracic mobility exercises, airway clearance techniques, and graded aerobic training. These interventions may help improve ventilation reduce dyspnea, enhance exercise tolerance, and improve overall quality of life in CKD patients**.**

Implications for integrated care

The findings of this study support the need for a multidisciplinary approach in the management of chronic kidney disease. Routine respiratory evaluation and physiotherapy evaluation into standard CKD care. This approach can reduce the hospital stay and give good treatment outcomes.

Strength and Limitations

Strengths

1. Adequate sample size: The study included 150 patients, which offers a dependable evaluate of prevalence.

2. Inclusion of all CKD stages: Patients from stages 1 to 5 were incorporated, permitting analysis of complications during disease progression.

3. Clear statistical analysis: Prevalence was evaluated with frequency and percentage, and the correlation with CKD stage was tested using Chi-square, providing valid results.

4. Clinically relevant findings: Determining the most common respiratory complications (pulmonary edema, pneumonia) offers useful patient care instructions.

Limitations

1. Cross-sectional design: The study analyzed the patients at a single point in time

2. Outcome tools not statistically analyzed: Tools like Borg scale, 6MWT, SpO_2, and PFT were used only for clinical assessment and were not involved in analysis, narrowing functional understanding.

3. Single-center study: this data was collected from one hospital or clinic; the results may not be applicable to all CKD populations.

4. Potential underreporting: Some respiratory complication, could have been overlooked or underreported specifically if asymptomatic.

5. Limited scope: The study viewed on prevalence and type of complications but did not evaluate the severity, duration, or treatment measures.

Conclusion

"Respiratory complications are widespread among patients with chronic kidney disease, affecting 78.7% of the study population. Pulmonary edema was being the frequently occurring complication (30%), followed by pneumonia (18.7%). The occurrence of complications with progressing CKD stage, with stage 5 patients being most affected. A statistically significant association was observed between CKD stage and respiratory complications (χ^2 = 99.070, df = 4, $p < 0.001$). These findings point out the importance of regular respiratory monitoring and early treatment in CKD patients to decrease morbidity and improve clinical outcomes.

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