

Estimation of Glomerular Filtration Rate (GFR) in Patients with Stable Chronic Obstructive Pulmonary Disease: A Cross-sectional Study**Chandan Kumar¹, Ashutosh Kumar², Raj Kumar Deepak³, Sumit Kumar⁴, Brajesh Kumar⁵**¹Senior Resident, Department of General Medicine, Government Medical College and Hospital, Bettiah, West Champaran, Bihar, India²Senior Resident, Department of TB and Chest, Government Medical College and Hospital, Bettiah, West Champaran, Bihar, India³Associate Professor and HOD, Department of General Medicine, Government Medical College and Hospital, Bettiah, West Champaran, Bihar.⁴Associate Professor, Department of General Medicine, Government Medical College and Hospital, Bettiah, West Champaran, Bihar, India⁵DNB PG Trainee, Government Medical College and Hospital, Bettiah, West Champaran, Bihar, India

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Conflict of interest: Nil

Abstract**Background:** Chronic obstructive pulmonary disease (COPD) is a systemic condition with numerous extrapulmonary complications. However, studies investigating the connection between COPD and renal impairment are few. The purpose of this study was to determine the relationship between estimated glomerular filtration rate (eGFR) and chronic obstructive pulmonary disease assessment test (CAT) score, modified medical research council (mMRC) scale, 6-minute walking test (6MWT), and postbronchodilator forced expiratory volume (FEV1) in COPD, as well as to compare the reduction in eGFR across GOLD stages.**Methods:** Between March 2026 and August 2026, 60 stable COPD patients attending the outpatient department (OPD) were selected at random. Participants underwent spirometry, Global Initiative for Chronic Obstructive Lung Disease (GOLD) staging, CAT score, mMRC grading, and a 6MWT. Serum creatinine was measured, and eGFR was computed. The interpretation was obtained by comparing the eGFR and GOLD stage findings with various parameters.**Results:** Among patients with normal eGFR, the average mMRC score was 2.00 ± 0.86 , 6MWD was 324.98 ± 47.08 m, and CAT score was 14.23 ± 6.09 . In patients with lowered eGFR, the average mMRC score was 2.32 ± 1.17 , 6MWD was 278.30 ± 75.98 m, and CAT score was 19.38 ± 9.05 . The results were statistically significant ($p = 0.0145$, $p < 0.0001$, and $p < 0.0001$, respectively). There was a negative association between eGFR and GOLD stages, with a Pearson correlation coefficient of -0.014 .**Conclusion:** In stable COPD patients with higher GOLD stages, eGFR levels were reduced. Patients with lower eGFR had a higher mMRC grade, higher CAT score, and lower 6MWD. To determine renal involvement in patients with stable COPD, routine eGFR measurement is recommended.**Keywords:** COPD, eGFR, renal involvement.**DOI:** 10.25258/ijcpr.18.10.34This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.**Introduction**

Chronic obstructive pulmonary disease (COPD) causes increasing, persistent shortness of breath and cough as a result of airway blockage and alveolar pathology.[1] The chronic airway restriction associated with COPD is produced by a combination of small airway illness and parenchymal damage (emphysema). Extrapulmonary comorbidities in these patients include ischemic heart disease (IHD), heart failure, arrhythmias, peripheral vascular disease,

gastroesophageal reflux disease (GERD), obstructive sleep apnea (OSA), and cerebrovascular accident (CVA).[2] These comorbidities have a substantial impact on the quality of life (QoL) and health outcomes in COPD. In fact, COPD patients die primarily from nonrespiratory diseases such as cardiovascular disease (25%), and lung cancer (20-33%). Chronic kidney disease (CKD) is defined as renal impairment that persists for three months or more and causes health problems.[3] To stage CKD,

an estimated glomerular filtration rate (eGFR) is preferable to serum creatinine. This study used the chronic kidney disease-epidemiology collaboration (CKD-EPI) equation to determine eGFR. Renal involvement is common in COPD patients and is mainly caused by smoking or old age, although the link between renal involvement and COPD is not well understood and is a largely overlooked area. Furthermore, COPD is a hypothesized cause of decreased eGFR, and early detection of CKD in COPD patients will result in early intervention and a considerable reduction in morbidity and mortality. So, the purpose of this study was to estimate eGFR in patients with stable COPD and to determine the relationship between eGFR and chronic obstructive pulmonary disease assessment test (CAT) score, modified medical research council (mMRC) dyspnea scale, 6-minute walking distance (6MWD), and postbronchodilator forced expiratory volume (FEV1).

Materials and Methods

From March to August 2026, a hospital-based observational descriptive study was undertaken among COPD patients attending the outpatient department (OPD) of the Department of Medicine at Government Medical College and Hospital, Bettiah, West Champaran, Bihar. A total of 60 patients were randomly selected. The trial comprised patients over 18 years old with a confirmed COPD diagnosis (symptoms, risk factors, and post-bronchodilator FEV1/FVC < 0.7 as per GOLD guidelines). Patients with diabetes, hypertension, systemic lupus erythematosus (SLE), known intrinsic renal impairment, age above 75 years, or a history of acute exacerbation of COPD during the previous month were excluded from the trial. Before taking a history and doing a clinical examination, an informed consent was obtained.

The severity of dyspnea was measured by mMRC grading. Each subject had a six-minute walking test (MWT). The severity of COPD was determined using GOLD staging and CAT score. In a sterile process, 5 mL of venous blood was drawn, and serum creatinine was determined using an automated biochemistry analyzer. eGFR was determined using the CKD-EPI equation and serum

creatinine levels. The CKD-EPI equation is $GFR = 141 \times \min(Scr/\kappa, 1)^\alpha \times \max(Scr/\kappa, 1)^{-1.209} \times 0.993Age \times 1.018$ (if female) $- 1.159$ (if black), where Scr is serum creatinine, κ is 0.7 for females and 0.9 for males, α is -0.329 for females and -0.411 for males, "min" indicates the minimum of Scr/ κ or 1, and "max" indicates the maximum of Scr. Normal eGFR was defined as more than 90 mL/minute/1.73 m². Reduced eGFR was defined as less than 89 mL/min/1.73 m². The collected data was manually sorted and coded before being entered into a Microsoft Excel sheet on a computer. An unpaired student's t-test was used. The interpretation was established by comparing the results of the eGFR and GOLD stages of COPD, as well as several COPD severity indicators such as the mMRC score, CAT score, and 6MWT, and assessing the degree of association.

Results

In this study, the majority of the patients were from 41–60 years age group (66.3%). About 64.2% of the COPD patients were males. The mean age of COPD patients was 56±8 years. Among them, 63.8% of the patients were smokers and 33.8% of the patients were exposed to biomass fuel, and 2.4% of the patients were exposed to both. About 19 (31.6%) patients were of dyspnea mMRC grade I, 21 (35.0%) patients were of grade II, 12 (20.0%) patients were of grade III, and 8 (13.4%) patients grade IV.

In this study, 13.8% of the patients were of GOLD stage I, 40.0% of stage II, 40.0% of the patients of stage III, and 6.3% of stage IV. About 46.3% of the patients had reduced eGFR. Among them, 20 (73.0%) patients were from the G2 eGFR subgroup, and 8 (27.0%) patients were from the G3a eGFR subgroup. Smoking significantly reduced eGFR (Chi-square value: 48.1378; $p < 0.0001$; odds ratio: 0.1326 (0.0726, 0.2420). Among patients with low eGFR, 56.8% were in GOLD stage II, whereas 43.2% were in stage III. The relationship between the GOLD stage and the eGFR group was statistically significant ($p < 0.0001$). The mean mMRC score for patients with lower eGFR was 2.32 ± 1.17 , which was statistically significant ($p = 0.0145$) (Table 1).

Table 1: Distribution of mean mMRC score and eGFR group

mMRC score	No. of cases	Mean±SD	Minimum	Maximum	Median	p-value
Normal eGFR	32	2.00±0.87	1.00	3.00	2.00	0.0145
Reduced eGFR	28	2.32±1.17	1.00	4.00	2.00	

These individuals had a mean CAT score of 19.38 ± 9.05 . Table 2 shows that the distribution of the mean CAT score with a lower eGFR group was statistically significant ($p < 0.0001$).

Table 2: Distribution of mean CAT score and eGFR group

CAT score	No. of cases	Mean±SD	Minimum	Maximum	Median	p-value
Normal eGFR	32	14.23±6.09	7.00	25.00	13.00	<0.0001
Reduced eGFR	28	19.38±9.05	9.00	35.00	18.00	

For patients with normal eGFR, the mean 6MWD was 324.98 ± 47.08 . The mean 6MWD of patients with decreased eGFR was 278.29 ± 75.97 . The distribution of mean 6MWD with the eGFR group was statistically significant ($p < 0.0001$; Table 3).

Table 3: Distribution of mean 6MWD and eGFR group

6MWD	No. of cases	Mean $\pm$ SD	Minimum	Maximum	Median	p-value
Normal eGFR	32	324.98 $\pm$ 47.08	260.00	390.00	344.00	<0.0001
Reduced eGFR	28	278.30 $\pm$ 75.97	159.00	402.00	280.00	

There was a negative correlation between eGFR vs GOLD stage [Pearson correlation coefficient (r) was -0.014].

Discussion

Patients with COPD are more likely to develop renal failure, either directly from hypoxia or indirectly through vascular disease and smoking.

Although there was some indication that renal injury and COPD were associated, no clinical evidence-based data had previously been published to explain the relationship between albuminuria, renal failure, smoking, and COPD. COPD hypoxemia and hypercapnia frequently cause renal tubular and interstitial damage, as well as salt retention, both of which contribute significantly to renal impairment in COPD patients.[4-6] Reduced glomerular filtration due to vascular stiffness contributes to the pathophysiology. Endothelins typically act as mediators in the pathophysiology of renal failure and COPD. Sofia et al. discovered a link between changes in endothelins and variations in PaCO₂ and PaO₂. COPD patients had significantly higher 24-hour urine excretion of endothelin than controls, demonstrating a link between endothelin and the progression of CKD in COPD.[7] COPD patients experience renal damage due to inflammatory mediators such as CRP, IL-6, IL-1 β , TNF- α , cigaret smoke toxins (nicotine and heavy metals), oxidative stress, neurohormonal activation, and abnormal immune cell signaling.[8]

Elmahallawy and Qora investigated the prevalence of underdiagnosed renal failure in 300 COPD patients.[9] They discovered normal renal function, veiled and overt CKD in 54, 26, and 20% of COPD patients, respectively; in the control group, the values were 78, 10, and 12%. They determined that chronic renal failure (CRF) was a significant comorbidity that required estimated GFR for screening.[9] Other studies have also reported a significant frequency of CKD among COPD patients.[10-13] There was also a considerable decline in renal function with time. Patients with obstructive airway illness had a greater risk of CKD, regardless of their COPD diagnosis.[14,15]

Shihong et al. reported renal involvement in 30.59% of group-D COPD patients, but less than 15% in other groups. The study found that COPD patients with renal impairment had lower lung function and clinical symptoms than those with

adequate renal function. Among the pulmonary functions predicted by FEV1%, FEV1/FVC was considerably altered.[16]

In this study, patients with low eGFR had significantly higher mean mMRC scores, lower 6MWD, and higher CAT scores. The Pearson correlation coefficient (r) for eGFR and GOLD stage was -0.014 . As a result, the findings of this study were comparable to those of Shihong et al.[16]. We were unable to locate any studies that demonstrated a correlation between renal impairment and mMRC score, CAT score, and 6MWD.

Conclusion

Finally, it is recommended that renal function be tested in all COPD patients during their initial appointment as well as at subsequent visits to determine the course of renal impairment.

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