International Journal of Basic & Clinical Pharmacology
*Zaawari A et al. Int J Basic Clin Pharmacol. 2022 Sep;11(5):404-409*
http://www.ijbcp.com
pISSN 2319-2003 | eISSN 2279-0780

DOI: https://dx.doi.org/10.18203/2319-2003.ijbcp20222135

**Original Research Article**

# Prevalence of anemia among chronic kidney disease patients in India: a single-centre study

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**Received:** 04 June 2022
**Accepted:** 24 June 2022

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## ABSTRACT

**Background:** Chronic kidney disease is defined as abnormalities in kidney structure or function with a decreased glomerular filtration rate <60 ml/min for three months or more, irrespective of the cause. CKD has many complications that usually develop throughout disease progression. Anemia is among these complications. The prevalence of anemia is very high among CKD patients and it is an important parameter to be monitored and addressed. This research study aimed to find out the prevalence of anemia among CKD patients and investigate the relationship between anemia and other predictive factors.
**Methods:** This was a unicenter, cross-sectional, prospective observational study conducted for six months between December 2020 and May 2021 at a tertiary care hospital to assess the prevalence of anemia among CKD patients. Data were collected, coded, and analyzed using SPSS software. A descriptive analysis was performed, and significance tests were applied where applicable. Multiple regression analysis and Pearson tests were applied to determine the relationship between variables, p>0.05 was considered statistically significant.
**Results**: A total of 715 patients were enrolled in the study, out of which 432 (59.2%) and 292 (40.8%) were male and female, respectively. The mean age was 56.4±15 SD. Out of 715 patients, 531 (74.3%) patients were anemic and 58 (8.1%) were severely anemic. Thus, the prevalence of anemia was 82.4% among study participants. Hypertension, diabetes, and CKD stage were associated with a high prevalence of anemia.
**Conclusions:** This study reported a high prevalence of anemia compared to previous studies. Assessing the anemic status of patients in earlier stages of the disease will contribute greatly to managing this complication.

**Keywords:** Chronic kidney disease, Anemia, Prevalence, Hypertension, Diabetes.

## INTRODUCTION

Chronic kidney disease (CKD) is defined as abnormalities in kidney structure or function with a decreased glomerular filtration rate (GFR) (<60 ml/min/1.73 $m^2$) for three months or more, irrespective of the cause. Impairment of normal renal function is often referred to as renal insufficiency.[1] The most common risk factors are diabetes mellitus, hypertension, glomerulonephritis, polycystic kidney disease, and interstitial fibrosis. A recent prospective study of over 300,000 individuals screened for the Multiple Risk Factor Intervention Trial (MRFIT) estimated that approximately 3% of individuals with diabetes mellitus would develop Stage 5 CKD during their life. Thus, someone with diabetes has a 12-fold greater relative risk of developing stage 5 CKD than someone without diabetes mellitus. Glomerular diseases are another vital category of risk factors for CKD.[2] Other conditions, such as IgA

nephropathy, membranous nephropathy, focal segmental glomerulosclerosis, lupus nephritis, and others, are considered causes of CKD.[3,4]

The National kidney foundation's kidney dialysis outcomes and quality initiative (KDOQI) group classified CKD based on the presence of structural or functional kidney damage for ≥three months, with or without decreased GFR from average values of ~120 ml/min.[5] CKD is further categorized by the level of kidney function (as defined by GFR) into stages 1 to 5 as follows: stage 1 with normal or high GFR (GFR >90 ml/min), stage 2 mild CKD (GFR=60-89 ml/min), stage 3A moderate CKD (GFR=45-59 ml/min), stage 3B moderate CKD (GFR=30-44 ml/min), stage 4 severe CKD (GFR=15-29 ml/min), stage 5 end stage CKD (GFR <15 ml/min).

### *Complications of CKD*

Progressive CKD is associated with various consequences and complications. These complications contribute to high morbidity and mortality as well as poor quality of life (QOL). A number of these complications (cardiovascular disease, hypertension, anemia, bone disorder, volume overload, electric electrolytes, and acid-base abnormalities) can be easily defined and quantified and require a specific management approach, such as prescribing erythropoietic stimulants to correct anemia. Anorexia, fatigue, pruritus, nausea, and sexual dysfunction are examples of minor, well-defined complications with less distinct pathogenesis.[6-8]

### *Anemia of chronic diseases in CKD*

Anemia is a common complication of CKD. It has been linked to many adverse clinical outcomes and has a significant impact on the QOL of people with CKD. Patients on dialysis typically required blood transfusions before the availability of recombinant human erythropoietin (rHuEPO, or epoetin), exposing them to the hazards of iron overload, viral hepatitis transmission, and sensitization. The introduction of rHuEPO in the late 1980s completely changed the scenario. Even though there is a solid argument for treating anemia in CKD patients, the best therapeutic options are yet unknown. In addition to ESA therapy, iron replacement is necessary for anemia treatment. Importantly, to guarantee an appropriate count of red cell production, CKD patients require target thresholds of iron parameters that differ from those of healthy individuals. The expense of anemia therapy is substantial; it is thus necessary to assess the risks and benefits rationally and carefully.[9] The anemia caused by CKD is hypoproliferative. The circulating reticulocyte count is low, and a bone marrow examination usually reveals no increase in progenitor cells, as reported in anemic patients without CKD. There is also a superimposed iron, folate, or vitamin B12 shortage, but red blood cells (RBCs) are usually normochromic and normocytic.[10]

The regulatory hormone erythropoietin, which stimulates the release of RBCs from the bone marrow into the circulation, is the most critical factor governing RBC synthesis in the bone marrow. Although other variables may play a role, the fundamental cause of CKD anemia is a relative deficiency of erythropoietin. Factors involved in the anemia of CKD are represented in (Table 1).

**Table 1: Factors involved in the anemia of CKD.**

| Factors |
|---|
| **Most important/common factors** |
| Decreased erythropoietin synthesis |
| Relative erythropoietin deficiency |
| **Important, common** |
| Iron deficiency (absolute) |
| Iron deficiency (functional) |
| Chronic blood loss, including from phlebotomy |
| Infection/inflammation-“anemia of chronic disease”. |
| **Less critical, less common, or of uncertain significance** |
| Vitamin B12 and folate deficiency |
| “Uremic toxins” |
| Reduced red blood cell life span |
| Increased red blood cell fragility |
| Carnitine deficiency |
| Aluminum toxicity |
| Severe hyperparathyroidism |
| ACEIs/ARBs |

Anemia is defined by the world health organization as a hemoglobin level of less than 13.0 g/dl in men and less than 12.0 g/dl in women. The same was adopted in our study. Apart from this, hemoglobin of less than 8.0 g/dl was referred to as severe anemia, as shown in the results section.

### *Aim and objectives*

This research study aimed to find out the prevalence of anemia among CKD patients and investigate the relationship between anemia and other predictive factors. Objectives of current study were; to assess the prevalence of anemia among patients with CKD in different stages, to find out the highly affected group and to examine if any association between anemia and other comorbidities exists.

## METHODS

### *Study design, location, duration and population*

This study was a cross-sectional prospective observational study to assess and determine the prevalence of anemia among patients with CKD in a

single center. The study was conducted in a tertiary care hospital, Hyderabad kidney and laparoscopic center. The study was conducted for six months between December 2020 and May 2021. The study was conducted among patients with CKD and end-stage renal disease (ESRD).

### *Sample size*

The study's sample size was calculated using the tool available at https://www.calculator.net/sample-size-calculator.html. With a 95% confidence interval and a 5% margin of error, while leaving the population size blank, the calculated sample size is 384. However, we increased the sample size to have better and more reliable results. A total of 715 participants fulfilled the study criteria by the end of the data collection period. The sample thus was 715 patients.

### *Inclusion criteria*

Inclusion criteria for current study were; patients over 18 years old with confirmed CKD and patients with low GFR and high serum creatinine levels, as well as those with ESRD.

### *Exclusion criteria*

Exclusion criteria for current study were; pediatric patients, pregnant women, patients with acute renal failure, patients visiting the center for the first time require at least three months to confirm a CKD diagnosis and patients who are not willing to participate in the study.

### *Data collection method*

Data was collected from patient profile forms using standard data collection forms. Data missing in the profile forms were collected from participants verbally. Data gathered included demographic details, past medical history, past medication history, family history, present illness, and lab values related to CKD and anemia.

### *Data analysis*

Data was coded and analyzed using SPSS Statistics for Windows Version IBM 22. Descriptive analysis was performed, and significance tests were applied where applicable. Multiple regression analysis and Pearson tests were applied to determine the relationship between variables, $p>0.05$ was considered statistically significant. The results were interpreted and discussed.

### *Ethical consideration*

The ethical approval for this study was obtained from the institutional review board (IRB) of Nova College of Pharmaceutical Education and Research with reference No: NCPER/11/25/IRB2020. All participants in the study signed an informed consent form before data collection.

## RESULTS

Throughout the study, 715 eligible patients visited the hospital. Seven hundred and fifteen participants were enrolled for the study after signing the informed consent form or giving a verbal agreement. Among the 715 participants, 423 (59.2%) and 292 (40.8%) were male and female, respectively. The distribution of the patient's gender is shown in (Figure 1).

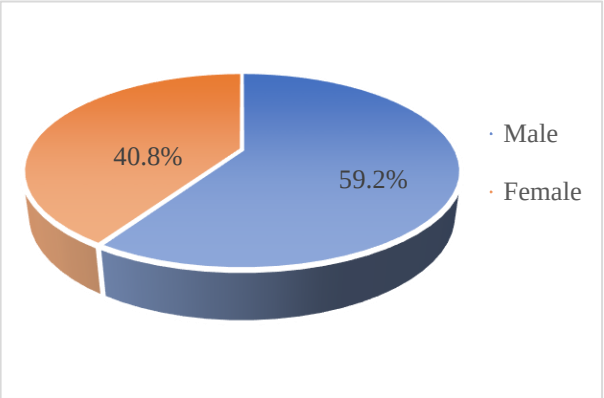


**Figure 1: Sex distribution of patients.**

The mean age was 56.4±15 SD. The age groups were divided into intervals to estimate the age of the majority of participants. Five age groups were done, and a high percentage was for participants aged between 60 and 80 years, which accounted for 292 (40.8%). The age-wise distribution is shown in (Table 2).

**Table 2: Age distribution of the study population (n=715).**

| Age (years) | N | % |
|---|---|---|
| **18-29** | 28 | 3.9 |
| **30-44** | 123 | 17.2 |
| **45-59** | 255 | 35.7 |
| **60-80** | 292 | 40.8 |
| **>80** | 17 | 2.4 |
| **Total** | 715 | 100 |

Anemia was defined as hemoglobin below 13 g/dl for males and below 12 g/dl for females, as per studies in the literature. Hemoglobin was an indicator of anemia in our study as per the above criteria. Creatinine level was used to calculate the CKD stage following other information. Participants were grouped into five steps according to eGFR value. eGFR was calculated using the CKD-EPI equation. Participants were lower in stage 1 and stage 2 compared to higher stages. This could be because most of the early stages of CKD go undiagnosed, and once patients get the essential evaluation and assessment, they are already in higher stages. The lack of high-alert symptoms in the early stages could be the reason why most patients are not getting the required assessment.

**Table 3: Distribution of study population according to CKD stage (n=715).**

| CKD stage | N | % |
|---|---|---|
| **Stage 1** | 27 | 3.8 |
| **Stage 2** | 62 | 8.7 |
| **Stage 3** | 274 | 38.3 |
| **Stage 4** | 167 | 23.4 |
| **Stage 5** | 185 | 25.8 |
| **Total** | 715 | 100.0 |

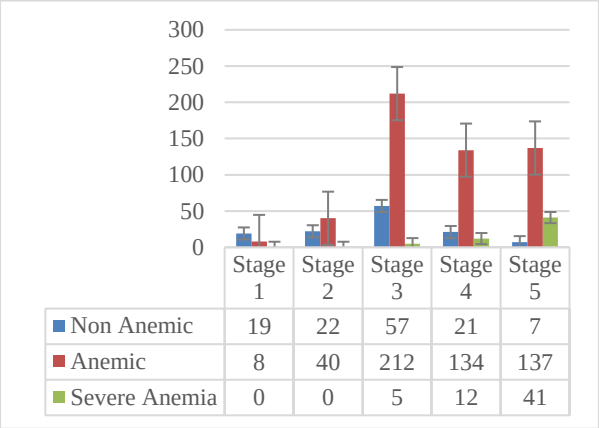


**Figure 2: Distribution of anemia among study population according to CKD stage (n=715).**

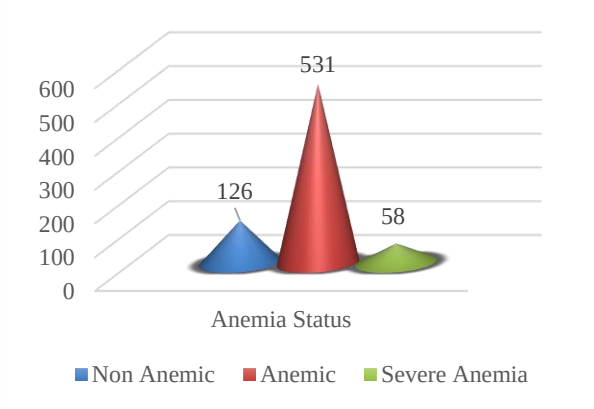


**Figure 3: General distribution of anemia among study participants (n=715).**

The highest number of patients was observed in stage 3, with 274 (38.3%) out of the 715 participants. Patients on stage 1 were relatively fewer and accounted for only 27 (3.8%). There was no high difference between patients in stages 4 and 5, accounting for 167 (23.4%) and 185 (25.8%) respectively. The distribution of the study population according to the CKD stage is shown in (Table 3). The mean creatinine level was 3.26±2.3 SD. The high SD value indicates that creatine level has different measure far from each other among study participant. That can be explained based on declining kidney function. The vast majority of the participants were anemic. Severe anemia and absence of anemia were less common. Out of 715 patients, 531 (74.3%) patients were anemic, and 58 (8.1%) were severely anemic. Thus, the prevalence of anemia was found to be 82.4% among study participants. The anemia distribution among the study population is shown in (Figure 2-3).

The mean hemoglobin level was (10.8±20.1 SD). The minimum reported value was 5.2g/dl. There was a higher prevalence than what was expected and reported in previous studies. Anemia was more common in males than females. However, severe anemia was reported with an exact prevalence among both genders. Hypertension was also taken into consideration as a risk factor for anemia in patients with CKD. Among the study participants, 554 (77.5%) patients were hypertensive, while 161 (22.5%) were not hypertensive. This demonstrates a strong relationship between hypertension and anemia in CKD. Hypertension was higher in males than females and was exceptionally high among patients aged between 60 and 80 years. Diabetes mellitus has also been taken into consideration as it is frequently associated with hypertension. The results were almost the same for the prevalence of diabetes and hypertension. This confirms the direct relationship between hypertension and diabetes. To understand the relationship between hypertension/diabetes and anemia, correlation and multiple regression analysis were performed for hypertension and anemia, diabetes and anemia, and stages with anemia (Table 4).

**Table 4: Association between anemia and other predictive variables (n=715).**

| Variable | N | % | P value |
|---|---|---|---|
| **Hypertension** | 554 | 77.5 | 0.01* |
| **Diabetes mellitus** | 555 | 77.6 | 0.02* |
| **CKD stage 1** | 27 | 3.8 | 0.7 |
| **CKD stage 2** | 62 | 8.7 | 0.1 |
| **CKD stage 3** | 274 | 38.3 | 0.01* |
| **CKD stage 4** | 167 | 23.4 | 0.01* |
| **CKD stage 5** | 185 | 25.8 | 0.01* |

(*) Indicate statistical significance at p<0.05, Pearson correlation, multiple regression.

In Pearson correlation analysis, hypertension was significantly associated with the development of anemia (p=0.01). The same holds true for diabetes (p=0.02). Stages of CKD were significantly associated with the development of anemia and were statistically significant (p=0.01), which indicates that advanced stages of CKD are associated with an increased risk of anemia.

## DISCUSSION

Anemia is very common among CKD patients worldwide. Our study reported an 82.4% prevalence of anemia among study participants. Melissa et al. reported the prevalence of anemia as 53.4% in the United States.[11] The prevalence is comparatively high in India, as reported by our study. The lack of routine screening and

evaluation for CKD patients plays a major role in preventing complications of CKD, including anemia. Numerous factors influence the development of anemia in patients with chronic conditions. As reported in the literature, hypertension and diabetes mellitus have been among the top predictive factors for the development of anemia.[12-16] The findings of our study come in parallel with previously reported studies regarding the association and relationship between anemia, hypertension, diabetes, and CKD. This was explored in our study through multiple regression analysis and Pearson correlation tests. The results were significant for hypertension and diabetes mellitus.[17,18] The stages of CKD were also associated with a high prevalence of anemia.[19,20] This accounts for stages 3, 4, and 5. Patients with higher stages of CKD were found to have severe anemia defined by hemoglobin below 8 g/dl. All practitioners need to educate CKD patients about the importance of routine checkups and examinations. Doing so will assure early detection and prevention of CKD complications.

### *Limitations*

Limitations of current study were; the study was a unicenter, which might affect generalizing the result to the population, there was no follow-up with most of the study participants to keep up with their anemic status and the type of treatment given for anemia before enrollment in the study was not taken into consideration. This might show bias when patient Hb is restored to normal after treatment. Thus, the patient is regarded as non-anemic.

## CONCLUSION

The current study findings reveal that the incidence and prevalence of anemia among CKD patients are more significant than previously thought. Furthermore, it is associated with renal function; its prevalence increases as renal function declines. Therefore, anemia may be identified and managed sooner, which improves the quality of life and reduces hospitalizations in CKD patients due to cardiovascular events. Anemia development is associated with hypertension, diabetes, and CKD stages. Patients with advanced CKD are more likely to develop anemia than those with early stages. The same holds for hypertension, where hypertensive individuals are more likely to have anemia than non-hypertensive ones. Diabetes mellitus is a risk factor for anemia. It is strongly associated with the development of anemia in CKD patients. The effect of diabetes can be extended to diabetic nephropathy as well. The results of this study reveal the importance of early assessment and management of anemia in CKD patients. Routine assessments and evaluation measures are to be implemented and performed periodically on patients with renal diseases to assure early detection and management of complications. This will not only prevent disease progression but also improve the quality of life of patients, which is an essential thing in the management goals of CKD.

## ACKNOWLEDGEMENTS

Authors are grateful to the medical and nursing teams at Hyderabad kidney and laparoscopic center for their collaboration and support throughout the study. Authors also extend their gratitude to Dr. Raja Ram, head of nephrology department, for his continuous guidance and support.

*Funding: No funding sources*
*Conflict of interest: None declared*
*Ethical approval: The study was approved by the Institutional Ethics Committee with reference No: NCPER/11/25/IRB2020.*

## REFERENCES

1. Levey AS, Eckardt KU, Tsukamoto Y. Definition and classification of chronic kidney disease: a position statement from kidney disease: improving global outcomes (KDIGO). Kidney Int. 2005;67(6): 2089-100.
2. Inker LA, Astor BC, Fox CH. KDOQI US commentary on the 2012 KDIGO clinical practice guideline for the evaluation and management of CKD. Am J Kidney Dis. 2014;63(5):713-35.
3. Zaawari A. Rapidly progressive IgA nephropathy leads to end-stage renal disease: a case report. Int J Inno Sci Res Tech. 2021;6(1):916-8.
4. Levin A, Stevens PE, Bilous RW, Coresh J. KDIGO 2012 clinical practice guideline for the evaluation and management of chronic kidney disease. Kidney Int Suppl. 2013:3:1-150.
5. Bello AK, Alrukhaimi M, Ashuntantang GE. Complications of chronic kidney disease: current state, knowledge gaps, and strategy for action. Kidney Int Suppl. 2017;7(2):122-9.
6. Eckardt KU. Erythropoietin: oxygen-dependent control of erythropoiesis and its failure in renal disease. Nephron. 1994;67:7-23.
7. Hsu CY, Bates DW, Kuperman GJ, Curhan GC. Relationship between hematocrit and renal function in men and women. Kidney Int. 2001;59(2):725-31.
8. Stauffer ME, Fan T. Prevalence of anemia in chronic kidney disease in the United States. PLoS One. 2014; 9(1):e84943.
9. Webster AC, Nagler EV, Morton RL, Masson P. Chronic kidney disease. Lancet. 2017;389(10075): 1238-52.
10. Hayashi T, Maruyama S, Nangaku M. Darbepoetin Alfa in Patients with Advanced CKD without Diabetes: Randomized, Controlled Trial. Clin J Am Soc Nephrol. 2020;15(5):608-15.
11. Liu M, Li XC, Lu L. Cardiovascular disease and its relationship with chronic kidney disease. Eur Rev Med Pharmacol Sci. 2014;18(19):2918-26.
12. Karohl C, Raggi P. Approach to cardiovascular disease prevention in patients with chronic kidney disease. Curr Treat Options Cardiovasc Med. 2012; 14(4):391-413.

13. Adera H, Hailu W, Adane A, Tadesse A. Prevalence of anemia and its associated factors among chronic kidney disease patients at university of gondar hospital, northwest Ethiopia: a hospital-based cross sectional study. Int J Nephrol Renovasc Dis. 2019; 12:219-28.
14. Ammirati AL. Chronic kidney disease. Rev Assoc Med Bras. 2020;66(1):s03-9.
15. Alharbi R. Prevalence, and severity of anemia in CKD patients. Egypt Acad J Biol Sci Physiol Mol Biol. 2019;11(2):71-83.
16. McClellan W, Aronoff SL, Bolton WK. The prevalence of anemia in patients with chronic kidney disease. Curr Med Res Opin. 2004;20(9):1501-10.
17. Sofue T, Nakagawa N, Kanda E. Prevalence of anemia in patients with chronic kidney disease in Japan: A nationwide, cross-sectional cohort study using data from the Japan Chronic Kidney Disease Database (J-CKD-DB). PLoS One. 2020;15(7): e0236132.
18. Hussain S, Habib A, Najmi AK. Anemia prevalence and its impact on health-related quality of life in Indian diabetic kidney disease patients: Evidence from a cross-sectional study. J Evid Based Med. 2019;12(4):243-52.
19. Shen Y, Wang J, Yuan J. Anemia among Chinese patients with chronic kidney disease and its association with quality of life - results from the Chinese cohort study of chronic kidney disease (C-STRIDE). BMC Nephrol. 2021;22(1):64.
20. Parfrey PS, Foley RN, Wittreich BH, Sullivan DJ, Zagari MJ, Frei D. Double-blind comparison of full and partial anemia correction in incident hemodialysis patients without symptomatic heart disease. J Am Soc Nephrol. 2005;16(7):2180-9.

**Cite this article as:** Zaawari A, Tejaswini KL, Davina GD, Singanaveni A. Prevalence of anemia among chronic kidney disease patients in India: a single-centre study. Int J Basic Clin Pharmacol 2022;11:404-9.