

# A Study on Etiology, Clinical Features and Complications of Chronic Kidney Disease Patients

MUHAMMAD UBAID<sup>1</sup>, AHSAN MOBIN<sup>2</sup>, IMTIAZ MANZOOR<sup>3</sup>, MUHAMMAD REHAN<sup>4</sup>, ZAHID QADRI<sup>5</sup>

<sup>1</sup>Consultant Physician, Assistant Professor Medicine, Mamji Hospital, Karachi

<sup>2,4</sup>Consultant Physician, Assistant Professor Medicine, Dow University of Health Sciences, Karachi

<sup>3</sup>Consultant Physician, Chiniot General Hospital, Karachi

<sup>5</sup>Consultant Physician, Mamji Hospital, Karachi

Corresponding author: Muhammad Ubaid, Email: [drubaidchk@gmail.com](mailto:drubaidchk@gmail.com)

## ABSTRACT

**Background and Aim:** Chronic kidney disease (CKD) is a major health issue that encompasses a variety of pathophysiological processes mostly related to declining rate of glomerular filtration and abnormal kidney function. Globally, the incidence of chronic kidney disease is increasing due to hypertension, diabetes, and cardiovascular disease. The present study aimed to investigate the etiology, clinical features, and complications of chronic kidney disease patients.

**Methodology:** This cross-sectional study was conducted on 136 chronic kidney disease patients admitted to the Department of Medicine of Mamji Hospital, Karachi Pakistan from January 2021 to December 2021. Prior to study conduction, ethical approval from the research and ethical committee of the institute was taken. Informed consent was obtained from each individual. Demographic details, para-clinical and clinical features, etiology, and therapeutic features were the different outcome variables. Clinical examinations with detailed history and laboratory investigations were assessed. For laboratory examinations, urine and blood samples from each participant were taken. Data analysis with detailed descriptive statistics was carried out in SPSS version 25.

**Results:** Out of 136 CKD patients, there were 74 (54.4%) male and 62 (45.6%) females. The overall mean age was  $38.6 \pm 4.8$  years. Age-wise distribution of the participants was as: 23 (16.9%) 15-25 years, 38 (27.9%) 26-35 years, 34 (25%) 36-45 years, 26 (19.1%) 46-55 years, and 15 (11.1%) >55 years. The chronic kidney disease associated comorbidities were high blood pressure (HBP) 64 (47.1%), human immunodeficiency virus (HIV) 25 (18.4%), Diabetic sugar 21 (15.4%), heart disease 19 (14%), and sickle cell anemia 7 (5.1%). Lesion diagnosis was found in 61 (44.9%) patients. The most prevalent diagnosis was chronic glomerulonephritis (CGN), Glom nephropathy, and vascular nephropathies presented in 27 (19.9%), 18 (13.2%), and 16 (11.8%) respectively. Intermediate 69 (50.7%), Hypertensive nephropathy 20 (14.7%), HIV-related nephropathy 17 (12.5%), Diabetic nephropathy 15 (11%), Primary segmental and focal hyalinosis 11 (8.2%), and Autosomal dominant polycystic kidney disease 4 (2.9%) were the different etiology diagnosed in CKD patients. The chronic disease complications such as Anemia, hyperkalemia, hyperuricemia, uremic encephalopathy, right femoral venous thrombosis, and acute pulmonary edema were seen in 107 (78.7%), 54 (39.7%), 13 (9.6%), 9 (6.6%), 2 (1.5%), and 8 (5.9%) respectively.

**Conclusion:** The present study concluded that hypertension, cardiovascular disease, diabetes, and HIV are the different predominant risk factors for chronic kidney disease. Also, the most prevalent etiology of the CKD was chronic glomerulonephritis (CGN) followed by Diabetic nephropathy in CKD patients. Anemia was the prevalent complication followed by hyperkalemia and hyperuricemia. Swelling at lower limb and weakness were the common symptoms of chronic kidney disease.

**Keywords:** Etiology, Clinical features, Complications, Chronic Kidney Disease.

## INTRODUCTION

Chronic Kidney Disease (CKD) is a major health issue affecting millions of people in both developing and developed countries [1, 2]. The incidence of chronic kidney disease varies significantly from region to region [3]. About 10 to 15% of the adult population is affected by CKD [4]. Chronic kidney disease (CKD) encompasses a variety of pathophysiological processes mostly related to declining rate of glomerular filtration and abnormal kidney function. Renal hematuria, reduced kidney size evaluated by sonography, persistent proteinuria, abnormalities in renal structure, and estimated glomerular filtration rate are different factors that identify chronic kidney disease or kidney damage [5, 6]. Hypertension and diabetes are the leading causes of chronic kidney disease [7]. Cystic kidney disease, vascular disease, kidney congenital defects, glomerular disease, recurrent renal calculi, obstructive uropathy, autoimmune diseases, tubulointerstitial disease, and rheumatoid arthritis were other causes of chronic kidney disease [8]. The morbidity and mortality rate of chronic kidney disease is caused by cardiovascular disease in the majority of cases. The most common lipid abnormalities in chronic kidney disease patients are reduced HDL concentration and hypertriglyceridemia [9].

Studies have shown that lower eGFR and higher serum creatinine levels are significantly associated with progression of chronic kidney disease [10]. Additionally, different risk factors for chronic kidney disease are gender, age, proteinuria, arterial hypertension, and other modifiable factors such as elevated phosphate levels, anemia, hyperuricemia, heart failure, hyperlipidemia, and end-stage renal disease [11]. In stage 4 CKD patients, the worsening eGFR comes from metabolic acidosis with

their approximate prevalence of 40% significantly associated with progression of CKD [12]. Anemia is frequently present in chronic kidney disease mostly related to poor outcomes such as increased risk of cardiovascular disease and mortality, reduced life's quality, and hospitalization [13]. Hyperuricemia mainly contributes to progression of chronic kidney disease caused by increasing levels of uric acid in turn increasing the risk of CKD development due to endothelial cell injury, inflammation, and renin-angiotensin system activation [14]. In advance CKD, Hyperkalemia is a prevalent factor whose prevalence rises with decreasing eGFR related to faster progression of chronic kidney disease [15]. The present study aimed to evaluate the demographic, etiological, clinical features and complications of chronic kidney disease patients.

## METHODOLOGY

This cross-sectional study was conducted on 136 chronic kidney disease patients admitted to the Department of Medicine of Mamji Hospital, Karachi Pakistan from January 2021 to December 2021. Prior to study conduction, ethical approval from the research and ethical committee of the institute was taken. Informed consent was obtained from each individual. Demographic details, para-clinical and clinical features, etiology, and therapeutic features were the different outcome variables. Clinical examinations with detailed history and laboratory investigations were assessed. For laboratory examinations, urine and blood samples from each participant were taken. The chronic disease comorbidities, etiologies, and complications were studied. Other investigations such as urine routine, peripheral smear, liver function test, complete blood count, electrocardiography, renal function test, and two dimensional echo

were carried out. Blood pressure >140/90 is referred to hypertension in patients who had a history of hypertension. Patients with prior history of diabetes or random blood sugar >200 or fasting blood glucose >126 are defined as diabetes. In detail history taking, ischemic stroke details, percutaneous angiography and stenting history, and history of coronary artery bypass graft were taken.

Data analysis was carried out in SPSS version 25. Numerical variables were expressed as mean and standard deviation. Categorical variables are described as frequency and percentage. Clinical, etiological features, comorbidities, and complications of chronic kidney disease were stratified for age, gender, and sociodemographic parameters. Post-stratification chi-square test was performed for comparing different factors with 95% confidence interval taking 5% level of significance.

**RESULTS**

Out of 136 CKD patients, there were 74 (54.4%) male and 62 (45.6%) females. The overall mean age was 38.6±4.8 years. Age-wise distribution of the participants were as follows: 23 (16.9%) 15-25 years, 38 (27.9%) 26-35 years, 34 (25%) 36-45 years, 26 (19.1%) 46-55 years, and 15 (11.1%) >55 years. The chronic kidney disease associated comorbidities were high blood pressure (HBP) 64 (47.1%), human immunodeficiency virus (HIV) 25 (18.4%), Diabetic sugar 21 (15.4%), heart disease 19 (14%), and sickle cell anemia 7 (5.1%). Lesion diagnosis was found in 61 (44.9%) patients. The most prevalent diagnosis was chronic glomerulonephritis (CGN), Glom nephropathy, and vascular nephropathies presented in 27 (19.9%), 18 (13.2%), and 16 (11.8%) respectively. Intermediate 69 (50.7%), Hypertensive nephropathy 20 (14.7%), HIV-related nephropathy 17 (12.5%), Diabetic nephropathy 15 (11%), Primary segmental and focal hyalinosis 11 (8.2%), and Autosomal dominant polycystic kidney disease 4 (2.9%) were the different etiology diagnosed in CKD patients. The chronic disease complications such as Anemia, hyperkalaemia, hyperuricemia, uremic encephalopathy, right femoral venous thrombosis, and acute pulmonary edema were seen in 107 (78.7%), 54 (39.7%), 13 (9.6%), 9 (6.6%), 2 (1.5%), and 8 (5.9%) respectively. Figure-1 represents gender's distribution. Age-wise distribution of the participants are illustrated in Figure-2. Table-1 shows the different stages of chronic kidney disease. Figure-3 illustrates the different comorbidities of chronic kidney disease. Lesion based diagnosis is shown in Table-II. Figure-4 depicts different etiologies of chronic kidney disease. Anemia was the most prevalent complication in chronic kidney disease followed by hyperkalemia and hyperuricemia is shown in Figure-5. Table-III shows the distribution of participants based on GFR, creatinine levels, and blood urea levels.

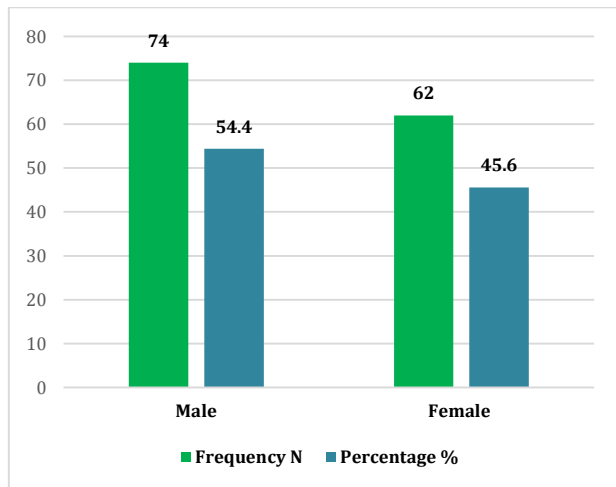


Figure-1: gender's distribution (n=136)

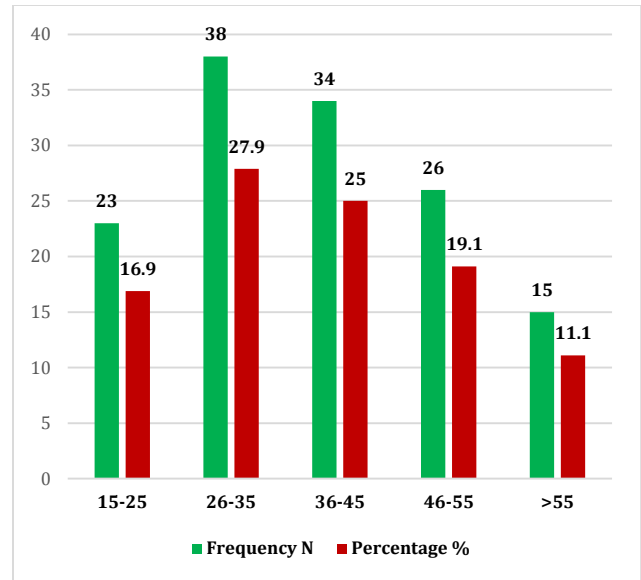


Figure-2: Age-wise distribution of CKD patients (n=136)

Table-1: Different stages of chronic kidney disease (n=136)

CKD Stages	Frequency N	Percentage %
Stage 1	8	5.9
Stage 2	3	2.2
Stage 3	9	6.6
Stage 4	13	9.6
Stage 5	103	75.7
Total	136	100

Table-2: Prevalence of lesion based diagnosis (n=61)

Lesion based diagnosis	Frequency N	Percentage %
chronic glomerulonephritis (CGN)	27	19.9
Glom nephropathy	18	13.2
Vascular nephropathies	16	11.8
Total	61	44.9

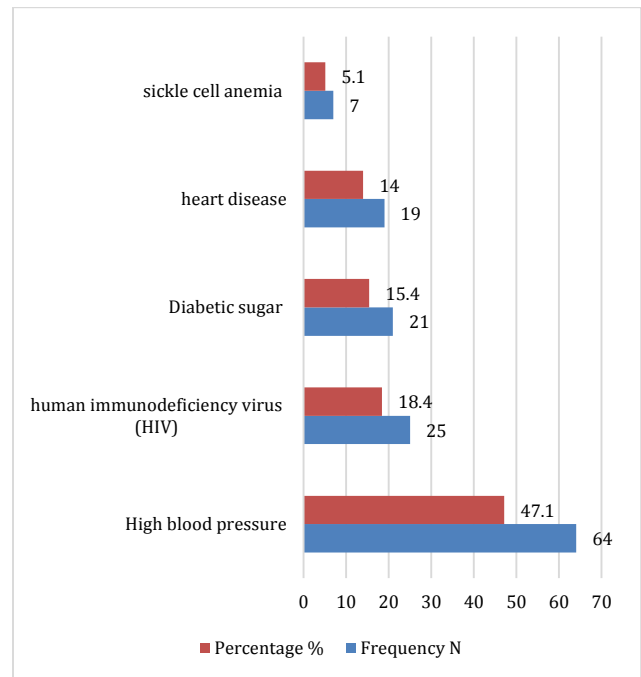


Figure-3: Comorbidities of CKD patients (n=136)

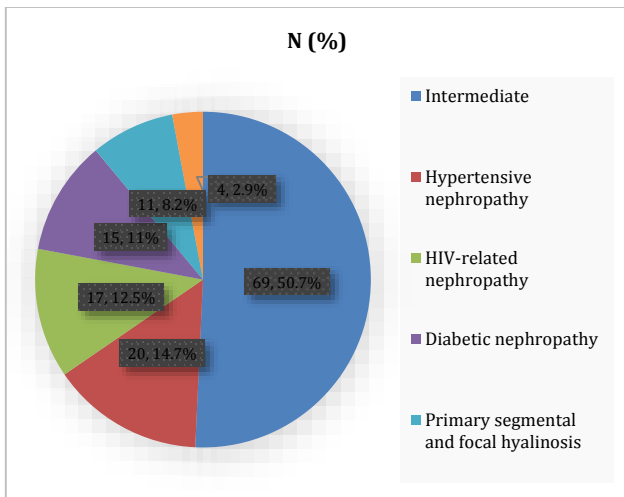


Figure-4: Etiologies of chronic kidney disease patients (n=136)

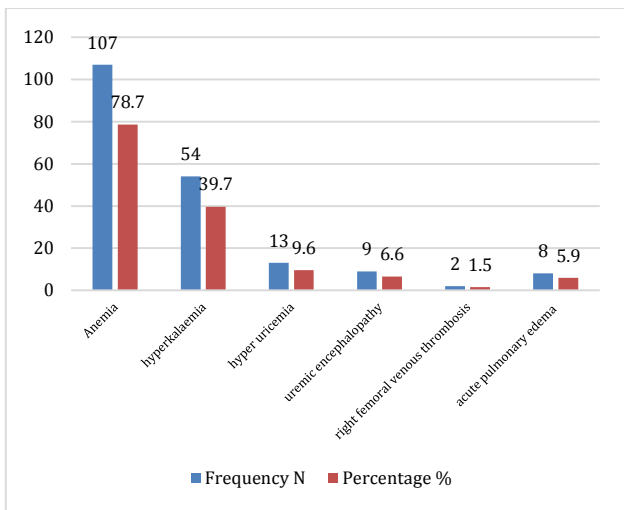


Figure-5: Complications of chronic kidney disease patients (n=136)

Table-3: Distribution of patients based on GFR, blood urea levels, and creatinine levels (n=136)

Variables	Frequency N	Percentage %
GFR (ml/min)		
<15	55	40.4
15-30	41	20.1
31-60	25	18.4
60-90	10	7.4
>90	5	3.7
Creatinine (mg/dl)		
<5	91	66.9
5-12	35	25.7
>12	10	7.4
Blood urea (mg/dl)		
<50	25	18.4
50-150	96	70.6
>150	15	11

**DISCUSSION**

The present study focused on demographic, etiological, clinical features and complications of chronic kidney disease patients and found that anemia, hyperkalaemia, hyperuricemia, uremic encephalopathy, right femoral venous thrombosis, and acute pulmonary edema were different complications in patients suffered from chronic kidney disease. The chronic kidney disease associated comorbidities were high blood pressure (HBP), human immunodeficiency virus (HIV), Diabetic sugar, heart disease, and

sickle cell anemia. Based on lesion diagnosis, chronic glomerulonephritis (CGN), glam nephropathy, and vascular nephropathies were the different diagnoses in CKD patients. It has been observed that intermediate, hypertensive nephropathy, HIV-related nephropathy, diabetic nephropathy, primary segmental and focal hyalinosis, and autosomal dominant polycystic kidney disease were the different etiology diagnosed in CKD patients. CKD is a major health issue found worldwide [16]. Chronicity and high-cost treatment are the main concerns for CKD patients undergoing dialysis. Diabetes is one of the major risk factor for developing the chronic kidney disease.

In the present study, the male to female ratio was 1.19:1 which showed that male are slightly more susceptible to chronic disease than females. Kaze et al [17] reported the similar male to female ratio in their study while Tannor et al [18] reported a male to female ratio 1.6:1. In our study, the majority of patients suffering from chronic kidney disease were from the age group 26-35 and 36-45 years. Several studies reported the male predominance in chronic kidney disease [19, 20]. In contrast, Keylem et al [21] found that females (51.26%) were more prone to chronic kidney disease than male population (48.74%).

The prevalence of high blood pressure was 47.1% among chronic kidney disease patients in our study. This was similar to the higher prevalence of hypertension reported in various studies from Africa [22, 23]. This might be due to the behavioral and environmental changes in terms of lack of physical activities, tobacco consumption, obesity, alcohol, inadequate diet, and prolonged exposure to these determinants. Ensuring the prevention of hypertension and cardiovascular disease with effective management could avoid chronic kidney disease among the population. Hypertension is a significant risk factor for both cardiovascular and renal disease. Certainly, hypertension is a predominant factor for progression of chronic kidney disease [24]. Diabetes is another risk factor for progression of CKD. Diabetes is the leading cause of CKD, according to numerous studies conducted around the world [25, 26]. This research focuses solely on nondiabetic causes. The most common aetiology was hypertension, followed by glomerulonephritis.

There are diverse causes for the progression of chronic kidney disease. The chronic kidney disease related research involves etiological, clinical, and biological examinations especially histology and immunology of renal rupture biopsy. In our study, the prevalence of stage 5 chronic kidney disease was 75.5% which is higher than 55.1% reported in a previous study [27]. The contraindication of performing renal puncture biopsy might be the cause for higher prevalence of stage 5. Another study carried out by Missamou et al [28] conducted 13.1% renal puncture biopsy in their study population.

In the present study, hypertensive nephropathy was found in 14.3% CKD patients as one of the leading causes besides diabetic nephropathy and HIV-related nephropathy. About 12.5% and 11% patients had HIV-related nephropathy and diabetic nephropathy respectively. A previous study conducted on black people of Africa found hypertension is the leading cause for chronic kidney disease [29]. Caravaca et al [30] reported that diabetes is the predominant factor for chronic kidney disease.

Etiology plays a significant role in the treatment of chronic kidney disease. Stage 5 CKD patients mainly rely on dialysis while waiting for kidney transplant. Kidney transplant is an excellent treatment for chronic kidney disease patients of stage 5 [31]. In the present study, a higher incidence of stage 5 CKD is found. Also, the current study reported various symptoms such as face puffiness, weakness, and loss of appetite were common among chronic kidney disease patients. According to a previous study, general weakness (97%), face puffiness (87%), and loss of appetite (63%) were the different symptoms founded in CKD patients [32].

Anemia, acute pulmonary edema, uremic encephalopathy, and severe acidosis are the common risk factors contributing to the mortality of chronic kidney disease patients. These risk factors are

mainly associated with delay diagnosis and renal failure severity among CKD patients. Our findings resemble Sinha et al results regarding similar risk factors for CKD patient's mortality [33]. Furthermore, HIV infection is another contributing risk factor for mortality. Kidney disease is significantly associated with HIB-infected patients due to its poor prognosis and outcomes [34].

## CONCLUSION

The present study concluded that hypertension, cardiovascular disease, diabetes, and HIV are the different predominant risk factors for chronic kidney disease. Also, the most prevalent etiology of the CKD was chronic glomerulonephritis (CGN) followed by Diabetic nephropathy in CKD patients. Anemia was the prevalent complication followed by hyperkalemia and hyperuricemia. Swelling at lower limb and weakness were the common symptoms of chronic kidney disease.

## REFERENCES

- Patel DS, Patel NR, Patel JV, Chavda AB. A cross-sectional study to evaluate etiopathogenesis, clinical features, complications, and treatment of patients of chronic kidney disease. *Natl J Physiol Pharm Pharmacol* 2022;12(05):680-683
- Tiendrebéogo, O. (2020) Epidemiology of Chronic Nephropathies in the Internal Medicine Department of the Yalgado Ouédraogo University Hospital Center (CHUYO) in Ouagadougou. *African Journal of Internal Medicine*, 7, 11-19.
- Amekoudi, E.Y., Sabi, K.A., Noto-Kadou-Kaza, B. and Combe, C. (2016) Epidemiology of Chronic Kidney Disease in Nephrology Consultation at the Sylvanus-Olympio CHU in Togo. *Nephrology & Therapeutics*, 12, 400. <https://doi.org/10.1016/j.nephro.2016.07.113>.
- Ramilitiana, B., Ranivoharisoa, E.M., Dodo, M., et al. (2016) A Retrospective Study on the Incidence of Chronic Renal Failure in the Department of Internal Medicine and Nephrology of the University Hospital of Antananarivo. *The Pan African Medical Journal*, 23, 89-96. <https://doi.org/10.11604/pamj.2016.23.141.8874>
- Houat, N., et al. (2017) Incidence of End-Stage Chronic Renal Failure in Maghnia. *Santé Maghreb*, 12, 8-14.
- Sinomono, D.T.E., Koumou, G.C. and Loumingou, R. (2017) Epidemiological Profile of Chronic Renal Failure at Brazzaville University Hospital in 2016. *Therapeutic Nephrology*, 13, 396. <https://doi.org/10.1016/j.nephro.2017.08.302>
- Missamou, A., Sinomono, D.T.E., Loumingou, R., et al. (2019) Management of Renal Failure at the Pointe-Noire General Hospital in Congo: Between Realities and Hopes. *Therapeutic Nephrology*, 15, 344. <https://doi.org/10.1016/j.nephro.2019.07.197>.
- Ngoie, S.M., Mulenga, P., Mukuku, O., et al. (2017) Chronic Renal Disease: Associated Factors, Etiologies, Clinical and Biological Characteristics in Lubumbashi in the Democratic Republic of Congo. *The Pan African Medical Journal*, 28, 1-11.
- Seck, S., Ka, F. and Cisse, M. (2014) Prevalence Survey of Chronic Kidney Disease in the Northern Region of Senegal. *Therapeutic Nephrology*, 10, 399. <https://doi.org/10.1016/j.nephro.2014.07.128>.
- Ahoui, S., Vigan, J., Albert, C., et al. (2016) Prevalence of Risk Factors for Chronic Kidney Disease in the Departments of Borgou and Alibori in Benin in 2014. *Medicine and Public Health*, 10, 1-12.
- Olowu WA, Niang A, Osafo C, et al. Outcomes of acute kidney injury in children and adults in Sub-Saharan Africa: A systematic review. *Lancet Glob Health* 2016;4:e242-50
- Abd ElHafeez S, Bolignano D, D'Arrigo G, Dounousi E, Tripepi G, Zoccali C. Prevalence and burden of chronic kidney disease among the general population and high-risk groups in Africa: a systematic review. *BMJ Open*. 2018; 8(1):e015069. <https://doi.org/10.1136/bmjopen-2016-015069>
- Carrero JJ, Hecking M, Chesnaye NC, Jager KJ. Sex and gender disparities in the epidemiology and outcomes of chronic kidney disease. *Nature reviews Nephrology*. 2018; 14(3):151-64. <https://doi.org/10.1038/nrneph.2017.181>
- Jardine MJ, Kasiske B, Adu D, Alrukhaimi M, Ashuntantang GE, Basnet S, et al. Closing the gap between evidence and practice in chronic kidney disease. *Kidney International Supplements*. 2017; 7(2):114-21. <https://doi.org/10.1016/j.kisu.2017.07.006>
- Adeniyi AB, Davids MR, Laurence CE, Volmink JA. Prevalence of chronic kidney disease and association with cardiovascular risk factors among teachers in Cape Town, South Africa. *Clinical Kidney Journal*. 2017; 10(3):363-9. <https://doi.org/10.1093/ckj/sfw138>
- George JA, Brandenburg J-T, Fabian J, Crowther NJ, Agongo G, Alberts M, et al. Kidney damage and associated risk factors in rural and urban sub-Saharan Africa (AWI-Gen): a cross-sectional population study. *The Lancet Global Health*. 2019; 7(12):e1632-e43. [https://doi.org/10.1016/S2214-109X\(19\)30443-7](https://doi.org/10.1016/S2214-109X(19)30443-7)
- Kaze AD, Illori T, Jaar BG, Echowffo-Tcheugui JB. Burden of chronic kidney disease on the African continent: a systematic review and meta-analysis. *BMC Nephrol*. 2018; 19(1):125. <https://doi.org/10.1186/s12882-018-0930-5>
- Tannor EK, Sarfo FS, Mobula LM, Sarfo-Kantanka O, Adu-Gyamfi R, Plange-Rhule J. Prevalence and predictors of chronic kidney disease among Ghanaian patients with hypertension and diabetes mellitus: A multicenter cross-sectional study. *Journal of clinical hypertension (Greenwich, Conn)*. 2019; 21 (10):1542-50. <https://doi.org/10.1111/jch.13672>
- Keylem, C.G., Sempore, Y.W., Yameogo, A.A., et al. (2020) Diagnosis and Management of Chronic Kidney Disease in a Context of Limited Resources: Specificities and Difficulties of an Internal Medicine Department. *African Journal of Internal Medicine*, 7, 11-19
- Kaze AD, Illori T, Jaar BG, Echowffo-Tcheugui JB. Burden of chronic kidney disease on the African continent: a systematic review and meta-analysis. *BMC Nephrol*. 2018; 19(1):125. <https://doi.org/10.1186/s12882-018-0930-5>
- Tannor EK, Sarfo FS, Mobula LM, Sarfo-Kantanka O, Adu-Gyamfi R, Plange-Rhule J. Prevalence and predictors of chronic kidney disease among Ghanaian patients with hypertension and diabetes mellitus: A multicenter cross-sectional study. *Journal of clinical hypertension (Greenwich, Conn)*. 2019; 21 (10):1542-50. <https://doi.org/10.1111/jch.13672>
- Galan I, Goicoechea M, Quiroga B, Maci 'as N, Santos A, Garcí 'a de Vinuesa MS, et al. Hyperuricemia is associated with progression of chronic kidney disease in patients with reduced functioning kidney mass. *Nefrologí 'a (Madrid)*. 2018; 38:73-8. <https://doi.org/10.1016/j.nefro.2017.04.006>.
- Hill NR, Fatoba ST, Oke JL, Hirst JA, O'Callaghan CA, Lasserson DS, et al. Global prevalence of chronic kidney disease: a systematic review and meta-analysis. *PLoS One*. 2016;11(7):0158765.
- Kumar RU, Shashank J, Swamy N. Study of clinical profile of chronic kidney disease in non-diabetic patients. *Int J Adv Med* 2021;8:1113-9.
- Bhide A, Kalawat U, Vishnubhotla S. Assessment of phagocytic activity of polymorphonuclear leukocytes in hospitalized patients with Stages 4 and 5 chronic kidney disease. *Natl J Physiol Pharm Pharmacol* 2019;9:1172-5.
- Rawat KJ, Joshi KS, Arora RD. Quality of life in patients on hemodialysis: A quasi-experiment with review of literature. *Int J Med Sci Public Health* 2017;6:786-91.
- Sinomono, D.T.E., Koumou, G.C. and Loumingou, R. (2017) Epidemiological Profile of Chronic Renal Failure at Brazzaville University Hospital in 2016. *Therapeutic Nephrology*, 13, 396. <https://doi.org/10.1016/j.nephro.2017.08.302>
- Missamou, A., Sinomono, D.T.E., Loumingou, R., et al. (2019) Management of Renal Failure at the Pointe-Noire General Hospital in Congo: Between Realities and Hopes. *Therapeutic Nephrology*, 15, 344. <https://doi.org/10.1016/j.nephro.2019.07.197>
- Ngoie, S.M., Mulenga, P., Mukuku, O., et al. (2017) Chronic Renal Disease: Associated Factors, Etiologies, Clinical and Biological Characteristics in Lubumbashi in the Democratic Republic of Congo. *The Pan African Medical Journal*, 28, 1-11.
- Caravaca-Fontañ F, Valladares J, Díaz-Campillejo R, Barroso S, Luna E, Caravaca F. Association of hyperkalemia with clinical outcomes in advanced chronic kidney disease. *Nefrologí 'a (English Edition)*. 2019; 39(5):513-22.
- Polychronopoulou E, Wuerzner G, Burnier M. How Do I Manage Hypertension in Patients with Advanced Chronic Kidney Disease Not on Dialysis? Perspectives from Clinical Practice. *Vascular health and risk management*. 2021; 17:1-11. <https://doi.org/10.2147/VHRM.S292522>.
- Jitraknatee J, Ruengorn C, Nochaiwong S. Prevalence and Risk Factors of Chronic Kidney Disease among Type 2 Diabetes Patients: A Cross-Sectional Study in Primary Care Practice. *Scientific Reports*. 2020; 10(1):6205. <https://doi.org/10.1038/s41598-020-63443-4>.
- Sinha AD, Agarwal R. Clinical Pharmacology of Antihypertensive Therapy for the Treatment of Hypertension in CKD. *Clinical Journal of the American Society of Nephrology*. 2019; 14(5):757-64. <https://doi.org/10.2215/CJN.04330418>.
- Fiseha T, Ahmed E, Chalie S, Gebreweld A. Prevalence and associated factors of impaired renal function and albuminuria among adult patients admitted to a hospital in Northeast Ethiopia. *PLoS one*. 2021; 16(2):e0246509. <https://doi.org/10.1371/journal.pone.0246509>.