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Factors of Progression of Chronic Kidney Disease in Hospitalized Patients at Chud-Ba in Parakou in 2026

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ABSTRACT

Background: *Chronic kidney disease (CKD) is a growing public health problem in sub-Saharan Africa. Its progression to end-stage renal disease (ESRD) is life-threatening and places a considerable economic burden on patients and health systems. Identifying progression factors is essential to improve patient outcomes.*

Objectives: *To identify factors associated with CKD progression in hospitalized patients at CHUD-BA in Parakou in 2026.*

Methods: *Cross-sectional descriptive and analytical study with prospective data collection, conducted from March 15 to Jun 15, 2026, in the nephrology department. Progression was defined as a GFR decline ≥ 25% or advancement to a higher CKD stage (KDIGO 2012).*

Results: *145 patients were included. Mean age was 52.3 ± 14.8 years with male predominance (58.5%). CKD progression was observed in 47.2% of patients. Factors independently associated with progression were: uncontrolled hypertension (OR = 4.12; 95%CI [2.08–8.16]; p < 0.001), type 2 diabetes (OR = 3.75; p < 0.001), proteinuria ≥ 1g/24h (OR = 5.60; p < 0.001), severe anemia (OR = 2.98; p = 0.004), and advanced CKD stage (OR = 6.44; p < 0.001).*

Conclusion: *CKD progression is frequent and multifactorial at CHUD-BA. Blood pressure control, proteinuria reduction, and anemia correction are the main therapeutic priorities to slow progression.*

Keywords

Chronic kidney disease, Progression, Hypertension, Proteinuria, Diabetes, Anemia, CHUD-BA.

Abbreviations

AKI: Acute Kidney Injury, CKD: Chronic Kidney Disease, RDC: Democratic Republic of Congo, GBD: Global Burden of Disease, HIV: Human Immunodeficiency Virus, KDIGO: Kidney Disease Improving Global Outcomes, eGFR: Estimated Glomerular Filtration Rate, Ors: Odds Ratios, NC: Not Computable.

Introduction

Chronic kidney disease (CKD) is defined by the persistence, for more than three months, of structural or functional kidney abnormalities, with or without a reduction in glomerular filtration rate (GFR). According to the most recent Global Burden of Disease Study 2023 data, CKD affected approximately 843 million people worldwide, representing nearly 10% of the adult global population [1].

In sub-Saharan Africa, the CKD epidemic is intensifying under the combined effect of the hypertension and type 2 diabetes epidemics, infectious nephropathies, and the use of traditional nephrotoxic substances [2]. In Benin, although national epidemiological data remain limited, hospital-based surveys report a growing prevalence of renal failure, which has become one of the leading

causes of mortality in internal medicine and nephrology wards at CHUD-BA [3].

The progression of CKD to ESRD is an unavoidable phenomenon in the absence of optimal management. ESRD requires renal replacement therapies hemodialysis, peritoneal dialysis, or kidney transplantation access to which remains very limited in resource-constrained settings, where the monthly cost of hemodialysis often exceeds the average household monthly income [4].

Several progression factors have been identified in the international literature: uncontrolled hypertension, proteinuria, poor glycemic control, anemia, hyperuricemia, metabolic acidosis, recurrent infections, and nephrotoxic drug exposure [5,6]. However, specific Beninese data on these factors are lacking, making it difficult to implement locally adapted preventive strategies.

Objectives

General objective

To identify factors associated with CKD progression in hospitalized patients at CHUD-BA in Parakou in 2026.

Specific objectives

1. To describe the sociodemographic and clinical profile of CKD patients.
2. To determine the frequency of CKD progression in our study population.
3. To identify factors independently associated with CKD progression by multivariate logistic regression.
4. To assess in-hospital mortality and complications associated with CKD.

Methods

Study design and setting

This cross-sectional, descriptive and analytical study with prospective data collection was conducted from March 15 to Jun 15, 2026, in the nephrology department of CHUD-BA in Parakou, the reference university hospital of Benin.

Population and sampling

All hospitalized patients with a confirmed diagnosis of CKD defined as GFR < 60 mL/min/1.73 m² using the CKD-EPI formula for more than three months, in accordance with KDIGO 2012 recommendations who provided written informed consent were included. Patients with isolated acute kidney injury without underlying CKD, pregnant women, and those with incomplete records were excluded.

Operational definitions

- CKD progression: GFR decline ≥ 25% over 6 months or advancement to a higher CKD stage (KDIGO 2012).
- Uncontrolled hypertension: blood pressure ≥ 140/90 mmHg despite antihypertensive treatment.
- Significant proteinuria: protein/creatinine ratio ≥ 0.5 g/g or 24-hour proteinuria ≥ 1 g.
- Severe anemia: hemoglobin < 8 g/dL.

Statistical analysis

Data were entered in Epi Data v3.1 and analyzed with SPSS v25.0. Quantitative variables are expressed as mean ± SD, qualitative variables as frequencies and percentages. Chi-square or Fisher's exact test were used for comparison of qualitative variables. Multivariate logistic regression was performed incorporating variables with $p < 0.20$ in bivariate analysis. The significance threshold was set at $p < 0.05$.

Ethics

The study was approved by the National Committee for Health Research Ethics of Benin (CNERS). Written informed consent was obtained from each patient. Data confidentiality was guaranteed through file anonymization.

Results

Sociodemographic characteristics

A total of 145 CKD patients were included. Mean age was 52.3 ± 14.8 years (range: 18–84 years). The 45–64 age group was most represented (42.3%). Males predominated with 83 cases (58.5%) and a sex ratio of 1.41. Most patients (67.6%) resided in urban areas and 54.2% had a low socioeconomic level (Table 1).

Table 1: Sociodemographic characteristics of patients and their association with CKD progression.

Characteristic	N (%)	Progressors (%)	p
Male sex	86 (58.5)	42 (61.8)	0.38
Female sex	59 (41.5)	25 (42.4)	0,19
Mean age (years)	52.3 ± 14.8	56.1 ± 13.2	0.04
Age 45–64 years	60 (42.3)	34 (56.7)	0.02
Urban residence	96 (67.6)	48 (66.7)	0.47
Low socioeconomic level	77 (54.2)	39 (56.5)	0.31

Sociodemographic characteristics of patients and their association with CKD progression.

Clinical and etiological profile

Hypertension was the leading etiology of CKD (62.7%), followed by type 2 diabetes (34.5%), primary glomerulopathies (18.3%), and obstructive nephropathies (12.7%). Significant proteinuria ≥ 1g/24h was present in 58.4% of patients. KDIGO stages III and IV accounted for 61.3% of cases (Table 2). Severe anemia (Hb < 8 g/dL) was found in 38.0% of patients.

Table 2: Clinical and etiological profile of patients and association with CKD progression.

Clinical parameter	N (%)	Progressors n (%)
Hypertension (main etiology)	92 (62.7)	51 (57.3)
Type 2 diabetes	49 (34.5)	32 (65.3)
Glomerulopathies	26 (18.3)	15 (57.7)
Obstructive nephropathies	18 (12.7)	7 (38.9)
Proteinuria ≥ 1g/24h	83 (58.4)	52 (62.6)
Severe anemia (Hb < 8 g/dL)	54 (38.0)	37 (68.5)
Uncontrolled hypertension	71 (50.0)	46 (64.8)
CKD stage III–IV (KDIGO)	87 (61.3)	48 (55.2)

Clinical and etiological profile of patients and association with CKD progression.

Table 3 provides information on the different stages of kidney disease progression towards death.

Table 3: Patient distribution by KDIGO stage and outcome (progression, death). Stages IV and V show the highest progression and mortality rates.

CKD Stage	N total	Progressors	Deaths
Stage III	58 (38.7%)	22 (40.0%)	5 (9.1%)
Stage IV	32 (22.5%)	26 (81.3%)	9 (28.1%)
Stage V	23 (16.2%)	19 (82.6%)	12 (52.2%)
Stages I–II	32 (22.5%)	0	0
TOTAL	145	67 (47.2%)	26 (18.3%)

Patient distribution by KDIGO stage and outcome (progression, death). Stages IV and V show the highest progression and mortality rates.

Frequency and characteristics of progression

CKD progression was observed in 67 of 145 patients, giving a frequency of 47.2%. Among progressing patients, 22 (15.5% of the total population) reached end-stage requiring renal replacement therapy. Overall, in-hospital mortality was 18.3% (26/145 patients). Figure 1 illustrates patient distribution by CKD stage and outcome.

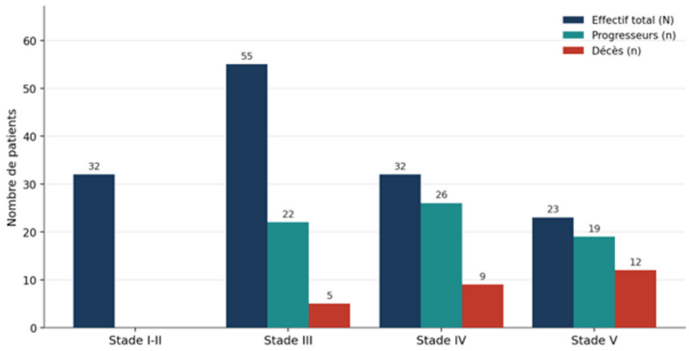

Figure 1. Patient distribution by KDIGO stage and outcome (progression, death).

Figure 1: Patient distribution by KDIGO stage and outcome (progression, death).

Frequency and characteristics of progression was observed, stage III occupies first place, stage IV and I-II the second place.

Factors associated with progression (multivariate analysis)

In multivariate logistic regression analysis, five factors were independently associated with CKD progression (Table 4). Proteinuria ≥ 1g/24h and advanced CKD stage were the most strongly associated factors.

Table 4: Multivariate logistic regression — Factors independently associated with CKD progression. OR: adjusted Odds Ratio; 95%CI: 95% Confidence Interval.

Factor	Adjusted OR	95% CI	P
Uncontrolled hypertension	4.12	[2.08–8.16]	< 0.001
Type 2 diabetes	3.75	[1.87–7.52]	< 0.001
Proteinuria ≥ 1g/24h	5.60	[2.71–11.56]	< 0.001
Severe anemia	2.98	[1.43–6.21]	0.004
Advanced CKD stage (IV–V)	6.44	[3.12–13.28]	< 0.001

Multivariate logistic regression — Factors independently associated with CKD progression. OR: adjusted Odds Ratio; 95%CI: 95% Confidence Interval.

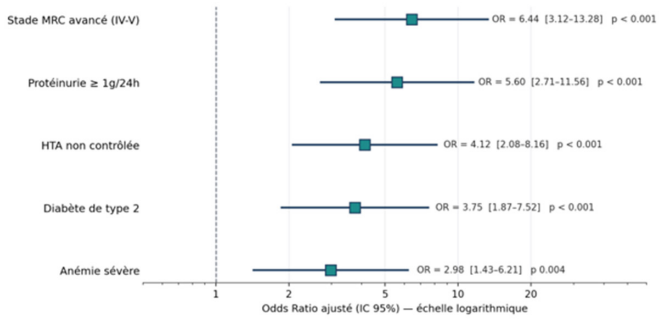

Figure 2. Forest plot of factors independently associated with CKD progression in multivariate analysis. ■: point estimate of adjusted OR; horizontal lines: 95% confidence interval.

Figure 2: Forest plot of factors independently associated with CKD progression in multivariate analysis (Adjusted OR).
Advanced CKD stage (IV–V): **1st place**
Proteinuria ≥ 1g/24h: **2nd place**
Uncontrolled hypertension**: 3rd place**
Type 2 diabetes: **4th place**
Severe anemia**: 5th place**

In multivariate logistic regression analysis, five factors were independently associated with CKD progression; Advanced CKD stage (IV–V) occupies first place and severe anemia fifth place.

Mortality and complications

Overall, in-hospital mortality was 18.3% (n = 26). It was significantly higher in progressing patients (29.9% vs 6.7% in non-progressors, p < 0.001). The main in-hospital complications were acute pulmonary edema (23.9%), severe hyperkalemia (21.1%), cardiac arrhythmias (16.9%), and uremic encephalopathy (11.3%), as shown in Figure 3.

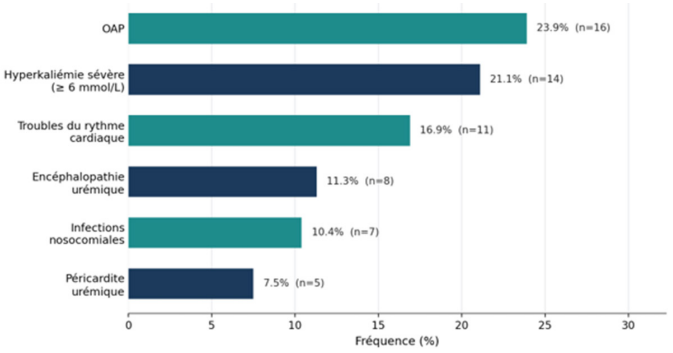

Figure 3: Frequency of in-hospital complications in the 67 CKD progression patients.

Mortality and complications, it was significantly higher in progressing patients). The main in-hospital complications were acute pulmonary edema (23.9%), severe hyperkalemia (21.1%).

Table 5: Frequency of in-hospital complications in the 67 CKD progression patients. Data are expressed as frequencies and percentages.

Complication	N	Frequency (%)
Acute pulmonary edema	16	23.9
Severe hyperkalemia (≥ 6 mmol/L)	14	21.1
Cardiac arrhythmias	11	16.9
Uremic encephalopathy	8	11.3
Uremic pericarditis	5	7.5
Nosocomial infections	7	10.4

Frequency of in-hospital complications in the 67 CKD progression patients. Data are expressed as frequencies and percentages.

Discussion

Frequency of progression

The 47.2% CKD progression frequency observed in our study is high and consistent with African literature data. Agbor-Enoh et al. (Cameroon, 2022) reported a 5-year progression rate of 52.3% in a comparable hospital-based urban population [7]. In Ivory Coast, Ecke et al. found 44.8% progression over 6 months in patients followed in specialized outpatient settings [8]. These figures are substantially higher than those reported in Europe: the CKD-REIN cohort study (France, 2023) estimated a 25.4% progression rate over 3 years in patients well-managed in primary care [9,10]. This gap underscores the decisive impact of risk factor control and access to care.

Role of hypertension

In our study, uncontrolled hypertension was the second most strongly associated progression factor (OR = 4.12). This role is well established in literature. The intraglomerular hypertension it generates accelerates glomerular sclerosis and tubulointerstitial fibrosis through activation of the renin-angiotensin-aldosterone system (RAAS) [11]. The SPRINT Kidney study demonstrated that a strict blood pressure target (SBP < 120 mmHg) reduced the risk of significant kidney decline by 37% compared to a target of 140 mmHg [12]. KDIGO 2024 guidelines recommend a BP target < 120 mmHg (standardized measurement) in CKD patients with high cardiovascular risk [13]. In our Beninese context, where only 29% of hypertensive patients achieve their blood pressure target according to the TAHBES 2023 survey [14], improving blood pressure control represents a major lever for nephroprotection.

Proteinuria and tubular nephrotoxicity

Proteinuria ≥ 1g/24h was the most strongly associated factor with progression in our study (OR = 5.60). This result aligns with the meta-analysis by Heerspink et al., covering 28 randomized trials and 19,800 patients, which concluded that a 30% reduction in proteinuria was associated with a 30% reduction in the risk of progression to ESRD [15]. The mechanisms involve direct toxicity of filtered proteins on proximal tubular epithelium, inducing interstitial inflammation and progressive fibrosis [16]. The CREDENCE trial and post-marketing data on SGLT2 inhibitors demonstrated that significant proteinuria reduction is associated with a marked slowing of GFR decline [17].

Type 2 diabetes and diabetic nephropathy

Type 2 diabetes (OR = 3.75) was the third progression factor identified. Diabetic nephropathy represents the leading cause of ESRD in the developed world and the second in Africa after hypertension [18]. Chronic hyperglycemia induces glomerular oxidative stress, mesangial matrix expansion, and podocyte fibrosis, mechanisms well described in the review by Tuttle et al. (NEJM, 2022) [19]. The FIDELIO-DKD trial (finerenone) and DAPA-CKD (dapagliflozin) demonstrated renoprotective benefits independent of glycemic control in diabetic nephropathy [20]. Unfortunately, access to these novel molecules remains extremely limited in our context.

Anemia and chronic renal hypoxia

Severe anemia was associated with progression (OR = 2.98). This is consistent with the KNOW-CKD cohort (South Korea, 2021, n = 2,238), which found a HR of 2.41 (95%CI [1.68–3.46]) for progression to ESRD in patients with Hb < 10 g/dL [21]. Anemia worsens chronic renal hypoxia, which stimulates prolyl hydroxylase, leading to interstitial inflammation, myofibroblast activation, and progressive fibrosis [22]. Results from the TREAT trial (darbepoetin) tempered enthusiasm for aggressive anemia correction (Hb target 13 g/dL) due to an excess of ischemic strokes [23]; the current KDIGO 2024 recommended target is 10–11.5 g/dL [13].

Advanced CKD stage

Advanced CKD stage (stages IV–V) was the most strongly associated factor with progression in our study (OR = 6.44). This result illustrates the concept of 'CKD begets CKD', whereby the reduction in functional nephron mass self-perpetuates through hemodynamic and fibrotic mechanisms [24]. The CKDopps cohort study (2022, 6 countries, n = 8,514) confirmed that the risk of progression doubled with each additional CKD stage [25]. This reinforces the importance of early screening and intensive management before reaching advanced stages.

Strengths and limitations

Among the strengths of this study are the prospective data collection, the use of standardized diagnostic criteria (KDIGO 2012), the CKD-EPI formula for GFR estimation, and multivariate analysis to control confounding factors. This is also the first Beninese study to systematically analyze CKD progression factors in a hospital setting.

The main limitations are the single-center nature of the study, limiting generalizability of results, the relatively short follow-up duration (5 months), the absence of renal biopsies in all patients for histological confirmation of etiology, and potential losses to follow-up.

Conclusion

The progression of chronic kidney disease is a frequent and multifactorial phenomenon at CHUD-BA in Parakou, observed

in nearly one in two patients. Uncontrolled hypertension, type 2 diabetes, significant proteinuria, severe anemia, and advanced CKD stage are the main independent determinants.

These findings highlight the need for early CKD screening, strict blood pressure control, aggressive proteinuria reduction, and optimal anemia correction to slow progression toward end-stage renal disease in our resource-constrained setting.

The establishment of a national CKD registry in Benin and strengthening of nephrology care capacity are essential prerequisites for a lasting improvement in the renal prognosis of these patients.

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