

Prevalence and Determinants of Chronic Kidney Disease in a Group of Patients Living with High Blood Pressure: A Prospective Study in a City in Northern Cameroon

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Abstract

Introduction: High blood pressure (hypertension) is a major public health problem. Its prevalence has doubled over the years and it affects 10 to 15% of adults in sub-Saharan Africa, with the particularity of being the leading cause of chronic kidney disease (CKD). In Cameroon, CKD remains a concern in the face of exacerbated risk factors, delayed diagnosis, heavy economic burden, and significant morbidity. The aim was to determine the prevalence and markers of kidney damage in hypertensive patients followed at the Garoua Regional Hospital (HRG) in the northern region of Cameroon. **Methods:** This was a prospective study including adults over 18 years of age, known hypertensive patients followed at HRG. Variables of interest were collected, and an assessment of renal impairment including a urine dipstick and serum creatinine test was performed in all participants at baseline and at 3 months. Markers of kidney damage were proteinuria, hematuria, and elevated serum creatinine. CKD was defined as the persistence of renal failure, proteinuria, or hematuria for more than three months. The data collected were analyzed using SPSS version 25 software. The significance threshold was <0.05 . **Results:** A total of 356 participants were collected with a sex ratio of 0.86, a mean age of 55.57 ± 12.13 years, and a mean duration of hypertension of 60 ± 21 months. Diabetes mellitus (31.17%), obesity (30.33%), dyslipidemia (27.52%), and hyperuricemia (23.59%) were the main risk factors for kidney disease. The overall prevalence of chronic kidney disease was estimated at 28.37% ($n =$

101), represented by renal failure (69.3%), proteinuria (52.47%), and hematuria (25%). An age > 59 years, the duration of hypertension evolution greater than 5 years, obesity, diabetes, and hyperuricemia were associated with the presence of a marker of CKD. **Conclusion:** High blood pressure is a significant vector of kidney disease, especially since there are other risk factors for chronic kidney disease.

Keywords

Prevalence, High Blood Pressure, Chronic Kidney Disease

1. Introduction

High blood pressure (hypertension) is an increase in blood pressure figures greater than 140 mmHg for systolic blood pressure and/or greater than 90 mmHg for diastolic blood pressure [1]. It represents a major public health problem because it affects more than a billion people worldwide, *i.e.*, more than a quarter of the world's population [2] [3]. Its prevalence has doubled over the years, from 648 million adults affected in 1990 to 1278 million in 2019, with a predominance in industrialized countries among adult males [4]. In the United States, about 46% of adults are affected; in France, a study conducted in 2015 revealed 32.3% hypertension [5]. It affects 10 to 15% of adults in sub-Saharan Africa, with a high rate in urban areas [6]. In South Africa, the prevalence is estimated at 46%, while in Cameroon it is 24% [7].

Hypertension is the main modifiable risk factor for heart disease (coronary artery disease) and stroke, but also for kidney disease, which in turn are precursors to hypertension [8]. On the one hand, hypertension is a potential cause of chronic kidney disease (CKD) insofar as it is responsible for nearly 30% of cases of end-stage chronic kidney disease (ESRD). On the other hand, hypertension is a common consequence of CKD, regardless of its cause [9]. It is currently the main global burden of morbidity and mortality because reaches up to 90% of people with chronic kidney disease and also potentiates the risk of acute kidney injury in intraoperative patients [9] [10]. In Europe, particularly in France, hypertension is the second cause of CKD with an incidence of 22%, and this incidence increases with age and sex, as men are at excess risk [9]. The prevalence in adult subjects is more than 30%; it is estimated that it concerns 12 to 13 million people. In African studies, hypertension is the leading cause of kidney disease, while in the world it is the second leading cause of kidney disease [11]. In Cameroon, hypertension is the leading cause of CKD with a prevalence of 32.3% [12].

In Africa, and particularly in Cameroon, kidney disease remains a concern in the face of risk factors and the heavy economic burden of care. Nearly 12.4% of newly diagnosed hypertensive patients have CKD [13]. This proportion was higher in the cohort of Hamadou *et al.* in the city of Garoua, where 32.3% of hypertensive patients had CKD [12]. The rate of blood pressure control is low in

Africa, explaining the rapid progression of CKD [14]. In this context, we thought it would be interesting to evaluate not only the prevalence of CKD but also the profile of kidney disease markers on kidney health, as well as the determinants to optimize adequate management focused on prevention measures and early and systematic detection of kidney disease.

2. Material and Method

2.1. Setting and Place of Study

This was a descriptive and analytical prospective study conducted at the Garoua Regional Hospital (HRG) from January 1, 2024, to July 31, 2024. The HRG is in the heart of the city of Garoua, an urban city and capital of the Cameroon Region. It is a second-level reference hospital in the health pyramid. The capacity is 290 functional beds and serves a population of about 2,652,841 inhabitants of the Northern Region of various ethnicities. It is built on 10 hectares in a pavilion mode with several buildings housing standard services. This hospital also has an intermittent hemodialysis unit with 8 functional generators.

2.2. Patients

We included patients over 18 years of age with high blood pressure who had had more than one visit to HRG, no prior chronic kidney disease, and who consented to participate in the study. Those who did not undergo renal function assessment at 3 months after the inclusion visit were excluded. Sociodemographic and clinical-biological data were reported after a face-to-face interview with the participants. A urine dipstick identifying proteinuria and hematuria, as well as a creatinine test, were performed in all participants at baseline and at 3 months. Creatinine was measured immediately after sample collection using the chemical colorimetric method known as Jaffé's method.

The minimum sample size was 336 patients, calculated using the Open Epi version 3 software revised in April 2013 for a hospital prevalence of arterial hypertension of 32.3% and a margin of error of 5% (typical value of 0.05).

The following terms were considered as follows:

- **Chronic kidney disease** (CKD) is the persistence of renal impairment, proteinuria, or hematuria for more than three months. Staging into stages follows that of KDIGO, based on creatinine estimation according to MDRD and CKD-EPI [15].
- **Renal impairment** was defined as creatinine > 1.1 mg/dl for women and >1.3 mg/dl for males.
- **Proteinuria** was considered positive for a value greater than or equal to 1+.
- **Adherence** was assessed using the six-question rhetorical questionnaire written by Girerd. A score out of 6 will be calculated, with 0 = No and 1 = Yes. For a score greater than or equal to 3, the patient was considered non-compliant. For a score of 1 or 2, the patient was considered to have a minimal compliance problem, and for a score of 0, they were well compliant.

- **Blood pressure** was stratified according to the 2024 European Society of Cardiology guidelines [16].
- **Obesity** was defined by a body mass index equal to or greater than 30 kg/m².
- **Hypertension-mediated organ damage** was considered based on the history and examinations available in the medical records. The hypertensive neuropathy considered here was a history of hypertensive encephalopathy, transient ischemic attack, or stroke. The hypertensive retinopathy was assessed by funduscopy performed by an ophthalmologist and was considered if there was arteriolar narrowing, arteriovenous nicking, or vascular tortuosity.
- **Nephrotoxic** refers to any leaf, plant, or root that does not enter the diet and is listed by Fouda *et al.*

2.3. Statistical Analyses

The information was collected using an electronic survey sheet, EPI Data Manager version 3.1, and then the data were analyzed using the *Statistical Package for Social Science* (SPSS) software version 26.0. Qualitative variables were expressed as proportions and percentages. Quantitative data were presented as a mean \pm standard deviation or median [Interquartile Range (IQR) 25th-75th] depending on the distribution.

2.4. Ethical Considerations

The ethical clearance of the Regional Ethics Committee for Human Health Research of the North number N°0043/CERSH/NO/2024 has been obtained, as well as the research authorization of the Administration of the Regional Hospital of Garoua (N°065/24/L/HRG/CM). This study was carried out in strict compliance with the fundamental principles of medical research.

3. Results

A total of 356 participants were included among the 372 eligible participants (16 lost to follow-up at 3 months). The study population was predominantly female (54.21%) with a mean age \pm standard deviation of 55.57 \pm 12.13 years, with extremes ranging from 19 to 89 years. The most represented age group was [41 - 60] years old. The most common comorbidity was diabetes mellitus (31.17%) and the use of nephrotoxics was common (43.53%). The general characteristics of the study population are summarized in **Table 1**.

3.1. High Blood Pressure Profile

The mean duration (\pm standard deviation) of hypertension was 60 \pm 21 months, with optimal blood pressure control in 26.21% of cases, the use of hypotensive monotherapy in 47.56% of cases, and good compliance in 56.7% of participants; treatment was dominated by the calcium channel blocker class (68.29% to 1915). These data are illustrated in **Table 2** and **Figure 1**. Also, cardiac involvement (17.41%) was the main complication of hypertension.

Table 1. General characteristics of the study population (N = 356).

Variables	Frequency (n)	Percentage (%)
Gender		
Male	163	45.78
Female	193	54.21
Age in year		
18 - 40	34	9.55
41 - 60	202	56.74
61 - 80	112	31.46
>80	8	2.24
Level of education		
Not in school	121	33.98
Primary	102	28.65
Secondary	65	18.25
Superior	68	19.10
Comorbidities		
Diabetes mellitus	111	31.17
Obesity	108	30.33
Dyslipidemia	98	27.52
Hyperuricemia	84	23.59
HIV	51	15.32
Viral hepatitis B	47	13.2
Viral hepatitis C	19	5.33
Other Factors of Chronic Nephropathy		
Chronic use of nephrotoxics	155	43.53
Smoking	22	6.17

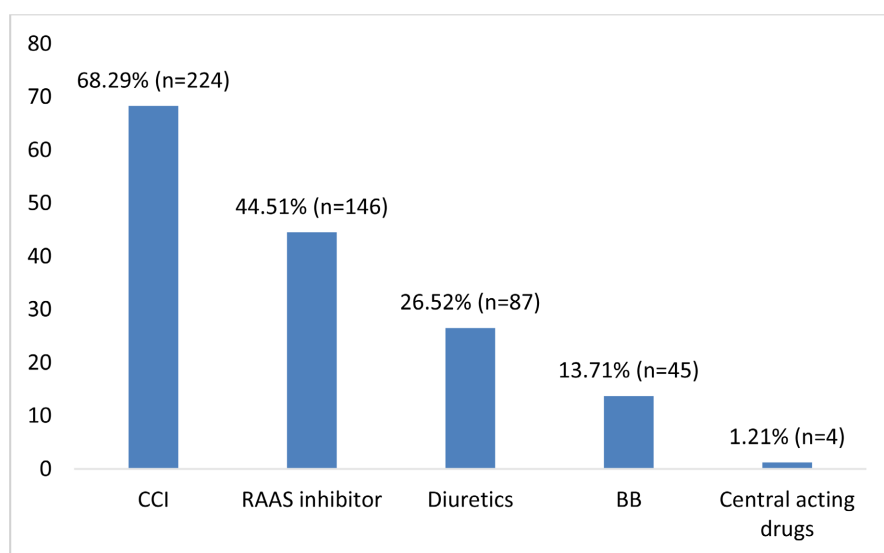
Table 2. Characteristics of hypertension in the study population (N = 356)

Variables	Frequency (n)	Percentage (%)
Mean duration of hypertension (SD), years	60 (21)	
Mean systolic BP (SD), mmHg	145 (26)	
Mean diastolic BP (SD), mmHg	90 (16)	
Blood pressure control		
Optimal	86	26.21
Elevated/high normal	62	18.9

Continued

HBP grade 1	103	31.4
HBP grade 2	64	19.51
HBP grade 3	41	12.5
Antihypertensive treatment	328	92.13
Good compliance	186	56.7
Monotherapy	156	47.56
Dual therapy	135	41.15
Triple therapy	34	10.6
More than 3 classes	3	0.91
End-organ damage		
Hypertensive heart disease	62	17.41
Hypertensive neuropathy	53	14.88
Hypertensive retinopathy	18	5.05

HBP: high blood pressure.



CCI: calcium channel inhibitor; RAAS inhibitor: Renin-Angiotensin-Aldosterone System inhibitors; BB: beta blocker.

Figure 1. Therapeutic classes used in the treatment of hypertension (n = 328).

3.2. Prevalence and Characteristics of Chronic Kidney Disease

Figure 2 illustrates the overall prevalence of chronic kidney disease (CKD) in the study population, which was 28.3% (n = 101). The different markers of CKD are represented in **Figure 3** and are mainly represented by renal insufficiency (69.3%).

The estimated glomerular filtration rate (GFR) was lower with the CKD-epi formula (77.85 ± 44.49 vs 81.26 ± 39.69 ml/min/1.73 m²) and allowed most participants to be classified as stage 1 of KDIGO, as described in **Table 3**.

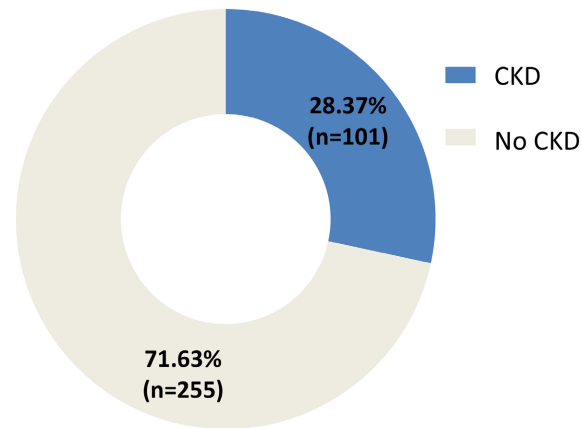


Figure 2. Prevalence of chronic kidney disease—CKD (N = 356).

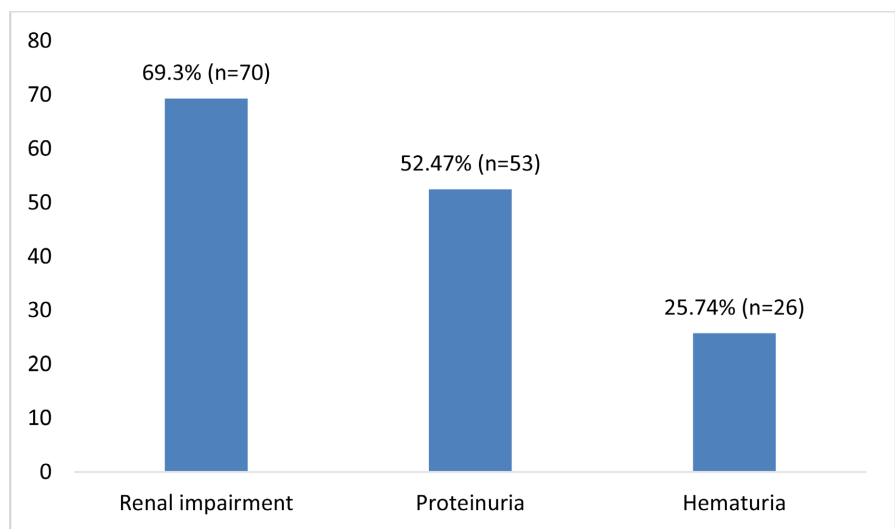


Figure 3. Profile of chronic kidney disease markers in the study population (n = 101); A patient could have more than one abnormality.

Table 3. Classification of chronic kidney disease by GFR.

Variables	MDRD, n (%)	CKD-EPI, n (%)
Mean eGFR ± SD ml/min/1.73m ²	81.26 ± 39.69	77.85 ± 44.49
Stage 1	162 (50.15)	147 (45.51)
Stage 2	64 (19.81)	71 (21.98)
Stage 3	85 (26.31)	86 (26.62)
Stage 4	12 (3.71)	18 (5.57)
Stage 5	0	1 (0.30)

MDRD: Modification of Diet in Renal Disease Study; CKD-EPI: Chronic Kidney Disease Epidemiology Collaboration; eGFR: Glomerular Filtration Rate; SD: Standard Deviation

3.3. Factors Associated with Chronic Kidney Disease

Table 4 illustrates that in univariate analysis, age, duration of hypertension, dia-

betes, hyperuricemia, obesity, and use of nephrotoxic drugs were associated with the presence of chronic kidney disease. In multivariate logistic regression analysis, age (OR 0.76 (CI 0.530 - 1.579)), obesity (OR 2.16 (1.277 - 2.7331)), diabetes (OR 2.93 (1.795 - 6.044)), and hyperuricemia (OR 3.61 (1.999 - 8.029)) were statistically associated with CKD as shown in **Table 5**.

Table 4. Factors associated with kidney disease (Bivariate analysis).

Risk factors	Chronic kidney disease		OR (95% CI)	p-value
	No, n = 255 (%)	Yes, n = 101 (%)		
Gender				
Male	115 (45.09)	48 (47.52)	1.103 (0.695 - 1.750)	0.679
Female	140 (54.90)	53 (52.47)		
Mean age \pm SD, years	54 \pm 16.00	59 \pm 16.50	1.767 (1.108 - 2.818)	<0.001
Mean duration of hypertension (IQ), years	58 \pm 28 (21.62)	65 \pm 29.50	1.490 (0.928 - 2.393)	0.006
Blood pressure				
mean \pm SD, mmHg	144 \pm 26	148 \pm 25	1.146 (0.718 - 1.830)	0.149
mean DBP \pm SD, mmHg	89 \pm 17	91 \pm 17		
Obesity	65 (25.49)	43 (32.57)	2.167 (1.335 - 3.519)	0.002
Mean BMI \pm SD, Kg/m ²	25.95 \pm 7.35	28.69 \pm 10.69	1.087 (0.677 - 1.747)	<0.001
Diabetes	52 (20.39)	49 (48.51)	2.933 (1.808 - 4.759)	<0.001
Dyslipidemia	191 (74.90)	67 (66.33)	1.514 (0.918 - 2.498)	0.103
Hyperuricemia	42 (16.47)	42 (41.58)	3.610 (2.150 - 6.047)	<0.001
HIV	42 (16.47)	9 (8.91)	0.496 (0.232 - 1.061)	0.472
HBV	31 (12.15)	16 (15.84)	1.360 (0.708 - 2.613)	0.355
HCV	12 (4.70)	7 (6.93)	1.508 (0.576 - 3.947)	0.066
Nephrotoxic drugs	102 (40.00)	56 (55.44)	1.867 (1.172 - 2.973)	0.008
Tobacco	13 (5.09)	9 (8.91)	1.821 (0.753 - 4.404)	0.178
Brain damage	33 (12.94)	20 (19.80)	1.924 (1.031 - 3.590)	0.101
Heart Damage	42 (16.47)	20 (19.80)	1.810 (0.999 - 3.281)	0.455
Retinopathy	8 (3.13)	9 (8.91)	3.020 (1.131 - 8.064)	0.021

SD: Standard Deviation; OR: Odds Ratio; CI: Confidence Interval; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; BMI: Body Mass Index; Hypertension: high blood pressure; HBV: hepatitis B virus; HCV: hepatitis C virus.

Table 5. Factors associated with kidney disease (multivariate analysis).

Variables	OR (IC = 95%)	p-Value
Age	0.76 (0.530 - 1.579)	<0.001
Obesity	2.16 (1.277 - 2.733)	<0.001

Continued

Diabetes	2.93 (1.795 - 6.044)	<0.001
Hyperuricemia	3.61 (1.999 - 8.029)	<0.001
Duration of hypertension	9.055 (1.045 - 4.271)	0.011

4. Discussion

At the end of this study, which included 356 known hypertensive participants over the age of 18 and followed at the Garoua Regional Hospital, it emerged that:

- The overall prevalence of chronic kidney disease (CKD) in the study population is 28.3%, marked by renal failure (69.3%), proteinuria (52.47%), and hematuria (25.74%);
- Age > 59 years (OR 1.76), obesity (OR 2.16), diabetes (OR 2.93), and hyperuricemia (OR 3.61) are statistically associated with CKD.

A Recent meta-analysis estimates the prevalence of CKD at 29% among hypertensive people in sub-Saharan Africa [17]. It points out that West and Central Africa are the most affected areas because of genetic susceptibilities (mutation of apolipoprotein 1). The prevalence of CKD in our hypertensive population is comparable to that reported in the Senegalese (25%), Nigerian (29.8%), Cameroonian (32.3%) series, and also to the results of the systematic review of Yirga *et al.* (29.01%) [12] [18]-[20]. This prevalence is much lower than that found in Bamako (58%) and Guinea (51.4%). Kaze *et al.* in Cameroon found a prevalence of CKD of 50% in a group of hypertensives; this difference in prevalence could be based on the higher frequency of risk factors for CKD (62% diabetics vs. 31% in our series). However, the reported prevalence of CKD in African hypertensive patients remains higher than in the Caucasian series. This could be explained contextually by weak literacy medical conditions that make treatment compliance difficult. But also, the lack of health insurance is a real obstacle to the early diagnosis of non-communicable diseases. On the other hand, the high frequency of comorbidities in our context is directly related to the westernization of our societies and explains the high prevalence of CKD in non-Caucasian subjects. Also, we found that despite the reported good therapeutic compliance, only 26.21% of the participants had optimal blood pressure control. This underlines the therapeutic inertia of healthcare providers as reported elsewhere [21] [22].

Stage 3 of KDIGO was the most represented stage, as in the Congolese study [23]. This is in line with the community nature of our work because, due to the delay in care, stage 5 is common in our environment at the first hospital consultation. This is how an African study reported that 82.5% of hypertensive patients who arrived for a kidney complication were already at stage 5 [20]. CKD was prevalent in 59 ± 16.50 years in our series and, although not statistically significant, was more common in female subjects; women are more represented in our cohort. In African women, hypertension is very often associated with obesity and type 2 diabetes. This “triplet” multiplies the aggressions on the nephron.

More than one in two patients had proteinuria. Although not specific to high blood pressure, proteinuria is an early marker of renal dysfunction and a potent progression factor during CKD. Aka *et al.*, during analysis of the profile of patients admitted to emergency rooms in Abidjan, showed that 95.9% of patients with malignant hypertension already had renal failure, 78% of whom were at the chronic stage at the first diagnosis [24]. Mi Yeon Yu *et al.* in Korea reported that microscopic hematuria in hypertensive patients without comorbidities would be rare but would be a predictive factor for mortality in hypertensive patients [25].

Age, obesity, diabetes, hyperuricemia, and the duration of hypertension are factors associated with CKD in our cohort. These factors are the same as those reported in the Cameroonian cohorts [12]. Long-standing hypertension predisposes to CKD. Indeed, even moderate hypertension, if it lasts, inevitably leads to a decline in kidney function in Black subjects [26]. Sumaili *et al.*, in Congo-Kinshasa, showed that old hypertension was responsible for more than 60% of chronic kidney disease cases [23]. They pointed out that the risk of CKD increased exponentially with each additional year of uncontrolled hypertension.

5. Limitations

This epidemiological study, which is important for understanding the factors associated with CKD in our context, has limitations:

- Selection bias due to the hospital nature of recruitment.
- Imputability of CKD is difficult to establish in the absence of renal histology.

6. Conclusion

More than one in four patients with chronic kidney disease (CKD) in our series had classic chronic kidney disease risk factors coexisting. Proteinuria is prevalent and underlines the importance of its regular evaluation in all hypertensive patients in view of its ease and speed of implementation. More proactive therapeutic adjustments would be important to address for better prevention of CKD progression.

Authors' Contributions

All authors contributed to the study conception. The study was designed by Hanadou Ba and Kaze F François. Material preparation, data collection, and analysis were performed by Maimouna Mahamat, Mebomie Essono, Ndofo Valerie, Moussa Oumarou, and Ali Abas. The first draft of the manuscript was written by Maimouna Mahamat and Teuwafeu Denis. All authors read and approved the final manuscript.

Consent for Publication

Not applicable.

Availability of Data and Materials

The materials described in the manuscript, including all relevant raw data, will be

freely available to any scientist wishing to use them for non-commercial purposes. The data that support the findings of this study are also available from the corresponding author.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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