

Study of Chronic Renal Failure in Children

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Abstract

Introduction: Chronic kidney disease (CKD) is not uncommon in children. It constitutes a major public health problem for both poor and developed countries. The objective of this study was to describe the sociodemographic, clinical, and prognostic profile of CKD in children to contribute to the improvement of its management. **Methodology:** This was a retrospective, descriptive study conducted from January 2020 to December 2024 in the pediatric departments of the CHU-ME and CHU-R. All patients aged between 3 months to 15 years admitted for CKD were included. The variables studied were sociodemographic, clinical, paraclinical and evolutionary. **Results:** During the study period, 42,123 pediatric patients were admitted. Of these, 50 met the inclusion criteria for CKD, resulting in a hospital prevalence of 0.11%. The mean age was 10.3 years with extremes being 3 months and 15 years. Males constituted 56% (n = 28) of the cohort, with a sex ratio of 1.3. The most common clinical presentations were proteinuria, detected on urine dipstick in 94% (n = 47) of cases, and edema of the lower limbs (78%, n = 39). All patients (100%) presented with anemia. A majority of patients (70%, n = 35) were in stage 5 CKD, according to KDIGO guidelines. Hemodialysis was required for 58% (n = 29) of patients, often due to complications such as uremic coma. The overall mortality rate was 42% (n = 21), with deaths primarily attributed to cardiorespiratory complications. **Conclusion:** The prevalence of chronic renal failure in children is low (0.11%). The clinical picture is dominated by proteinuria and peripheral edema. Chronic glomerulonephritis represented the most frequent etiologies. Hemodialysis is the only therapeutic option. Overall mortality remains high.

Keywords

Chronic Kidney Disease, Children, Chad

1. Introduction

Chronic kidney disease (CKD) is defined by the presence for more than 3 months, markers of renal damage which may be morphological, histological or biological (proteinuria, albuminuria, hematuria, leukocyturia, or a drop in glomerular filtration rate (GFR) below 60 ml/min/1.73m²) [1]. It is classified into stages of increasing severity according to the level of GFR. It is a complex pathology affecting adults as well as children [2]. CKD is not exceptional in children; it presents specific characteristics since their organism is growing. It constitutes a major public health problem for both poor and developed countries [3]. It is associated with significant morbidity and mortality as well as impaired quality of life [4]. Although the renal parenchyma has extraordinary adaptation and regeneration capacities, chronic kidney diseases are capable of progressively destroying the functional structures of the kidney: the glomeruli, the tubes and the interstitium, or the vessels [5].

Worldwide, it is estimated that 850 million people suffer from chronic kidney disease. It is responsible for significant morbidity and mortality [3].

In France, the overall incidence of terminal CKD in 2010 was 8 million children under 20 years of age [6].

In Africa, few studies have focused on chronic renal failure in children. In South Africa, Bhimma highlighted the lack of national registries and the high cost of renal replacement therapy [7]. The lack of more comprehensive information in Africa has led to a poor understanding of its clinico-pathological manifestations, etiology and management. In Nigeria, Olowu *et al.* in 2013 highlighted a prevalence of 1.83% [8].

In Senegal, Keita Y. *et al.* in a hospital study found a prevalence of 0.62% in 2014 [9].

In Togo, a prevalence of 0.2% in 2012 was observed by Balaka *et al.* [10].

In countries south of the Sahara, the prognosis is increasingly unfavorable due to the lack of resources and support structures [11].

A retrospective study carried out at the Central Hospital of Douala in Cameroon demonstrated a frequency of 15.5% of children affected by chronic kidney disease (stages 3 and 5) [12].

In Chad, no study has been done on chronic renal failure in children. Given the importance of the impact of this disease on the social level of children, the difficulties of management and the enormous financial cost of the disease, we decided to conduct this study, the objectives of which were to determine the hospital prevalence of CRF in children; to describe the main clinical and paraclinical signs, to list the etiologies, to evaluate the management and prognosis of chronic renal failure in children.

2. Patients and Method

This was a retrospective, descriptive study conducted over a five-year period, from January 2020 to December 2024.

The study population included all children of both sexes aged 3 months to 15 years who were hospitalized or followed on an outpatient basis for kidney disease at any stage during the study period. Included were patients aged 3 months to 15 years with a glomerular filtration rate (GFR) < 60 mL/min/1.73m² for ≥ 3 months (calculated using the Schwartz formula), and with proteinuria (dipstick or quantitative), hematuria, or renal ultrasound abnormalities, whose parents consented to participate. Excluded were patients with a GFR > 60 mL/min/1.73m² or with acute renal failure.

The pediatric departments of CHU-ME and CHU-R served as the framework for this study. These two CHUs are third-level national reference hospitals, each with a capacity of 310 beds and 240 beds.

Data collection was carried out using a pre-established form. The variables studied were sociodemographic (prevalence, age, sex ratio), clinical (history, lower limb edema, proteinuria, hematuria, vomiting, etc.), paraclinical (hemogram, calcemia, albuminuria, phosphatemia, CRP, creatinine, blood urea), therapeutic and progressive. We used the KDIGO 2012 classification [13] to classify CKD into stages as shown in Table 1. Only stages 3 ($30 \leq \text{GFR} < 59$ mL/min/1.73m²), stages 4 ($15 \leq \text{GFR} < 29$ mL/min/1.73m²) and stages 5 ($\text{GFR} < 15$ mL/min/1.73m²) were retained in this study. The 2006 WHO growth charts were used to calculate Body Mass Index (BMI) [14] of patients as shown in Table 2. A BMI < 18 defined a state of underweight. Data entry was performed in Microsoft Word and Excel 2016, and statistical analyses were conducted using SPSS version 26.0. All ethical and administrative procedures were strictly observed.

Table 1. Classification of stages of chronic kidney disease according to KDIGO 2012.

GFR (ml/min/1.73m ²)	KDIGO 2012
≥ 90	Stage 1: Chronic kidney disease with normal or \uparrow GFR
60 - 89	Stage 2: Chronic kidney disease with a slightly decreased GFR
30 - 59	Stage 3 A: (GFR between 45 - 59): Moderate chronic renal failure Stage 3B: (GFR between 30 - 44): Moderate chronic renal failure
15 - 29	Stage 4: Severe chronic renal failure
< 15	Stage 5: End-stage chronic renal failure

KDIGO 2012 [13].

Table 2. Different BMI categories.

Category	BMI (Kg/m ²)
Underweight	< 18.5
Normal weight	18.5 - 24.9
Overweight	25 - 29.9
Obesity	≥ 30

WHO BMI 2006 [14].

3. Results

During the study period, we recorded 42,123 patients, 50 of whom were included, giving a hospital prevalence of 0.11%. The average age was 10.3 years with extremes of 3 months and 15 years. The most represented age group was 10 to 15 years old with 22/50. The male sex was the majority with 28/50 with a sex ratio (M/F) of 1.3. Peripheral edema was the primary reason for patient admission with 39/50, proteinuria in 47/50 of cases, hematuria in 28/50 of cases and high blood pressure in 24/50 of patients. Physical asthenia 48/50 was present in almost all patients. Nearly half of the patients were oliguria 20/50 and 17/50 were anuric. Sickle cell disease and recurrent angina were the most common medical antecedents found in 6 children.

It appears that approximately two-thirds of the patients were thin 34/50. The average BMI was 16.44 kg/m² with extremes of 10 and 31 kg/m². In biology, the average blood urea, blood creatinine, and estimated GFR were respectively 2.19 mg/dl; 994.6 µ/dl and 16.7 ml/min. Normochromic normocytic anemia was objectified in all 50 patients. The distribution of patients showed that 5/50 were at stage 5 of chronic kidney disease according to KDIGO. The phosphocalcic assessment found hypocalcemia in 48/50, hyperphosphatemia in 23/50. Ultrasound was performed in 41 of our patients, 16 of whom had renal atrophy. A cardiac assessment was performed in 17 patients, 6 of whom presented concentric ventricular hypertrophy. The most reported etiology was chronic glomerulonephritis 18/50. Conservative treatment was emphasized on blood transfusion, oral iron supplementation, calcium + vitamin D3 and antihypertensives with respective 48/50, 40/50, 48/50 and 46/50. Hemodialysis was indicated for uremic coma in 29/50. The evolution was punctuated by complications with 21/50 of deaths due to cardiorespiratory disorders.

4. Discussion

The prevalence of CKD is low (0.1%) in our series. This prevalence is significantly lower than that reported by Keita *et al.* in Senegal in 2014 [9] and by Chioma *et al.* in Nigeria in 2020 [15], who respectively found 0.6% and 1.7%. This disparity is explained by several factors, including sample size, often limited access to health care and lack of awareness among the population. This delays the diagnosis of the disease. The most represented age group is that of 10 to 15 years with 44% of cases. This result is consistent with the data of Keita *et al.* in Senegal in 2014 [9] where this same age group represented 64.1% of cases, as well as that of Kamel *et al.* in Tunisia in 2016 [16] which reported a predominance of 71%. These differences in older children are explained by the fact that some chronic nephropathies begin early but do not reach an advanced stage, therefore diagnosed only after several years of evolution. Furthermore, older children are likely to be referred for nephrological assessment due to their ability to express symptoms; which leads to better detection in this age group. Finally, systematic consultations are less frequent in younger children.

A male predominance is observed (sex ratio = 1.3). This trend is also reported in regional literature. Indeed, Balaka *et al.* in Togo in 2012 [10] and Kamel *et al.* in Tunisia in 2016 [16] found proportions of 54.3% and 58.4% respectively. In the literature, in men, testosterone promotes glomerular fibrosis, aggravating the occurrence of CKD. The more rapid decline in renal function is also explained in men by the greater accumulation of risk factors (tobacco, alcohol, metabolic syndrome, severe hypertension and diabetes) [17].

Peripheral edema (74%) is the main reason for admission in children with CKD. This result is in agreement with the data of Keita *et al.* in Senegal in 2014 [9] which reports 69.8 %, while Chioma *et al.* in Nigeria in 2020 [15] reports a lower frequency with 39.4%. It is noted that edema is a frequent warning sign in pediatric nephrology, particularly in nephrotic syndromes and GNA which are major causes of CKD in children in our study. This difference in proportion observed is explained by the prevalence of nephrotic syndrome in the study population, the stage of the disease at the time of diagnosis and the awareness of the population.

Proteinuria is observed in 96% of children with CKD. This rate is higher than Keita *et al.* in Senegal in 2014 [9] who found 88% and much higher than that of Chioma *et al.* in Nigeria in 2020 [15] where only 39.4% of children presented with proteinuria at BU. This high proteinuria observed can be explained by the predominance of glomerular etiologies (nephrotic syndrome and glomerulonephritis) and the early onset of Proteinuria in nephropathies. Oliguria was found in 40% of children during the study. This proportion is relatively close to that reported by Balaka *et al.* in Togo in 2012 [10], but considerably higher than that observed by Chioma *et al.* in Nigeria in 2020 [15] where only 26.9% of children have oliguria. This is a frequent and worrying sign in the context of CKD. These observed differences can be explained by the type, stages of CKD at diagnosis and the time to consultation in a specialized center.

All children with CKD had biological anemia on blood count (100%). This result is in perfect agreement with the data of Keita *et al.* in Senegal in 2014 [9] who also reported 100% anemia. On the other hand, Maale J. *et al.* in Tunisia in 2018 [5] note a slightly lower frequency with 83% of anemia. Anemia is a common and well-documented complication of CKD, resulting in particular from a defect in the production of erythropoietin, chronic inflammation, iron metabolism disorders and other associated factors (uremic toxicity on the bone marrow, vitamin B1 or folate deficiency and secondary hyperparathyroidism).

More than half (70%) of the children had CKD at stage 5, the terminal stage of the disease. Our finding is higher than that of Hesham *et al.* in Egypt in 2015 [18] who reported 57.6% and significantly higher than that observed by Odetund *et al.* in Nigeria 2014 [19] which report 44.9% of cases at stage 5. This particularity is explained by the delay in diagnosis, and the absence of a specialized pediatric nephrology service in our context.

GNC (36%) is identified as the leading cause of CKD in children. This result is in between the data reported by Odetund *et al.* in Nigeria 2014 [17] where GNC

represents 63.6 % and those of Kamel *et al.* in Tunisia in 2016 [16] who note a much lower prevalence of 9.6% for this etiology, in favor of congenital anomalies of the urinary tract found in 35.5% of cases. This notable discordance is explained by environmental and socioeconomic geographical differences but also by variability in access to specialized etiological diagnosis.

During treatment, 42% of our patients required dialysis. This finding differs from that of other authors, notably Odetund *et al.* in Nigeria 2014 [19] who found a lower prevalence with 25.5% and Hesham *et al.* in Egypt 2015 [18] which, on the other hand, show 93.6%. These differences reflect both the very contrasting clinical and systemic realities. The high rate of dialysis in our context is explained by the high proportion of children who reach stage 5 of the disease.

In this series, we note a mortality rate of 42%, an alarming level almost close to those reported by Chioma *et al.* in Nigeria 2020 [13] and Maale J *et al.* in Tunisia [16] which each found 40% mortality. This convergence of results despite different health contexts illustrates the great vulnerability of children with CKD. This mortality is explained by the advanced stage at the time of diagnosis, the delay in treatment, therapeutic limitations and the absence of continuous specialized care.

We report cardiorespiratory origin as the main cause of death with a rate of 40.9%. This result is significantly higher than those reported by Kamel *et al.* in Tunisia 2016 [16] and Chioma *et al.* in Nigeria 2020 [13] which respectively find 37.7% and 32%.

This high predominance in our context is explained by the lack of rapid access to dialysis, late diagnosis and insufficient cardiovascular monitoring.

5. Conclusion

The prevalence of chronic renal failure in children is low (0.11%). The clinical picture is dominated by proteinuria and peripheral edema. Chronic glomerulonephritis represented the most frequent etiologies. Hemodialysis is the only therapeutic option. Overall mortality remains high.

Conflicts of Interest

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

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Abbreviations

CKD	Chronic Kidney Disease
KDIGO	Kidney Disease Improving Global Outcomes
CHU-R	Renaissance University Hospital Center
CHU-ME	Mother and Child University Hospital Center