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ORIGINAL ARTICLE

Clinical Profile and Outcomes of Children with Chronic Kidney Disease at a Tertiary Care Hospital in Bangladesh

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Abstract

Background: *Chronic kidney disease (CKD) in children is a growing health concern, associated with significant morbidity and mortality.*

Objective: *To assess the clinical, biochemical and anthropometric profiles of children diagnosed with chronic kidney disease (CKD) and to evaluate their outcomes.*

Methods: *This study enrolled 123 children aged 2 - 16 years, diagnosed with chronic kidney disease (CKD). CKD was defined in accordance with KDOQI guidelines. Medical records of 123 children aged 2 - 16 years diagnosed with chronic kidney disease (CKD) who were managed at Department of Pediatric Nephrology, Bangladesh Medical University (BMU), Dhaka, Bangladesh, between September 2024 and August 2025 were reviewed. CKD was defined in accordance with KDOQI guidelines. Data on demographic characteristics, clinical presentation, laboratory parameters, CKD stages, treatment modalities and outcomes were collected accordingly. Data were analyzed and compared by statistical tests.*

Results: *The mean age of study children was 9.4 ± 3.2 years and 58.5% was male. The most common etiology of CKD was congenital anomalies of the kidney and urinary tract (36.6%), followed by glomerulonephritis (28.5%). At presentation, anemia (91.1%), hypertension (65.0%), and growth retardation (52.0%) were the most prevalent clinical features. Most children (63.4%) presented in advanced stages (Stage 4 - 5). Biochemical abnormalities included proteinuria (70.7%), hyperphosphatemia (61.0%), and hypocalcemia (49.6%). Conservative management was the main treatment (53.7%), while 26.8% required hemodialysis. Of them, 25.2% progressed to end-stage renal disease (ESRD) and 5.7% was died. Advanced CKD stages was significantly associated with anemia, growth failure, hypertension, and biochemical derangements ($p<0.05$).*

Conclusion: *Pediatric CKD in this cohort was predominantly diagnosed at advanced stages, with high rates of anemia, growth retardation, and biochemical abnormalities. A considerable number of CKD children suffer ESRD.*

Key words: *Chronic Kidney Disease (CKD), Congenital Anomalies, Glomerulonephritis, Growth Retardation, Renal Failure*

Introduction

Chronic kidney disease (CKD) in children is a progressive and irreversible condition marked by a sustained reduction in renal function or structural kidney abnormalities for more than three months[1]. It is a major contributor to childhood morbidity and is associated with complications such as

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growth failure, anemia, hypertension, and metabolic disturbances[2,3]. Despite medical advancements, pediatric CKD remains underdiagnosed and underreported in low- and middle-income countries, where healthcare infrastructure and awareness remain limited[4]. In South Asia, the prevalence of CKD in children is increasing, yet the data on its clinical profile and outcomes remain scarce. A study by Yasmin F et al. found that 88.9% of children with CKD were underweight and 97.2% were anemic, with a significant proportion exhibiting hypertension[2]. Similarly, Khondaker MS et al. reported poor outcomes among Bangladeshi children with steroid-resistant nephrotic syndrome, 43% of whom progressed to end-stage renal disease (ESRD)[4]. These findings underscore the need for early detection and intervention to reduce long-term complications.

Studies from neighboring countries echo similar concerns. Amanullah F et al. in Pakistan reported a high prevalence of late-stage CKD among children, often presenting with growth retardation, anemia, and proteinuria[5]. In India, Bingi SS et al. highlighted congenital anomalies of the kidney and urinary tract (CAKUT) and glomerulonephritis as major causes of pediatric CKD, with most patients presenting in Stages 3 to 5[6]. Likewise, Javaid MS et al. found that 60 pediatric patients admitted for dialysis in a tertiary health care hospital of them 43.3% recovered, 15% were transformed into CKD, and 13.3% into ESRD and 28.3% died[7]. Multiple Indian studies, including those by Gulvadi S et al.[8] and Dada AO et al.[9], have emphasized the socio-demographic challenges associated with pediatric CKD, such as malnutrition, lack of parental education, and financial constraints, which hinder consistent treatment. In a Tanzanian study, Meremo AJ et al. noted that limited access to nephrology services and high treatment costs contributed to high mortality rates in children with CKD, a pattern echoed in other resource-limited countries[10].

While some tertiary care hospitals in Bangladesh have initiated pediatric nephrology units, comprehensive data on pediatric CKD remains limited, particularly in tertiary care settings. Given the evolving disease burden and lack of robust surveillance systems, it is crucial to establish baseline data on the clinical and biochemical profile of affected children in such settings. This study therefore, aims to evaluate the clinical presentation, laboratory characteristics, and outcomes of pediatric CKD patients treated at at Bangladesh Medical University (BMU) hospital, Dhaka, Bangladesh. Findings from this study will contribute to the growing literature on pediatric CKD in South Asia and provide evidence to improve policy-making, early screening, and long-term disease management strategies.

Methods

Study design

This was a cross-sectional observational study conducted in the Department of Pediatric Nephrology at Bangladesh Medical University (BMU), Dhaka, Bangladesh; a tertiary care hospital serving both urban and rural pediatric populations.

Study population and inclusion criteria

Children aged 2 to 16 years, who were either admitted to the Pediatric Nephrology unit or attended at the outpatient follow-up clinic between September 2024 and August 2025, were considered for inclusion. Children younger than 2 years were excluded because glomerular filtration rate (GFR) is gradually increases during infancy and reaches near adult values by about 2 years of age. All children included were diagnosed with CKD based on the National Kidney Foundation- Kidney Disease Outcomes Quality Initiative (KDOQI) criteria defined as either a decreased glomerular filtration rate (GFR <60 ml/ minute /1.73 m²) or evidence of structural or functional renal abnormalities persisting for more than 3 months [1]. Patients underwent supportive therapy, maintenance hemodialysis, or conservative management were eligible for inclusion. Children with acute kidney injury (AKI) or incomplete records were excluded.

Sample size calculation

For a cross sectional study estimating prevalence, the standard formula is:

$$n = \frac{Z^2(p \times q)}{d^2}$$

Where,

- n = required sample size
- Z = Z value for 95% confidence interval = 1.96
- p = estimated prevalence = 7.9% = 0.079[11]
- q= 1-p = 0.921
- d = absolute precision (margin of error) = 5% = 0.05

$$n = \frac{(1.96)^2 \times 0.079 \times (1-0.079)}{(0.05)^2}$$

$$n = \frac{(3.84 \times 0.079 \times 0.921)}{0.0025}$$

$$n = \frac{0.279}{0.0025}$$

$$n = 111.6$$

Final Sample Size-

Minimum required sample size was 112 children

Adding 10% contingency for incomplete data: 112+11=123

Sampling technique

A consecutive sampling method was employed.

Operational Definition

Conservative management

Conservative management is a broader treatment approach in which dialysis or transplantation is not initiated. It includes supportive therapy along with measures to slow disease progression, manage comorbidities, and provide comprehensive care.

Supportive therapy

Supportive therapy refers to treatments aimed at relieving symptoms, preventing complications, and improving quality of life without necessarily altering the underlying disease process.

Data collection

Data were extracted from hospital medical records, including inpatient files, outpatient follow-up sheets, and the pediatric nephrology database. A pretested structured data collection form was used to gather information on:

- Demographic details (age, sex, residence, socioeconomic status)
- Anthropometric measurements (height-for-age, weight-for-age, BMI-for-age z-scores)
- Clinical features (edema, anemia, hypertension, urinary abnormalities)
- CKD staging based on estimated GFR
- Biochemical parameters (hemoglobin, serum creatinine, urea, calcium, phosphate, parathyroid hormone)
- Treatment details (e.g., steroid use, dialysis, antihypertensive medications)
- Outcomes (follow-up status, progression, referral, or mortality)

Anthropometric indices were assessed using WHO growth standards. Blood pressure was interpreted using pediatric percentile charts. Staging of CKD was based on Schwartz formula–derived eGFR.[12]

Data Analysis

Data were analyzed using Statistical Package for Social Sciences (SPSS) version 26.0 (IBM Corp, Armonk, NY, USA). Descriptive statistics were used to summarize variables. Continuous variables were presented as mean ± standard deviation (SD) or median (interquartile range) depending on distribution. Categorical variables were summarized as frequencies and percentages. Chi-square tests were used to assess associations between categorical variables. A p-value <0.05 was considered statistically significant.

Ethics statement

All patients' legal guardians were consented to participate in the study with anonymity. The Institutional Review Board (IRB) of Bangabandhu Sheikh Mujib Medical University (BSMMU), predecessor of Bangladesh Medical University (BMU) waived the ethical requirement citing 'no patients were selected for the purpose of research, but rather their past medical record was used after they received regular treatment.'

Results and observations

It was observed that the majority of children with CKD were aged 6 to 10 years (41.5%), with a male predominance (58.5%). Most patients resided in urban areas (55.3%) and a substantial proportion (63.4%) belonged to low-income families, indicating a potential link between socioeconomic status and CKD burden (Table- II).

Table-I

Demographic characteristics of study patients (N= 123)

Variables	Category	Frequency (n)	Percentage (%)
Age groups (years)	2–5	35	28.5%
	6–10	51	41.5%
	11–16	37	30.0%
	Mean ± SD	9.4±3.2	
Sex	Male	72	58.5%
	Female	51	41.5%
Residence	Urban	68	55.3%
	Rural	55	44.7%
Socioeconomic status	Low income	78	63.4%
	Middle/High income	45	36.6%

Table-II demonstrates that congenital anomalies of the kidney and urinary tract (CAKUT) were the leading cause of CKD (36.6%), followed by glomerulonephritis (28.5%) and hereditary nephropathies (12.2%). In 13% of cases, the underlying etiology remained unknown, reflecting diagnostic limitations or late-stage presentation (Table- II).

Table-II

Etiological classification of chronic kidney disease among study participants (N= 123)

Causes of CKD	Frequency (n)	Percentage (%)
Congenital anomalies (CAKUT)	45	36.6%
Glomerulonephritis	35	28.5%
Hereditary nephropathies	15	12.2%
Obstructive uropathy	12	9.8%
Unknown/Undetermined	16	13.0%

Among the CKD children anemia (91.1%) and hypertension (65.0%) were the most prevalent clinical features followed by edema (58.5%) and growth retardation (52.0%). Oliguria was noted in 45.5% of patients, while bone-related symptoms were less frequent (13.8%), suggesting predominantly late-stage presentation with multisystem involvement (Table- III).

Table-III

Clinical features at presentation among children with CKD (N= 123)

Clinical features	Frequency (n)	Percentage (%)
Anemia	112	91.1%
Hypertension	80	65.0%
Edema	72	58.5%
Growth retardation	64	52.0%
Oliguria	56	45.5%
Bone pain/deformities	17	13.8%

In this study a large proportion of study children presented in advanced stages of CKD, with 34.1% in Stage 5 and 29.3% in Stage 4. Stages 3 and 2 accounted for 22.8% and 13.8% of cases respectively, highlighting a significant burden of late-stage CKD at diagnosis (Table- IV).

Table-IV

Distribution of CKD stages among study participants based on eGFR (N= 123)

CKD Stages	Frequency (n)	Percentage (%)
Stage 2	17	13.8%
Stage 3	28	22.8%
Stage 4	36	29.3%
Stage 5	42	34.1%

It was observed that anemia was the most common biochemical abnormality (91.1%), followed by proteinuria (70.7%) and hyperphosphatemia (61.0%). Hypocalcemia and elevated parathyroid hormone (PTH) levels were present in 49.6% and 44.7% of study patients respectively, reflecting significant disturbances in mineral metabolism and renal function (Table-V).

Regarding management; over half of the children (53.7%) were managed conservatively. Hemodialysis was initiated in 26.8%, while 8.1% received peritoneal dialysis. A considerable proportion were received only supportive care (11.4%), indicating limited access to advanced renal replacement therapies (RRT) (Table- VI).

Table-V

Biochemical abnormalities among children with chronic kidney disease (N= 123)

Biochemical parameters	Abnormality	Frequency (n)	Percentage (%)
Hemoglobin	Anemia (<11 g/dL)	112	91.1%
Phosphorus	Hyperphosphatemia (>4.5 mg/dl)	75	61.0%
Calcium	Hypocalcemia (<8.8 mg/dl)	61	49.6%
PTH*	Elevated PTH (>65 ng/L)	55	44.7%
Urine Protein	Positive (proteinuria)	87	70.7%

*PTH= Parathyroid hormone

Table-VI

Treatment modalities administered to children with CKD (N= 123)

Management types	Frequency (n)	Percentage (%)
Conservative treatment only	66	53.7%
Maintenance hemodialysis	33	26.8%
Peritoneal dialysis	10	8.1%
Supportive care	14	11.4%

Analyzing the outcomes revealed that 67.4% of children continued regular follow-up, while 25.2% progressed to end-stage renal disease (ESRD). Referral to specialized centers occurred in 12.2% of cases. The mortality rate was 5.7%, primarily among those with advanced disease, underscoring the need for earlier detection and improved long-term care strategies (Table-VII).

Table-VII

Outcomes of pediatric CKD patients during follow-up (N= 123)

Outcomes	Frequency (n)	Percentage (%)
Continued on follow-up	83	67.4%
Progressed to ESRD	31	25.2%
Referred to specialty centers	15	12.2%
Death	7	5.7%

A significant association was found between CKD stages and several clinical and biochemical complications. Children in advanced stages (Stages 4 - 5) had a significantly higher prevalence of anemia (98.7%), hypertension (74.4%), growth retardation (64.1%), proteinuria (78.2%), and hyperphosphatemia (74.4%) compared to those in early stages (Stages 2 - 3). All associations were statistically significant ($p<0.05$), indicating that complications increase in frequency and severity with disease progression (Table-VIII).

Table-VIII

Association between CKD stages and clinical/ biochemical features among pediatric patients (N= 123)

Clinical features	Early stages (2-3) (n= 45)	Late stages (4-5) (n= 78)	χ^2 value	p-value
Anemia	35 (77.8%)	77 (98.7%)	12.4	0.001*
Hypertension	22 (48.9%)	58 (74.4%)	7.3	0.007*
Growth retardation	14 (31.1%)	50 (64.1%)	10.2	0.001*
Proteinuria	26 (57.8%)	61 (78.2%)	5.2	0.023*
Hyperphosphatemia	17 (37.8%)	58 (74.4%)	14.6	<0.001*

*Significant

Discussions

This cross-sectional observational study was conducted over a one-year period (between September 2024 and August 2025) at the Department of Pediatric Nephrology, Bangladesh Medical University (BMU), Dhaka, Bangladesh. The primary aim was to evaluate the clinical, biochemical, and treatment profiles of children aged 2 to 16 years diagnosed with chronic kidney disease (CKD) and assess their outcomes. Given the scarcity of pediatric CKD data from Bangladesh, especially in urban healthcare facilities and tertiary centers, this study provides critical insights into disease patterns and management challenges in a low-resource context.

In the present study, most children with CKD were aged between 6 and 10 years (41.5%), with a mean age of 9.4 ± 3.2 years. This age distribution is consistent with findings from Yasmin F et al.[2] who reported a mean age of 9.09 ± 3.01 years in pediatric CKD patients. Male predominance (58.5%) was observed, aligning with trends reported by Khondaker MS et al.[4] and Amanullah F et al.[5], possibly due to the higher prevalence of congenital anomalies and steroid-resistant nephrotic syndrome (SRNS) in males, as well as gender disparities in healthcare access. Urban residence (55.3%) and low-income status (63.4%) were also prominent, suggesting that although urban patients may access care more readily, financial barriers remain significant echoing similar findings from a couple of previous study[6,7].

Etiologically, congenital anomalies of the kidney and urinary tract (CAKUT) were the leading cause (36.6%), followed by glomerulonephritis (28.5%) and hereditary nephropathies (12.2%). This mirrors the distribution reported by Yasmin F et al.[2] and Amanullah F et al.[5], who noted CAKUT as the predominant cause of CKD in children in Bangladesh and Pakistan, respectively. Glomerular diseases, particularly SRNS, are also prominent contributors, as seen in Khondaker MS et al[4]. A notable proportion (13%) of patients had unknown etiology, likely due to delayed referrals and diagnostic limitations, a challenge also documented in related studies[3,7].

Clinically, anemia (91.1%), hypertension (65.0%), edema (58.5%) and growth retardation (52.0%) were the most frequent presenting features. These findings were consistent with those of Yasmin F et al., who reported anemia in 97.2% and hypertension in 66.7% of study patients[2]. Recent studies similarly identified anemia as dominant feature in pediatric CKD cohorts across South Asia[5, 6]. Hypertension and growth failure were especially

prevalent in advance stages of CKD, likely due to metabolic derangements, fluid overload, and chronic malnutrition.

A majority of children (63.4%) presented in advanced CKD stages 34.1% in Stage 5 and 29.3% in Stage 4. This finding reflects a pattern of delayed diagnosis, as supported by previous studies; where late-stage presentation was predominant[2,4]. Similar trend was reported in Pakistan and India, with 70% or more children diagnosed at CKD Stages 4 - 5[5,13], These trends highlight systemic weaknesses such as poor early detection, limited referral pathways, and socioeconomic constraints.

Biochemical abnormalities were common, with anemia (91.1%) being the most prevalent, followed by proteinuria (70.7%), hyperphosphatemia (61.0%), hypocalcemia (49.6%), and elevated PTH (44.7%). A number of previous studies reported comparable profiles, linking these derangements to CKD progression[2,3,13]. CKD-mineral bone disorder (CKD-MBD), manifesting as hyperphosphatemia and hypocalcemia, is a hallmark of late-stage disease and contributes to long-term morbidity[14]. Persistent proteinuria, noted in SRNS cases by Khondaker MS et al., also signals advanced glomerular damage and predicts faster disease progression[4].

Among the study children, treatment modalities were largely conservative. Over half of the children (53.7%) received non-dialytic care, while 26.8% underwent hemodialysis, 11.4% were received only supportive care and 8.1% CKD children received peritoneal dialysis. Similar treatment trends were observed in related previous studies; where most children were treated conservatively due to limited dialysis access and financial constraints [10, 15]. Some studies also highlighted systemic barriers to renal replacement therapy (RRT) access in India, including high treatment costs and inadequate pediatric dialysis infrastructure [13, 16]. These limitations underscore the urgent need for government-supported RRT programs and improved transplant services for children.

Outcomes during follow-up revealed that 25.2% of children progressed to end-stage renal disease (ESRD), 5.7% died, and 32.5% remained stable. Yasmin F et al.[2] similarly reported ESRD in 29% and mortality in 6.9% of study cases[2]. A few related studies noted poor survival and high complication rates in children with advanced CKD, particularly when RRT was delayed or unavailable[3,16]. The 5.7% mortality rate in this study may underestimate true mortality due to losses to follow-up a challenge also discussed by Sayed et al[15]. Most deaths occurred in children already in CKD stage 5, consistent with the observations of a previous study[13].

In present study demonstrated significant associations between CKD stages and clinical/biochemical complications. Children in late-stage CKD had significantly higher rates of anemia, hypertension, growth retardation, proteinuria, and hyperphosphatemia ($p < 0.05$). These findings reinforce the progressive nature of pediatric CKD and match regional data; which observed worsening complications with advancing CKD stages[2,5,17,18]. The increasing prevalence of CKD-MBD, growth failure, and proteinuria with disease severity emphasizes the need for proactive monitoring from early stages.

Collectively, these findings paint a comprehensive picture of pediatric CKD in a tertiary care context in Bangladesh. The patterns observed in clinical features, disease staging, biochemical derangements, treatment access, and outcomes closely align with South Asian literature and reflect common barriers in low- and middle-income countries (LMICs). The late presentation of most patients and high complication burden highlights the urgent need for early detection, robust community-level screening, better primary care training, and expansion of pediatric nephrology infrastructure. Improved coordination between primary and tertiary care, along with government investment in dialysis and transplant programs, are essential to reduce the growing burden of end-stage renal disease in children.

Conclusion

This study highlights that a significant proportion of children with CKD present in late stages with multiple complications, including anemia, hypertension and growth failure. The predominance of congenital and glomerular causes reflects the regional epidemiology, while the limited use of dialysis and transplant referral underscores infrastructural and socioeconomic barriers. Early identification, improved community-level screening, and strengthening of pediatric nephrology services are essential to prevent progression to ESRD and reduce morbidity and mortality in this vulnerable population.

Limitations of the study

The current study had several limitations that should be considered while interpreting the findings. First, as a cross-sectional observational study, it only provides a snapshot of the clinical profile of the children with CKD at a single point in time. Second, the study was conducted at a single

tertiary care center which may limit the generalizability of the results. Third, the sample size was relatively small and may not fully represent the entire spectrum of pediatric CKD.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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