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Incidence And Etiopathology Of Chronic Kidney Disease(CKD) In Children

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ABSTRACT

Background: *CKD in children is an emerging public health problem even in developing countries. In India, there is a lack of epidemiology in pediatric CKD; most of the cases present at a very advanced stage of the disease; the results are poor outcomes. Early detection and timely treatment are crucial in preventing disease progression. It tries to assess the incidence, clinical presentation, and etiological factors of pediatric CKD in children aged 1-14 years presenting at a tertiary care center in India, with an attempt to reflect upon the disease burden and necessity for early diagnosis and management.*

Methods: *This is a prospective, observational study conducted between November 2016 and November 2018. Approximately 1,100–1,200 pediatric patients, aged between 1 and 14 years, with chronic kidney disease (CKD) were selected for data collection. CKD was defined as an estimated glomerular filtration rate (eGFR) of less than 60 ml/min/1.73 m² for a duration exceeding three months. The study was carried out at S.C.B. Medical College and Hospital, Cuttack, India. Data was collected on clinical presentation, laboratory findings, and etiological factors, followed by necessary analysis.*

Results: *During the study, approximately 1,100–1,200 pediatric cases were evaluated, with 51 (about 4.2–4.6%) identified as having CKD. There was a male predominance among CKD cases, with males accounting for 62.74%. The age group most affected was 6–10 years, comprising 49.02% of CKD cases. Common clinical features in these pediatric patients included failure to thrive (100%), anemia (96.07%), and hypertension (64.70%). The primary causes of CKD were obstructive uropathy (43.13%) and renal dysplasia (31.37%). A large portion of patients presented with advanced CKD, as indicated by the fact that 45.09% were in Stage 5 at presentation. Dialysis was required in 41.17% of cases, with the majority (90.47%) receiving hemodialysis.*

Conclusion: *The pediatric CKD in this cohort has features of late diagnosis and advanced disease at presentation. Obstructive uropathy and renal dysplasia were the leading causes. Early detection and early intervention are necessary to mitigate the progression of disease and improve outcomes. Improved access to renal care including pediatric renal transplantation is urgently needed in resource poor settings.*

Keywords: *Pediatric Chronic Kidney Disease, Obstructive Uropathy, Renal Dysplasia, Hemodialysis, Early Detection, India, CKD Staging*

I. INTRODUCTION

CKD is a major, growing public health problem. It affects adults and children worldwide. Adults seized attention, while healthcare providers overlooked the immense CKD burden in children. Pediatric CKD varies by region due to genetic, environmental, and socio-economic factors. This affects its prevalence and progression. But limited information exists on pediatric CKD in India [1]. Most of it refers to the more advanced stages of the disease. The lack of enough epidemiological data makes it hard to estimate the disease burden. It is often diagnosed at a very late stage [2].

Without guidelines, most kids with early-stage CKD (stages 1, 2, and 3) don't get timely help. Lack of awareness results in one-third of new diagnoses being ESRD cases. A study from India found that 80% of adults with a congenital urinary tract problem, called vesicoureteral reflux, had CKD at presentation. Of these, 38% were already in ESRD. Among children, 58% of those with renal failure were at the ESRD presentation stage. These findings are important for early detection and treatment to prevent disease progression [3, 4].

Data from the NAPRTCS registry in developed countries shows that many children with CKD get diagnosed early. Healthcare providers identify 28% of cases in Stage 1 and 70% of cases in Stages 2-3. In contrast, several Indian studies show that CKD in children often presents at an advanced stage [5].

The most common causes of CKD in Indian children are:

1. Obstructive nephropathy.
2. Reflux nephropathy.
3. Chronic glomerulonephritis.

Age enhances chronic glomerulonephritis, but birth defects and inflammation drive CKD in youth. This trend is typical of other developing countries. There, obstructive uropathies and nephritis cause most pediatric CKD [6-7].

There are also reports that, in contrast to the data above, the leading cause of pediatric CKD in developed countries is CAKUT, followed by hereditary nephropathies and glomerulonephritis. Experts estimate that developed countries have 4-12 cases of pediatric CKD per million people each year [8]. The prevalence remains unstandardized. Data show that boys, older children, and African Americans have higher rates. However, there are few detailed studies on pediatric CKD in India. Also, without a national CKD registry, we cannot estimate the true disease burden [9].

This study aims to assess the incidence of CKD in children in a tertiary care nephrology department in India. It will also investigate the causes of CKD in the children. This will allow for early detection and treatment. Understanding the cause is key to guiding treatment. Early CKD detection is vital to slowing disease progression. This study must outline the burden of pediatric CKD in India. It must also highlight the need for early diagnosis and management.

II. METHODS

Study Design: A hospital-based, prospective observational study. It aimed to report the incidence and causes of CKD in children. Researchers conducted the study at S.C.B. Medical College and Hospital in Cuttack. It is a tertiary referral and teaching hospital. Researchers conducted the study in the departments of Nephrology and Pediatrics. This hospital is the main inpatient facility for sick children. It accepts transfers from other hospitals.

We included pediatric patients aged 1 to 14 who met the study's criteria as both OPD and IPD cases. The study included all children with kidney damage for over 3 months. They also had an eGFR of less than 60 ml/min/1.73 m^2. It excluded children under one year old or over 14, and those who did not meet the criteria.

Study Period

The study duration was two years, starting in November 2016 and ending in November 2018.

Recruitment of Study Participants

The study included all children who came to the OPD or IPD and met the inclusion criteria. The Institutional Ethics Committee secured clearance, and then participants or guardians gave consent.

Data Collection

We used a predesigned pro forma to collect the relevant data on each patient. The patients' histories included their demographics, chief complaints, and past illnesses. Providers noted family history, especially of renal disorders. They also documented, when relevant, personal and occupational histories.

Clinical Examination

We conducted thorough patient assessments, documenting BMI and examining skin, nails, and pulse. We monitored blood pressure, respiration rate, and temperature with precision. We also did detailed exams of the GI, cardiovascular, respiratory, and nervous systems for any problems.

Investigations

Routine laboratory investigations consisted of CBC and peripheral smear. We measured the serum levels of sodium, potassium, calcium, phosphate, uric acid, PTH, and ALP. We assessed renal function using blood urea, serum creatinine, serum protein, and albumin. We assessed glucose metabolism using FPG, 2hPPPG, and HbA1c. We did LFTs, lipid profiles, and viral tests for HIV, hepatitis B (HBsAg), and hepatitis C (HCV). We also did a urine test. It included routine and microscopic exams. We also estimated 24-hour protein levels. We did abdominal and pelvic USG to check the kidneys. We aimed to see their structure and function.

Special Investigations

Researchers conducted more studies on the selected cases. The pathologist used an 18-gauge, spring-loaded biopsy gun to perform the renal biopsies.

We stained the tissue with:

- hematoxylin and eosin
- periodic acid-Schiff
- silver methenamine
- Masson's trichrome.

Then, we collected and evaluated two cores of renal tissue. To investigate urogenital abnormalities, we did other imaging studies. They included voiding cystourethrography and retrograde urethrography.

Inclusion Criteria

Children between one and 14 years old with chronic kidney impairment met. An estimated glomerular filtration rate measured their kidney function. This rate was below 60 ml/min/1.73 m^2 with kidney damage. This damage was structural or functional, lasting over three months. This condition received a medical classification of chronic kidney disease. We chose individuals from both outpatient and inpatient populations. They met the diagnostic threshold.

Exclusion Criteria

We excluded patients below 1 year of age and those older than 14 years of age. Also excluded was any pediatric patient who did not meet any of the major diagnostic criteria. These are an eGFR > 60 ml/min/1.73 m^2 and no kidney damage lasting over three months. This ensured that the study population represented all pediatric CKD cases. It did so with functional impairment and disease chronicity.

Diagnosis of Chronic Kidney Disease (CKD)

Doctors diagnosed CKD by calculating the eGFR < 60 ml/min/1.73 m^2. They used the Schwartz formula, a standard method for assessing kidney function in children. The patients also had either bilateral small, contracted kidneys or other structural anomalies consistent with USG. In many patients, renal biopsies confirmed structural damage. They showed the degree of renal involvement.

Healthcare providers used clinical history, labs, imaging, and biopsy results to find the cause of CKD. If micturating cystourethrography showed primary vesicoureteral reflux, or if there was a history of recurrent urinary tract infections that indicated irregular renal outlines on USG, we then checked for renal scarring in reflux nephropathy. Urinary tract dilatation on the X-ray confirmed obstructive uropathy. If a cystourethrogram showed a large bladder with no obstruction, it suggested a neurogenic bladder.

Imaging studies found small, irregular kidneys, sometimes with cysts. This led to a diagnosis of renal dysplasia. Doctors suspected HUS due to acute renal failure, anemia, and a renal biopsy. We classified the patients with CKD as unknown when we could not establish the underlying cause.

Statistical Analysis

We created data tables and applied statistics to draw conclusions. Incidence and etiopathology patterns emerged in pediatric CKD patients. We analyzed data on the pattern of disease presentation, underlying causes, and the progression of the disease. We used selected tests to check for statistical significance in the data collected.

The present study has attempted to depict a comprehensive view of the burden of CKD in children and to outline its etiology in a tertiary care setup in India.

III. RESULTS

During this study, approximately 1,100–1,200 pediatric cases were evaluated. Among these, 51 cases showed evidence of CKD, resulting in a total CKD incidence of about 4.2–4.6% within the study population. Out of the 51 CKD cases, 32 were male (62.74%) and 19 female (37.26%), indicating a higher prevalence of CKD among males.

Age Distribution:

The highest number of CKD cases occurred in the age group of 6–10 years (n = 25, 49.02%), followed by 11–14 years [n = 16 (31.38%)] and 1–5 years [n = 10 (19.60%)].

Age Group (Years)	Number of Cases	Percentage (%)
1–5	10	19.60
6–10	25	49.02
11–14	16	31.38
Total	51	100

Clinical Signs and Symptoms:

All 51 patients (100%) presented signs of failure to thrive. Anemia was seen in 49 cases (96.07%), hypertension in 33 cases (64.70%), and vomiting in 46 cases (90.19%). Additional symptoms included decreased urination (7.84%), edema (60.78%), hematuria (54.90%), and nocturia (82.35%).

Clinical Symptom	Number of Cases	Percentage (%)
Failure to Thrive	51	100
Anemia	49	96.07

Hypertension	33	64.70
Vomiting	46	90.19
Decreased Urination	4	7.84
Edema	31	60.78
Hematuria	28	54.90
Nocturia	42	82.35

Etiology of CKD:

The primary causes of CKD included obstructive uropathy (43.13%), renal dysplasia (31.37%), and neurogenic bladder (3.92%). Other causes included HUS, SRNS, and FSGS, with 7.84% of cases having an undetermined etiology.

Etiology	**Number of Cases**	**Percentage (%)**
Obstructive Uropathy	22	43.13
Renal Dysplasia	16	31.37
Neurogenic Bladder	2	3.92
HUS	1	1.96
SRNS	2	3.92
FSGS	2	3.92
Undetermined	4	7.84

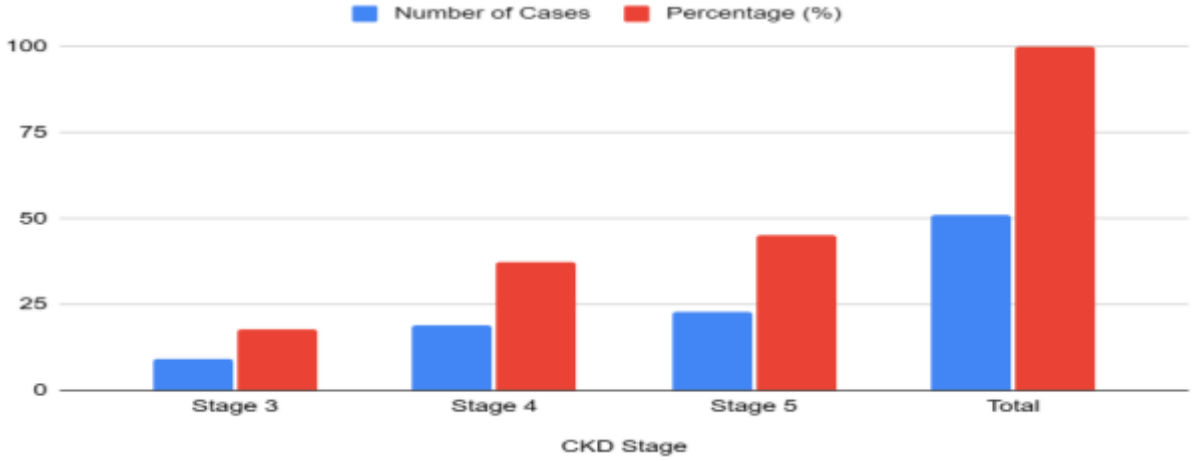

Figure1: CKD Staging at Presentation

A majority of the cases were presented at advanced stages, with 45.09% at Stage 5, 37.25% at Stage 4, and 17.64% at Stage 3 [figure1].

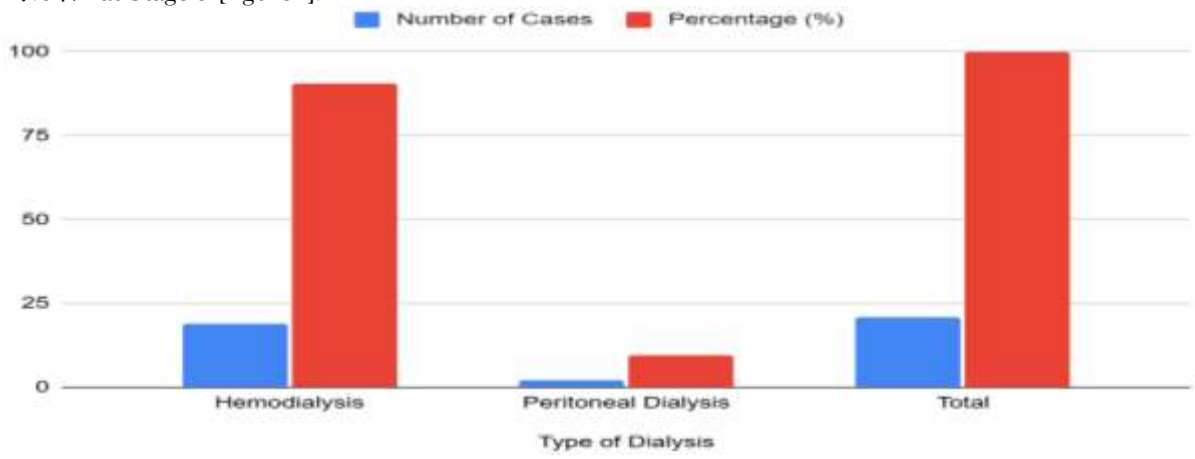

Figure2: Requirement for Dialysis

Of the 51 CKD patients, 21 (41.17%) were on dialysis, with 19 (90.47%) on hemodialysis and 2 (9.53%) on peritoneal dialysis.

IV. DISCUSSION

CKD in children now represents an emerging public health problem, especially in poor developing countries, including India. Therefore, the present study was undertaken at S.C.B. Medical College and Hospital, Cuttack, Odisha, to determine the incidence, clinical features, and etiological factors among children aged 1-14. Using the findings from 1758 pediatric cases, the incidence in our series was 2.9%, which compares well with other studies in the region [10]. CKD remains one of the major causes of morbidity and mortality among children, and elucidation of the demographic and clinical profiles is of utmost importance in potentially enhancing management options [11].

In our cohort of 51 pediatric CKD cases, there was a male predominance, with a male-to-female ratio of 1.68:1. This finding is in tune with other studies, such as those conducted by Pankaj Hari et al. in 2003 and Shi Ying Tan et al. in 2016, in which the male-to-female ratio ranges from 1.3:1 to 2.7:1. Indeed, most series in the literature demonstrate a male predominance, which may be related to gender-based differences in the etiology of CKD or healthcare-seeking behavior [12].

In our study, the most common age at presentation was 6-10, accounting for 49.02% of the total cases. This age group in the NAPRTCS database encompasses the highest cases of CKD among children aged 6 to 13. This could be related to the nature of CKD being a progressive disease and the natural presentation clinically during school-age years [13].

Clinically, failure to thrive was the most common symptom in our cohort, which all the patients had (100%). This is a well-known aspect of CKD in children due to the disease's chronic nature, which impacts growth and development. Anemia was present in 96.07% and hypertension in 64.7%, both of which are recognized complications of CKD in pediatric populations. These findings align with Qader et al. (2016), who reported similar prevalence rates of anemia and hypertension [14].

Of the children, 58.82% experienced oliguria, while 3.92% exhibited anuria. Their findings are consistent with those of McDonald et al. (2004) and Gulati et al. (1999), who found that approximately 60-64% of their pediatric CKD patients had oliguria. In patients with CKD, oliguria is usually a symptom of an advanced disease and may require RRT [15].

In our study, the primary cause of CKD was CAKUT. Obstructive uropathy and reflux nephropathy are the most common causes of CKD. In males, the incidence of PUVs was 56.25%, whereas in females, the leading cause of CKD was reflux nephropathy (63.15%). These findings are in concert with the studies by Pankaj Hari et al. and Gulati et al., where obstructive uropathy and reflux nephropathy have also been found to be major causes of CKD in children [16].

In contrast, glomerulonephritis was not a major cause in our cohort, whereas this condition was reported by other studies, such as Shi Ying Tan et al. in 2016, as one of the major causes of CKD. Such discrepancies can reflect regional differences in disease prevalence or indicate variance in study population composition [17].

Most of our patients (45.09%) presented with ESRD (Stage 5 CKD), which indicates that there is a delay in diagnosis and the disease is already at an advanced stage upon presentation. In agreement with Maalej B et al. and Kolvek et al., the majority of chronic kidney disease (CKD) cases were observed to be diagnosed at an advanced stage. The high incidence of end-stage renal disease (ESRD) at presentation underscores the importance of early detection, which could potentially alter the course of the illness [18].

Regarding management, 41.17% of our patients needed dialysis: 90.47% were on hemodialysis and 9.53% on peritoneal dialysis. The high rate of HD usage contrasts with the findings of Maalej B et al. and Kolvek et al., who reported greater use of peritoneal dialysis. This could be due to the limited resources available and the patient preferences at our center [19].

None of the patients in our study underwent renal transplantation, highlighting the significant financial and logistical barriers to this definitive treatment in Odisha's pediatric population. In contrast, studies by Pankaj Hari et al. and Ahmadzadeh et al. reported higher rates of transplantation in their cohorts, emphasizing thus the need for better infrastructure and financial support for renal transplantation in our region [20].

Chronic kidney disease (CKD) in children remains a significant public health issue, leading to considerable morbidity and mortality. This study underscores the need for early detection, effective management, and enhanced healthcare infrastructure to provide advanced treatments like renal transplantation for children with CKD in Odisha. These initiatives should include public awareness and preventive measures, as congenital anomalies of the urinary tract are the leading cause of pediatric CKD in our population.

V. CONCLUSION

In conclusion, our study underlines a large burden of pediatric CKD with congenital anomalies of the kidney and urinary tract as a common cause: posterior urethral valve, especially in males, and reflux nephropathy in females. Highly incident presentation in advanced stages of CKD, coupled with common symptoms such as failure to thrive, anemia, and oliguria, drew attention to the impact of late detection and referral in resource-poor settings. Although dialysis was available, a significant proportion of the children in this series were managed conservatively, and no renal transplants were performed; better access to enhanced renal care is required, including pediatric renal transplantation. Early diagnosis and intervention are crucial for preventing CKD progression in children with obstructive uropathy.

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