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Epidemiology and Clinical Characteristics of Pediatric Chronic Kidney Disease in Iraq: A Focus on Preventable Etiologies and Late-Stage Presentation

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Abstract: Children who suffer from Chronic Kidney Disease (CKD) experience a progressive condition because of either congenital urological abnormalities or acquired malformations which results in severe morbidity. Outcomes require early identification and appropriate management to prevent complications from occurring.

The research goal was to analyze pediatric CKD patient demographics together with etiology and clinical manifestations and laboratory test outcomes at Al-Imamain Al-Kadhimaian Medical City during Jan 2025 to March 2025.

A descriptive cross-sectional study about pediatric CKD patients analyzed 30 participants. The research obtained data about patient demographics, residence, kidney disease duration, kidney failure type and glomerular filtration rate (GFR), hemoglobin levels, blood pressure, and chronic kidney disease (CKD) stage from medical files. The researchers performed statistical analysis through descriptive methods.

Most patients exceeded ten years of age (63.3% of the study group) and males made up 55% of the total participants. Urban residency was more common (75%). The main causes of CKD in children were recurrent urinary tract infections experienced by 50% of patients and vesicoureteral reflux discovered in 25% of cases. About sixty percent of patients showed reduced glomerular filtration rate which was diagnosed as less than 90 mL/min/1.73 m² and forty-one percent of these patients were classified in Stage 3 CKD. The research showed Anemia affected 96.7% of patients and hypertension existed in 33.3% of patients. The evaluated cases showed that cardiovascular disease occurred as a comorbidity in 30% of patients.

Most pediatric patients with CKD in this study population developed their condition due to preventable causes particularly UTIs and VUR but received diagnoses in moderate to advanced disease stages. Early detection alongside better urological treatments with focused intervention strategies must be promoted to improve patient outcomes because hypertension and anemia exist at high levels.

Key points: Chronic Kidney Disease, Pediatrics, Epidemiology, Iraq, Glomerular Filtration Rate.

INTRODUCTION

The long-term deterioration of kidney function in children causes Chronic Kidney Disease which prevents the body from maintaining regular equilibrium as well as fluid regulation and waste elimination (1,2,3).

The medical definition describes this condition as persistent glomerular filtration rates (GFR) below 60 mL/min/1.73 m² lasting longer than three months. Children develop CKD mainly because of congenital abnormalities of the kidney and urinary tract (CAKUT) instead of following lifestyle-related developmental factors which cause adult CKD. The five-stage classification system of CKD has end-stage renal disease (Stage 5) as its final level which requires dialysis or transplantation while Stage 1 represents mild kidney damage (4,5,6,7).

The global frequency of pediatric CKD ranges between 15–74 per million children where boys show a higher risk due to their increased susceptibility to CAKUT. Regional variations exist in pediatric CKD causes since children in high-income nations develop CAKUT most frequently whereas glomerulonephritis along with infections pose greater risks to children in low-income countries. Better survival rates of children born with congenital kidney diseases have led to an increase in the number of patients who develop serious stages of CKD (8,9,10).

Pediatric patients develop CKD because of various reasons including birth defects of their kidney and urinary system and glomerular pathologies including focal segmental glomerulosclerosis and hereditary kidney conditions including polycystic kidney disease and systemic diseases like diabetes and lupus nephritis. The decline in kidney function progresses due to glomerular hyperfiltration together with tubulointerstitial fibrosis along with metabolic disturbances(11,12,13).

The symptoms of CKD depend on disease progress so patients can start with unnoticeable changes at initial stages before developing severe uremic symptoms that require dialysis at the last stages. The medical diagnosis relies on a mix of laboratory tests including serum creatinine measurements and eGFR results and the usage of imaging procedures such as ultrasound and a kidney biopsy(14,10).

Children with CKD experience multiple medical conditions starting from developmental problems and mineral bone disorders going to heart problems and disturbances of electrolytes alongside anemia and neurological system issues. Effective treatment of pediatric CKD requires blood pressure regulation in addition to nutritional care and may require either dialysis or kidney transplantation depending on individual needs. New progress in dialysis methods and kidney transplant procedures improves survival chances yet cardiovascular problems persist as persistent medical obstacles(15,16,17)

Science continues to find genetic markers and biomarkers for premature kidney disease progression and novel treatment approaches including stem cell discovery which offer promising prospects to enhance kidney disease care delivery for children in the future(18,19).

Methodology

The research applied a descriptive cross-sectional methodology to explore demographic traits together with etiology and clinical manifestations and laboratory results of pediatric Chronic Kidney Disease (CKD) patients found at Al-Imamain Al-Kadhimaian Medical City's Pediatrics Clinic and Al-Jawadain Dialysis Center. The research duration extended from Jan 2025 until March 2025 while the sample included 30 pediatric subjects diagnosed with CKD. Fifty meritoious patients were selected among those who visited both medical facilities during the investigation period.

Patient records and medical charts provided retrospective data collection while medical staff received necessary consent for all applicable situations. The collected demographic data included patient age and sex and place of residency between urban and rural areas. Researchers obtained information about CKD duration and origin and recorded details from clinical tests such as glomerular filtration rate (GFR) and blood pressure together with the stage of CKD at diagnosis and

hemoglobin levels as well as blood pressure measurements. Patient files used the clinical diagnoses from pediatric nephrologists to categorize CKD etiologies which included UTIs and VUR as well as other identified causes.

The combination of serum creatinine tests alongside tests of hemoglobin levels and urinalysis data enabled medical staff to compute GFR measurements and check for symptoms including anemia and hypertension. The medical staff undertook blood pressure measurements according to standard clinical procedures for CKD patients while making notes on heart disease signs through physical evaluations and imaging assessments.

Researchers conducted the analysis through basic statistical evaluation methods. The researchers used frequencies and percentages to present summary information about the categorical variables which included sex, residency status, and CKD stage. A statistical analysis of the continuous variables consisting of age, GFR, hemoglobin levels and blood pressure measurements determined their mean values and standard deviations. Researchers used SPSS software for the analysis to find most common aspects among pediatric CKD patients and to discover patterns appearing in their disease origins and clinical symptoms.

The research assessed typical comorbidities affecting children with CKD through an analysis of anemia alongside hypertension being commonly linked with CKD. Research participants received ethical treatment while maintaining complete anonymity along with complete confidentiality from the start to the finish of the research period.

Result

Table 1: Age and Residency Categories of the Study Population

Age (years)	Frequency	Percentage
< 5	1	3.3
5-10	10	33.3
> 10	19	63.3
Residency	**Frequency**	**Percentage**
Urban	15	75
Rural	5	25

In the cohort of pediatric patients with chronic kidney disease (CKD), seventy-five percent (15 out of 20) of patients lived in urban areas but rural areas included only twenty-five percent of the patients (5 out of 20). The urban predominance of patients with CKD might result from improved healthcare services in cities that aid quick detection and continuous monitoring of this disease condition. Higher population density together with referral patterns in urban areas might contribute to this pattern of distribution.

Sex distribution among the study participants revealed that males exceeded females as males composed 55% (n=11) compared to 45% (n=9) females.

The patients in the study showed extensive variation in how long they remained with CKD. Twenty-five percent of patients had been experiencing their disease for 4 years which matched the frequency of patients with 3-year and 6-year duration and 7-year duration (each present in 15% of participants). Other patients with CKD had disease durations of 1, 2, 5, 8, and 11 years according to the reports of 2 individuals (10%).

Table 2: Distribution of CKD Duration in the Study Population

Duration of CKD (year)	Frequency	Percentage
< or = 1	3	16.67
1-5	12	66.67
5-10	2	11.1
>10	1	5.56

The primary reason for chronic kidney disease development (CKD) among this group of patients were recurring urinary tract infections (UTIs) which affected 50% (n=12) of the cases. Among the studied patients 25% (n=7) experienced VUR in both kidneys while 10% (n=4) were diagnosed with FSGS and 10% (n=4) had a neurogenic bladder with VUR and 5% (n=3) presented with isolated VUR.

Thirty percent (n=6) of patients with heart disease were present whereas 70 percent (n=14) patients did not show heart disease among the cohort.

Table 3: Cardiovascular Comorbidity Among Pediatric CKD Patient

Heart Disease	Frequency	Percentage
No	14	70
Yes	6	30

The GFR analysis demonstrated reduced kidney function by showing that 60% (n=18) of patients had GFR levels less than 90 mL/min/1.73 m² along with normal or near-normal GFR (≥ 90 mL/min/1.73 m²) in 40% (n=12) of the participants.

The blood pressure check revealed hypertension in 33.3% (n=10) of children with normal blood pressure found in 66.7% (n=20) of patients. The patients displayed an average systolic blood pressure of 109.67 mmHg along with an average diastolic pressure of 75 mmHg.

The collected data indicated that Stage 5 represented 17% (n=5) of patients and Stage 4 represented 28% (n=8) of patients followed by Stage 3 at 41% (n=12) and Stage 2 at 14% (n=5) of patients. This showed that most children suffered from advanced stages of CKD.

The two main contributors to CKD etiology were bilateral vesicoureteral reflux (VUR) and recurrent urinary tract infections (UTIs) because they were present in 33.3% (n=10) of patients. Out of all patients examined 23.3% had neurogenic bladder with VUR whereas 10% displayed Focal Segmental Glomerulosclerosis (FSGS).

Laboratory findings showed anemia in nearly all patients with 96.67% (n=29) having blood levels below 12 g/dL. Among all subjects only one patient exhibited a blood level that exceeded 12 g/dL.

DISUCSSION

Pediatric patients having chronic kidney disease presents as a major public health problem because it damages their normal growth and interrupts their brain development as well as their life quality. The study results revealed that sixty percent of patients were beyond 10 years of age according to Warady et al.'s findings about late childhood and adolescent age groups facing higher CKD prevalence due to progressive renal conditions [20,21].

The patient demographic displayed a small population of male patients who made up 55% of the study sample and matched the findings reported by NAPRTCS for higher CKD frequency in the male population [22,23]. Medical experts attribute this sex discrepancy to the common occurrence of vesicoureteral reflux (VUR) and posterior urethral valves among male patients [24].

The majority of patients (65%) lived in urban areas where better medical facilities and diagnosis services might have prompted earlier medical interventions. Solarin et al. discovered a higher incidence of CKD among patients residing in rural locations because these areas have reduced medical services accessibility and patients tend to delay their visits to doctor [25].

Patients in this study most commonly reported a diagnosis duration of CKD at four years although some patients had been battling their condition for an extended period of time. The chronic progressive course of CKD supports the need for prompt early detection as well as continuous medical surveillance [26].

Recurrent urinary tract infections (UTIs) together with bilateral VUR represented the main causes which together explained 75% of all cases. Studies by Harambat et al. provide global support for

their findings which show that congenital anomalies of the kidney and urinary tract (CAKUT) stand as the primary reason for pediatric CKD [27]. The findings that neurogenic bladder with VUR (10%) occurred like European and Asian cohort data [28,29] along with FSGS at 10% show consistency with those studies.

Hypertension affected 33.3% of patients according to our study although the Chronic Kidney Disease in Children (CKiD) research revealed blood pressure elevation in about 50% of pediatric CKD cases [30]. The recorded blood pressure readings of 109.67 mmHg systolic and 75 mmHg diastolic indicate average blood pressure control which might result from timely medical care.

The results showed that decreased GFR values below 90 mL/min/1.73 m² affected 60% of patients. This finding matched observations from Turkish and Indian research that demonstrated delayed nephrology intervention because of substandard patient care practices [31,32].

The prevalent CKD stage among our sample was Stage 3 in which 41% of patients were included followed by Stages 4 and 5 indicating major kidney dysfunction involvement. The study outcomes show a similar pattern to the results published by Ardissino et al. who showed that children with pediatric CKD commonly fall into the Stage 3 category because of late symptom appearance due to disease progression [33].

The study revealed anemia affected 96.67% of the tested patients due to their low hemoglobin level below 12 g/dL. Previous research aligns with our findings because anemia proves to be a regular occurrence in pediatric CKD among patients whose bodies produce less erythropoietin while also sustaining iron deficiency problems [34,35].

The research demonstrates that pediatric patients need urgent detection combined with targeted prevention of treatable risks like VUR and persistent UTIs. The successful treatment and enhanced outcomes for children with CKD require standardized monitoring of renal function together with blood pressure evaluation as well as regularly tracking hemoglobin levels.

CONCLUSION

The research shows that pediatric chronic kidney disease (CKD) heavily affects children older than 10 years who present a slight male prevalence. Urinary tract infections together with bilateral vesicoureteral reflux became known as the main preventable causes behind this illness. Alternative findings of glomerular filtration rate reduction together with anemia and hypertension demonstrate how this disease progresses and highlight the requirement for early detection together with total care services. Analysis of patients revealed that most of them had moderate to advanced CKD stages which indicates nhắcelic referral and diagnostic delays.

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