



Original Research Article

Ibuprofen Use as Emerging Determinants of Acute Kidney Injury in Pakistani Children: Evidence from a Tertiary Care Center

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Abstract: Background: Pediatric kidney disease is a growing global health concern with long-term implications for the health of adults. While genetic factors are well-documented, the role of modifiable lifestyle and medication-related factors remains underexplored in specific regional contexts. **Objective:** This study investigates the prevalence and risk factors associated with Acute Kidney Injury (AKI) and chronic kidney disease (CKD) among children in District Faisalabad. **Methods:** A cross-sectional analytical study was conducted with 100 pediatric patients. Data were gathered through medical record reviews and structured questionnaires, with associations analyzed via chi-square testing. **Results:** AKI was prevalent in 71% of the cohort. Significant associations were identified between kidney disease and ibuprofen use (69%, $P=0.049$), sedentary lifestyle (60%, $P=0.01$), and cold drink consumption (58%, $P=0.036$). **Conclusion:** Modifiable risk factors, particularly NSAID exposure and lifestyle choices, are heavily linked to pediatric AKI. These findings underscore the urgent need for targeted parental education and early screening protocols.

Keywords: Pediatric Nephrology, Acute Kidney Injury, Ibuprofen, Sedentary Lifestyle, Pakistan.

INTRODUCTION

Global Burden and Pediatric Challenges Kidney disease in children is a complex and emerging global

health issue that is more common than generally perceived. However, prevalence rates vary significantly across different healthcare systems. In

developed nations, chronic kidney disease (CKD) affects approximately 1 in 1,000 children; however, in developing countries, the incidence is believed to be significantly higher due to a greater burden of untreated infections and limitations in early diagnostic capabilities (Groothoff, 2023). Unlike adults, children with kidney disease face unique developmental challenges, including growth retardation and cognitive delays, which can severely impact their long-term quality of life (Tsochatzis *et al.*, 2014). The disease presentation is often nonspecific, manifesting as fatigue or poor growth, which frequently leads to delayed diagnosis until significant renal damage has already occurred (Yen Tay *et al.*, 2020).

From Congenital to Acquired Risks Traditionally, the etiology of pediatric kidney disease has been dominated by congenital anomalies of the kidney and urinary tract (CAKUT) and genetic disorders. However, recent epidemiological trends indicate a shift toward acquired causes driven by environmental and lifestyle factors. Acute Kidney Injury (AKI), which is often precipitated by infections, dehydration, and nephrotoxic exposure, is becoming a critical area of concern. While AKI was previously considered a temporary condition, contemporary research suggests it acts as a gateway to long-term chronic pathology if not managed effectively (Patel *et al.*, 2023). Understanding the transition from acute insults to chronic disease is essential for preventing End-Stage Renal Disease (ESRD) in later life.

The Role of Nephrotoxic Medications and Lifestyle Among the acquired risk factors, the unregulated use of nephrotoxic medications poses a severe threat to pediatric renal health. Non-steroidal anti-inflammatory drugs (NSAIDs), particularly ibuprofen, are widely used for fever and pain

management in children. Studies indicate that these drugs can cause significant kidney damage over time, especially in children with pre-existing vulnerabilities or volume depletion (Hernández *et al.*, 2018). Evidence has identified NSAID use as a leading cause of pediatric AKI in emergency admissions, highlighting the dangers of self-medication (Aljinović-Vučić, 2025). Furthermore, modern lifestyle shifts, such as increased sedentary behavior and the consumption of high-phosphate cold drinks, are exacerbating metabolic risks that may compromise renal perfusion and function.

Rationale and local gap analysis Despite the rising incidence of renal dysfunction, there is a paucity of comprehensive data regarding the risk profile of children in Pakistan, particularly in industrial districts like Faisalabad. Most existing literature focuses on adult populations or specific congenital defects, leaving a gap in understanding how modifiable lifestyle factors, such as ibuprofen usage, hydration habits, and physical inactivity, contribute to the differential diagnosis of AKI versus CKD in local pediatric cohorts. Identifying these specific determinants is crucial, as early intervention can significantly reduce the risk of long-term complications and improve survival rates (Baracaldo-Santamaria *et al.*, 2022, Aljinović-Vučić, 2025).

This study was conducted to evaluate the prevalence of acute and chronic kidney disease among children in District Faisalabad and to determine the statistical association of clinical, lifestyle, and familial risk factors with renal outcomes. Specifically, this research aims to highlight the impact of modifiable risks, such as ibuprofen exposure and sedentary lifestyle, to inform better public health strategies and clinical practices in the region.

17 years using a non-probability consecutive sampling technique 3. Participants were recruited from both inpatient wards and outpatient clinics based on clinical presentation suggestive of renal involvement. To ensure the study focused on acquired and potentially modifiable risk factors, strict exclusion criteria were applied. We excluded children with congenital renal anomalies diagnosed at birth, as well as those with non-renal chronic systemic illnesses (such as congenital heart disease or chronic liver disease) that could confound the renal outcomes. Children with incomplete medical records were also omitted from the final analysis.

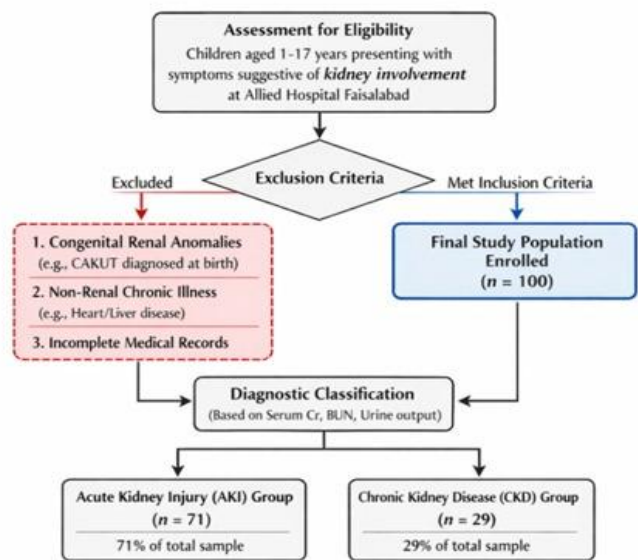
MATERIALS AND METHODS

Study Design and Setting

This cross-sectional analytical study was conducted at the Department of Nephrology, District Headquarters (DHQ) Hospital, Faisalabad. As a primary tertiary care center in an industrial hub, this setting provides a diverse demographic representation of the region. The study duration spanned three months, from March 2025 to June 2025.

Study Population and Sampling Strategy

We enrolled a total of 100 pediatric patients aged 1 to



Data Collection and Risk Assessment

Data were collected using a structured, pre-tested questionnaire administered to parents or guardians, supplemented by a comprehensive review of medical records⁷. The instrument was designed to capture three specific domains of risk:

Figure 1: Study enrollment and Diagnostic Classification

Data Collection and Risk Assessment

Data were collected using a structured, pre-tested questionnaire administered to parents or guardians, supplemented by a comprehensive review of medical records⁷. The instrument was designed to capture three specific domains of risk:

1. **Clinical History:** Documentation of previous urinary tract infections (UTIs), diabetes, hypertension, and family history of renal disease.
2. **Medication Exposure:** Specific inquiry into the frequency of nephrotoxic drug use, particularly non-steroidal anti-inflammatory drugs (NSAIDs) like ibuprofen, and the use of unverified herbal remedies.
3. **Lifestyle and Dietary Habits:** Assessment of daily water intake (hydration status), consumption of sugar-sweetened beverages (cold drinks), and physical activity levels (sedentary behavior vs. active play).

Laboratory and Diagnostic Protocol

All participants underwent a standardized clinical evaluation. Renal function was assessed via serum creatinine and blood urea nitrogen (BUN) measurements, alongside urinalysis to detect proteinuria or hematuria. Renal ultrasonography was performed to evaluate kidney structure and rule out anatomical defects. The Estimated Glomerular Filtration Rate (eGFR) was calculated using age-appropriate formulas to classify the severity of kidney dysfunction. Based on these clinical and laboratory findings, patients were stratified into two diagnostic groups: Acute Kidney Injury (AKI) or chronic kidney disease (CKD).

Statistical Analysis

Data were processed and analyzed using SPSS (Statistical Package for the Social Sciences) version 2515. Descriptive statistics (frequencies and percentages) were used to summarize demographic and clinical profiles¹⁶. The core analysis involved the Chi-square test to determine the association between categorical risk factors (e.g., ibuprofen use, sedentary lifestyle) and the type of kidney disease (AKI vs. CKD). A p-value of less than 0.05 was considered statistically significant.

RESULTS

Demographic Profile of Study Participants

A total of 100 children with confirmed renal dysfunction were enrolled in the study. The demographic analysis revealed a female predominance, with 5 of the participants being female and 41% male¹¹. The age distribution showed that renal health concerns affected all pediatric age groups, but were most frequent in late adolescence. The 16–20 age group constituted the largest proportion (31%), followed by the 0–5 and 6–10-year groups (24% each). Geographically, the majority of participants (58%) resided in rural areas, while 42% belonged to urban settings.

Table 1: Demographic Characteristics of the Study Population (N=100)

Characteristic	Category	Frequency (n)	Percentage (%)
Gender	Male	41	41.0%
	Female	59	59.0%
Age Group	0–5 Years	24	24.0%
	6–10 Years	24	24.0%
	11–15 Years	21	21.0%
	16–20 Years	31	31.0%
Residence	Rural	58	58.0%
	Urban	42	42.0%

Prevalence of Kidney Disease Types

The study found a significant predominance of acute renal conditions over chronic pathology. Out of the 100 children evaluated, 71% were diagnosed with Acute Kidney Injury (AKI), while 29% presented with chronic kidney disease (CKD), as shown in (Figure 2). This indicates that the pediatric population in District Faisalabad is disproportionately affected by acute insults rather than chronic progression.

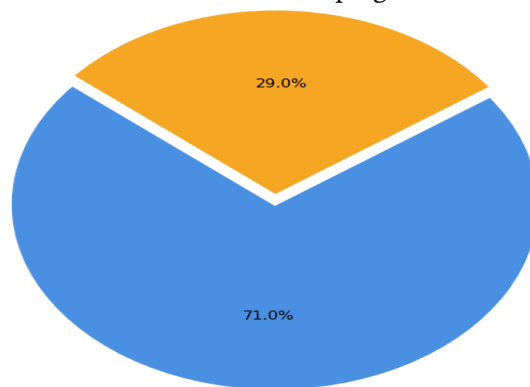


Figure 2: Gender Distribution of Study Participants (n = 100)

Prevalence of Modifiable and Clinical Risk Factors

A comprehensive screening of lifestyle, dietary, and pharmacological exposures was conducted. The analysis identified three predominant factors that exceeded a 50% prevalence rate within the study group:

- **Ibuprofen Exposure:** 69% of patients had a history of significant ibuprofen use.
- **Sedentary Lifestyle:** 60% of patients reported a lack of regular physical activity.
- **Cold Drink Consumption:** 58% of patients frequently consumed carbonated or sweetened cold drinks.

In contrast, traditional chronic risk factors such as Diabetes (4%), Family History (12%), and Dehydration (21%) were less prevalent in this specific cohort, emphasizing the unique environmental profile of the Faisalabad pediatric population. To investigate the relationship between these risk factors and the specific type of kidney disease (AKI vs. CKD), a Chi-square (X^2) test was employed. The results, detailed in **Table 2**, highlight the variables that reached statistical significance ($P < 0.05$).

Table 2: Statistical Correlation of Risk Factors with Disease Type

Risk Factor	Frequency (n)	Percentage (%)	p-value	Significance
Sedentary Behavior	60	60%	0.010	Highly Significant
Cold Drink Intake	58	58%	0.036	Significant
Ibuprofen Use	69	69%	0.049	Significant
History of UTI	28	28%	0.120	Not Significant
History of Dehydration	21	21%	0.812	Not Significant

The strong correlation between Ibuprofen uses and AKI ($P=0.049$) is particularly noteworthy for clinical practice, suggesting that over-the-counter NSAID administration may be a primary driver of acute renal failure in local

children.

Risk Factor Analysis and Disease Association

We analyzed the association between various clinical and lifestyle risk factors and the type of kidney disease and found the following variations:

Sedentary Lifestyle: A lack of physical activity was significantly associated with acute renal outcomes. A sedentary lifestyle was observed in 67% of AKI patients compared to 53% of CKD patients. The statistical analysis confirmed this association to be significant ($P=0.01$).

Ibuprofen Exposure: Use of the nephrotoxic NSAID ibuprofen was notably higher in the AKI group (77.6%) compared to the CKD group (64.7%). This difference was statistically significant ($P=0.049$), highlighting the role of NSAIDs in precipitating acute renal failure.

Cold Drink Consumption: The consumption of sugar-sweetened beverages was also identified as a significant factor ($P=0.036$), although it was prevalent across both groups. In contrast, traditional risk factors such as Diabetes ($P=0.326$), UTI history ($P=0.546$), and Family History ($P=1.000$) did not show a statistically significant difference between AKI and CKD groups, suggesting these may be generalized risks rather than specific determinants of disease type.

Table 3: Prevalence of Risk Factors Among AKI and CKD Patients

Risk Factor	AKI (%)	CKD (%)
Sedentary lifestyle	67.0	53.0
Ibuprofen use	77.6	64.7
Cold drink consumption	39.4	42.0

Statistical Significance of Associations

The Chi-square test results for the association between risk factors and kidney disease type are summarized in **Table 4**. Modifiable lifestyle factors (Sedentary behavior, Cold drinks) and medication use (Ibuprofen) showed statistically significant associations ($P < 0.05$), whereas clinical history factors did not.

Table 4: Association of Risk Factors with Kidney Disease Type (Chi-Square Analysis)

Risk Factor	Chi-Square Value (χ^2)	P-Value	Significance
Sedentary Lifestyle	6.63	0.010	Significant
Cold Drink Consumption	4.40	0.036	Significant
Ibuprofen Exposure	3.88	0.049	Significant
Diabetes	0.96	0.326	Not Significant
UTI History	0.36	0.546	Not Significant
Dehydration History	0.04	0.838	Not Significant
Family History	0.00	1.000	Not Significant

DISCUSSION

The findings of this study provide critical insights into the shifting landscape of pediatric nephrology in District Faisalabad. The most striking observation is the high prevalence of Acute Kidney Injury (AKI), which accounted for 71% of cases (Tahir et al., 2021). This suggests that pediatric renal failure in this region is primarily driven by acute, potentially reversible insults rather than long-standing congenital or genetic pathologies.

The Nephrotoxic Burden: Ibuprofen and AKI

The most clinically significant finding of this research is the strong association between ibuprofen exposure and AKI ($P=0.049$). With 69% of the total cohort and an alarming 77.6% of AKI patients reporting significant ibuprofen use, the data points toward a

crisis of NSAID-induced nephrotoxicity. Ibuprofen acts by inhibiting prostaglandin synthesis, which can lead to renal vasoconstriction and reduced glomerular filtration, particularly in children who may already be experiencing mild dehydration or infection (Shao et al., 2021, Lin et al., 2022). Our results mirror global concerns regarding the over-the-counter availability of NSAIDs; however, the prevalence in our study is notably higher than reported in Western cohorts, suggesting a localized trend of self-medication or inadequate parental awareness regarding dosage and renal safety.

Lifestyle Determinants: Sedentary Behavior and Diet

This study highlights a paradigm shift where lifestyle-related factors are now surfacing as "highly significant" determinants of pediatric renal health

($P=0.010$) (DI APERTURA and ESERCIZIO, 2022). The 60% prevalence of sedentary behavior suggests that physical inactivity is no longer just an adult metabolic concern but a pediatric renal risk factor. Furthermore, the significant association with cold drink consumption ($P=0.036$) underscores the impact of high-fructose corn syrup and phosphoric acid found in carbonated beverages (Sigala, 2020). These substances are known to induce hyperuricosuria and oxidative stress in renal tissues. The finding that 58% of children regularly consume these drinks calls for immediate public health interventions targeting school-based nutrition and dietary habits.

Demographic Vulnerabilities

The data revealed a distinct female predominance (59%) and a peak incidence in late adolescence (16–20 years, 31%) (Abreu et al., 2018). The adolescent peak may be attributed to increased autonomy in dietary and medication choices, often leading to poor nutritional habits and higher self-administration of analgesics like ibuprofen. Additionally, the finding that 58% of patients reside in rural areas suggests that limited access to specialized pediatric care and a reliance on local pharmacies for symptomatic relief may exacerbate the transition from simple infections to acute renal failure (Lynn et al., 2016).

Traditional vs. Emerging Risk Factors

Interestingly, traditional risk factors such as Diabetes ($P=0.326$) and Family History ($P=1.000$) did not show statistical significance in differentiating between AKI and CKD in this cohort (Zidan, 2023, Luo et al., 2025). This indicates that while genetics and systemic diseases are important, the immediate driver of the pediatric renal burden in Faisalabad is overwhelmingly environmental and behavioral. This acquired nature of the disease provides a unique opportunity for prevention through community education and pharmaceutical regulation.

Our findings align with recent studies suggesting that AKI is a major precursor to CKD if not managed early. The significant p-values for modifiable factors support the "AKI-to-CKD continuum" theory, where repeated acute insults such as multiple episodes of NSAID-induced stress eventually lead to permanent nephron loss.

Conclusion

This study underscores a critical transition in pediatric nephrology within the Faisalabad region, where the high prevalence of Acute Kidney Injury (71%) is significantly driven by modifiable environmental factors rather than solely by congenital pathologies. The statistically significant associations identified between renal impairment and excessive ibuprofen use ($P=0.049$), sedentary behavior ($P=0.010$), and high consumption of sugar-sweetened beverages ($P=0.036$) highlight a "triple threat" of

pharmacological and lifestyle-related risks. These findings mandate an urgent shift toward preventative public health strategies, specifically targeting parental education on NSAID safety and the promotion of active lifestyles, to mitigate the risk of acute insults progressing into lifelong chronic kidney disease.

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