# PREVALENCE OF VARIOUS METABOLIC ABNORMALITIES IN PEDIATRIC CASES OF KIDNEY STONES

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**ABSTRACT**

**Objective:** To determine the incidence of various metabolic abnormalities in pediatric cases of renal calculi.

**Place and Duration of Study:** This was a cross-sectional study conducted at Ghurki Trust Teaching Hospital, Lahore from November 2022 to April 2023.

**MATERIAL AND METHODS:** This research employed a cross-sectional study design. The sample size of 125 patients was calculated. This study included pediatric patients ranging from 1 to 18 years old who have been clinically diagnosed with kidney stones on ultrasound or non-contrast CT scans. Informed consent from parents or legal guardians is a requisite for participation. Cases without a confirmed diagnosis of kidney stones, verified through imaging studies, are excluded. Clinical and demographic data were collected using standardized forms. Information included age, gender, medical history, dietary habits, and family history of kidney stones. Statistical analyses were conducted using SPSS, comparing the prevalence of metabolic abnormalities among pediatric patients with kidney stones.

**RESULTS:** There were 55 male patients, constituting 44% of the total, and 70 female patients, representing 56% of the total. There were 90 cases with a family history of kidney stones, constituting 72% of the total, while 35 cases had no family history, accounting for 28% of the total. Study indicates that 82.4% of the studied population exhibited the presence of metabolic abnormalities, There were 65 cases of hypercalciuria, making up 52% of the total. Hyperoxaluria was observed in 50 cases, constituting 40% of the total. Additionally, hyperuricosuria was present in 40 cases, representing 32% of the total. Hypocitraturia was identified in 30 cases, accounting for 24% of the total. Hypomagnesuria was observed in 20 cases, contributing to 16% of the total.

**CONCLUSION:** In conclusion, our study highlights a significant prevalence of metabolic abnormalities, with 82.4% of the pediatric population exhibiting these conditions. The prominence of hypercalciuria underscores the importance of targeted interventions for effective management and prevention of recurrent kidney stones in children. These findings contribute valuable insights for clinicians in devising tailored strategies for improved patient care.

**KEYWORDS:** Hypercalciuria, Metabolic Abnormalities, Pediatric, Pediatric Kidney Stones, Prevalence, Prevention

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## INTRODUCTION:

Pediatric kidney stones, though relatively uncommon compared to adults, can pose significant challenges and concerns for young patients. These stones are solid crystalline masses that form in the kidneys, often resulting from the accumulation of calcium, oxalate, or other substances in the urine.[1,2] Children with kidney stones may experience symptoms such as severe abdominal pain, blood in the urine, or recurrent urinary tract infections. Understanding the underlying causes of pediatric kidney stones is crucial for effective management and prevention.[3] Metabolic abnormalities, genetic factors, and inadequate fluid intake are common contributors to stone formation in children. In some cases, a family history of kidney stones may elevate a child's susceptibility. Metabolic abnormalities, such as hypercalciuria, hyperoxaluria, or cystinuria, can also contribute to stone formation.[4] Other potential culprits include urinary tract infections, anatomical abnormalities, and certain medical conditions affecting the kidneys. The pathogenesis involves the crystallization of minerals in the urine, forming stones that may obstruct the urinary tract, leading to symptoms and complications.+ Understanding and addressing these metabolic factors are critical for accurate diagnosis and targeted treatment strategies. Comprehensive assessments, including laboratory tests and imaging studies, are essential to identify specific metabolic contributors in pediatric patients.[6,7]

A comprehensive evaluation, including imaging studies and laboratory tests, is typically conducted to identify the specific factors leading to stone development in each case. Treatment approaches for pediatric kidney stones vary depending on the size and location of the stones, as well as the underlying causes.[8,9] Management strategies encompass a spectrum of interventions, ranging from conservative measures like increased fluid intake and dietary modifications to more invasive procedures like lithotripsy or surgery in severe cases. Prevention efforts focus on addressing underlying metabolic abnormalities, promoting hydration, and fostering a kidney-friendly lifestyle to mitigate the risk of recurrent kidney stone formation in children on a global scale.[10]

The exploration of the prevalence of metabolic abnormalities in pediatric kidney stone cases is essential for a nuanced understanding of the underlying factors contributing to stone formation in young patients. This research rationale seeks to unravel the intricate relationship between diverse metabolic irregularities and the incidence of kidney stones in children. By identifying the frequency of these abnormalities, healthcare practitioners can tailor targeted interventions, improving diagnostic accuracy and treatment efficacy. This knowledge is pivotal in advancing pediatric nephrology, guiding clinicians in implementing preventive measures and personalized care plans to mitigate the impact of metabolic factors on kidney stone development in the pediatric population.

## Methodology:

This research employed a cross-sectional study design. The study adhered to ethical guidelines and obtained approval from the Institutional Review Board. The sample size of 125 patients was determined based on considerations of 95% confidence level (95%) and a margin of error of 5% (E = 0.05). This study included pediatric patients ranging from 1 to 18 years old who have been clinically diagnosed with kidney stones, a confirmation established through imaging studies, including ultrasound or non-contrast CT scans. Informed consent from parents or legal guardians is a requisite for participation. Moreover, participants are expected to willingly undergo comprehensive laboratory assessments, including serum and urine analyses, to evaluate various metabolic parameters. Patients falling outside the designated age range, either below 1 year or above 18 years, are not considered. Cases without a confirmed diagnosis of kidney stones, verified through imaging studies, are excluded.

Clinical and demographic data were collected using standardized forms. Information included age, gender, medical history, dietary habits, and family history of kidney stones. Laboratory analyses of serum and urine samples were conducted to assess metabolic parameters, including calcium, oxalate, uric acid, and relevant metabolic markers. Abdominal ultrasound and, when necessary, non-contrast computed tomography (CT) scans were performed to confirm the presence of kidney stones, determine their size and location, and assess any anatomical abnormalities.

Statistical analyses were conducted using SPSS, comparing the prevalence of metabolic abnormalities among pediatric patients with kidney stones. Descriptive statistics were employed for demographic data, and inferential statistics, such as chi-square tests and logistic regression, were used to identify associations between metabolic abnormalities and stone formation.

**RESULTS:**

The study included a total of 35 patients aged 1-5 years, 40 patients aged 6-10 years, 30 patients aged 11-15 years, and 20 patients aged 16-18 years. There were 55 male patients, constituting 44% of the total, and 70 female patients, representing 56% of the total. The duration of the disease was ≤ 6 months for 68 patients, accounting for 54.4% of the total, while > 6 months for 57 patients, making up 45.6% of the total as in table 1.

There were 90 cases with a family history of kidney stones, constituting 72% of the total, while 35 cases had no family history, accounting for 28% of the total. Diet-wise, 45 cases followed a balanced diet, representing 36% of the total, and 30 cases opted for a low-salt diet, comprising 24% of the total. Additionally, 25 cases each adhered to a high-calcium diet and a low-oxalate diet, contributing 20% each to the total. In terms of the side affected, 60 cases were associated with the left side, making up 48% of the total, 40 cases were associated with the right side, representing 32% of the total, and 25 cases were affected on both sides, accounting for 20% of the total as in table 2.

Study indicates that 82.4% of the studied population exhibited the presence of metabolic abnormalities, while 17.6% did not. There were 65 cases of hypercalciuria, making up 52% of the total. Hyperoxaluria was observed in 50 cases, constituting 40% of the total. Additionally, hyperuricosuria was present in 40 cases, representing 32% of the total. Hypocitraturia was identified in 30 cases, accounting for 24% of the total. Hypomagnesuria was observed in 20 cases, contributing to 16% of the total. In total, there were 125 cases, with each metabolic abnormality contributing to the overall percentage distribution as in table 3.

**Table 1: Demographic Characteristics of Pediatric Kidney Stone Patients**

| **Variables** | Category | Frequency (%) |
|---|---|---|
| **Age Group** | 1-5 years | 35 (28%) |
| | 6-10 years | 40 (32%) |
| | 11-15 years | 30 (24%) |
| | 16-18 years | 20 (16%) |
| Gender | Male | 55(44%) |
| | Female | 70(56%) |
| Duration of Disease | ≤ 6 months | 68 (54.4%) |
| | > 6 months | 57 (45.6%) |

**Table 2: details of family history of kidney stones, diet type, side affected by kidney stones**

| **Variables** | **Category** | **Frequency** | **Percentage** |
|---|---|---|---|
| Family History of Kidney Stones | Yes | 90 | 72% |
| | No | 35 | 28% |
| Diet Type | Balanced | 45 | 36% |
| | Low Salt | 30 | 24% |
| | High Calcium | 25 | 20% |
| | Low Oxalate | 25 | 20% |
| Side Affected | Left | 60 | 48% |
| | Right | 40 | 32% |
| | Both | 25 | 20% |

**Table 3: Metabolic Abnormalities in Pediatric Kidney Stone Patients**

| **Variables** | **Category** | **Frequency** | **Percentage** |
|---|---|---|---|
| Presence of Metabolic Abnormality | Yes | 103 | 82.4% |
| | No | 22 | 17.6% |
| Type of Metabolic Abnormality | Hypercalciuria | 65 | 52% |
| | Hyperoxaluria | 50 | 40% |
| | Hyperuricosuria | 40 | 32% |
| | Hypocitraturia | 30 | 24% |
| | Hypomagnesuria | 20 | 16% |
| | **Total** | 125 | 100% |

## DISCUSSION:

This study explores the prevalence of urinary metabolic abnormalities in pediatric patients with urolithiasis, shedding light on the intricate relationship between metabolic factors and stone formation. The relationship between metabolic abnormalities and pediatric kidney stones is a critical aspect explored in this study. The study contributes valuable insights into the prevalence and significance of specific metabolic abnormalities, guiding clinicians in devising targeted interventions for effective management and prevention of recurrent kidney stones in children.[11,12]

In our study focusing on the prevalence of urinary metabolic abnormalities in pediatric patients with urolithiasis, we observed a substantial incidence of 82.4% with varying metabolic irregularities. Hypercalciuria emerged as the most prevalent abnormality at 71%, closely followed by hyperuricosuria at 59%. Comparisons with relevant literature underscore the significance of our findings. A study by Khan et al. (2019) have indicated hypomagnesuria in 39 patients (34.51%), hypercalciuria in 54 patients (47.79%), hyperuricosuria in 21 patients (18.58%), and hypocitraturia in 64 patients (56.64%) were all noticed in this study.[13] However, our study demonstrates a notably higher occurrence of metabolic abnormalities in the studied pediatric population, shedding light on the evolving landscape of urinary stone disease in children. A different study by Velasquez-Forero et al.(2016) found that 70% of patients had hypocitraturia, 42% had hypomagnesuria, and 37% had hypercalciuria. The most common metabolic risk factors for pediatric urolithiasis were hypercalciuria (79.6% of cases) and hypocitraturia (40.9% of cases), which is not surprising considering that the rate of urine mineral excretion often decreases with age.[14]

Hypercalciuria was the most common metabolic anomaly seen, followed closely by cystinuria. The metabolic abnormalities listed by Alpay et al. (2009) are as follows: hyperuricosuria, hypocitraturia, hyperoxaluria, and hypercalciuria. hyperoxaluria(26.5%), Hypocitraturia(33.8%), hypocitraturia with Hypercalciuria (21.1%), Hyperuricosuria (25.4%), cystinuria(5.7%) and hyperphosphaturia (20.8%), were among the metabolic abnormalities detected in 87% of cases.[15] Metabolic abnormalities such as hyperuricosuria and hypocitraturia are common in children with urolithiasis who are not yet in school, according to recent findings from Turkey bu Elmaci et al. (2014). Urine chemistry values can vary due to factors such as food habits and genetics. According to a study conducted in South Korea by Kim et al. (2013), the recurrence rate for pediatric urolithiasis was 13%, which is lower than the national average of 20% to 48%. The major component of stones, according to studies, is calcium oxalate, highlighting the need of metabolic assessments in pediatric urolithiasis. Particularly, between 77% and 86% of all stones in endemic countries like Tunisia and Turkey include calcium oxalate and phosphate.[17]

Similar findings were reported in other studies by Jehan et al. (2023) & Sajid et al.(2021), emphasizing the consistent prevalence of hypercalciuria across diverse populations. Furthermore, the observed prevalence of hyperuricosuria, although varying across studies, is consistent with the understanding that it constitutes a significant metabolic risk factor in the context of urinary stone formation.[18,19]

Our study contributes valuable insights into the landscape of pediatric urolithiasis, emphasizing the need for tailored management strategies. The intricate relationship between metabolic abnormalities and stone formation underscores the importance of regular metabolic evaluations to guide preventive measures and reduce the likelihood of stone recurrence in this vulnerable population. While our study provides a detailed exploration of the prevalence of specific metabolic abnormalities, future research may delve into the nuanced interplay between these factors, considering regional and genetic influences. The comparison with existing studies highlights the dynamic nature of pediatric urolithiasis, urging continued research efforts to enhance our understanding and refine management approaches for the benefit of affected children.

## CONCLUSION:

In conclusion, our study highlights a significant prevalence of metabolic abnormalities, with 82.4% of the pediatric population exhibiting these conditions. The prominence of hypercalciuria underscores the importance of targeted interventions for effective management and prevention of recurrent kidney stones in children. These findings contribute valuable insights for clinicians in devising tailored strategies for improved patient care.

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