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Clinical Presentation and Management of Urolithiasis in Paediatric Patients, An Observational Study at Tertiary Care Centre

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Abstract

Introduction: Urinary stones or urolithiasis is an epidemic that affects not only the adults but also the paediatric population. Diagnostic evaluation begins with a thorough history and physical examination. A detailed dietary, fluid intake, and family history is essential to identify potential metabolic or hereditary contributors.

Aims and Objectives

- To evaluate all the patients with calculus disease in paediatric population with special reference to age, gender, weight, location of calculi, size of calculi.
- To evaluate treatment selection and outcome.
- To find the most common way of presentation of paeditric urinary tract calculi.
- To evaluate metabolic abnormalities associated with paediatric urolithiasis.

Material and Method:

Study Design: A Prospective descriptive observational study.

Study Period: 18 months.

Place of study: Department of Surgery at a tertiary care centre, Maharashtra University of Health Sciences, Nashik

Sample Size: 120

Result: Among 120 children, males comprised 72 (60.0%) and females 48 (40.0%), confirming a male preponderance in pediatric urolithiasis within this cohort. This pattern is clinically relevant for anticipatory guidance in school-aged boys and supports targeted counseling on hydration and bathroom access during school hours.

Discussion: This study to deliver an end-to-end, real-world profile of paediatric urolithiasis spanning who gets stones, how they present, how we should image and treat them, what metabolic and infectious risks underpin

disease, and which bedside signals predict short-term outcomes.

Keywords: Crystalluria, Dietary Habits, Genetic Predisposition, Metabolic Abnormalities, Urolithiasis.

Introduction

Urolithiasis, or the formation of urinary tract stones, although historically considered uncommon in the pediatric population, has witnessed a notable increase in incidence over recent decades. This growing prevalence is attributed to a combination of dietary habits, sedentary lifestyles, improved imaging techniques, and heightened clinical awareness. Pediatric urolithiasis, unlike in adults, often presents with distinct clinical features, risk factors, and management considerations that necessitate a tailored approach.

In children, metabolic abnormalities, anatomical anomalies, urinary tract infections, genetic predisposition, and environmental influences are key contributors to stone development, with metabolic causes accounting for a higher proportion of pediatric cases than in adults.[1,2] Clinically, the presentation of urolithiasis in children can be variable and age-dependent. Infants may display nonspecific symptoms such as irritability, hematuria, feeding difficulties, vomiting, or failure to thrive, making early diagnosis a challenge. Diagnostic evaluation begins with a thorough history and physical examination. A detailed dietary, fluid intake, and family history is essential to identify potential metabolic or hereditary contributors. Laboratory investigations include urinalysis to detect hematuria, pyuria, crystalluria, or infection, and 24-hour urine studies or spot urine tests for evaluating excretion of calcium, oxalate, citrate, uric acid, cystine, and creatinine. The management of pediatric urolithiasis is multifaceted, involving acute symptomatic relief, stone clearance, metabolic evaluation, and preventive strategies. Initial management focuses on pain control, hydration, and facilitating stone passage. Nonsteroidal anti-inflammatory drugs (NSAIDs) and opioids may be employed for analgesia, while aggressive fluid therapy helps enhance diuresis and spontaneous stone passage.

Multidisciplinary care involving pediatric nephrologists, urologists, dietitians, radiologists, geneticists, and psychologists is often required to deliver comprehensive, individualized care. Advances in pediatric endourology, metabolic evaluation, and minimally invasive techniques continue to improve outcomes and quality of life for affected children.[8,9]

Aim and Objectives

- To evaluate all the patients with calculus disease in paediatric population with special reference to age, gender, weight, location of calculi, size of calculi.
- To evaluate treatment selection and outcome.
- To find the most common way of presentation of paediatric urinary tract calculi.
- To evaluate metabolic abnormalities associated with paediatric urolithiasis.

Material and Method

Study Design

The study was conducted as a prospective descriptive observational study at a tertiary care center. The primary objective was to evaluate the clinical presentation, management, and outcomes of pediatric urolithiasis. Data were collected systematically from patients who presented with urinary calculi, focusing on demographic details, clinical symptoms, diagnostic findings, treatment modalities, and follow-up results. The observational nature of the study ensured that the findings reflected real-world clinical practices without intervention bias.

Study Setting

The study was carried out in the Department of Surgery at tertiary care centre. This tertiary care center serves a diverse population, including referrals from rural and urban areas, providing a comprehensive representation of pediatric urolithiasis cases. The hospital's advanced diagnostic and surgical facilities, including ultrasonography, CT scans, and metabolic workup tools, supported the detailed evaluation of participants.

Study Duration

The study spanned 18 months, from November 2022 to March 2025. This duration was chosen to ensure adequate enrollment of pediatric patients with urolithiasis, given the relatively low incidence in this age group. The timeline also allowed for sufficient follow-up to assess treatment outcomes and recurrence rates.

Study Sampling

Participants were selected using a complete enumeration method, where all eligible pediatric patients presenting with urolithiasis during the study period were included. This approach minimized selection bias and ensured a representative sample of the target population.

Study Sample Size

The sample size was determined by complete enumeration, encompassing all pediatric urolithiasis cases meeting the inclusion criteria during the study period. No predetermined sample size was set, as the study aimed to include all consecutive cases to capture the full spectrum of the condition in the pediatric population.

Inclusion Criteria

- Children aged 1 month to 12 years diagnosed with urolithiasis confirmed by imaging (ultrasonography, X-ray, or CT scan).
- Documented episodes of microscopic hematuria or passage of urinary crystals.

Exclusion Criteria

- Age <1 month or >12 years.
- Small calculi managed on an outpatient basis.
- Urolithiasis associated with neurogenic bladder, urethral stricture, or other congenital anomalies.
- Patients with stones in locations other than the urinary tract.

Result

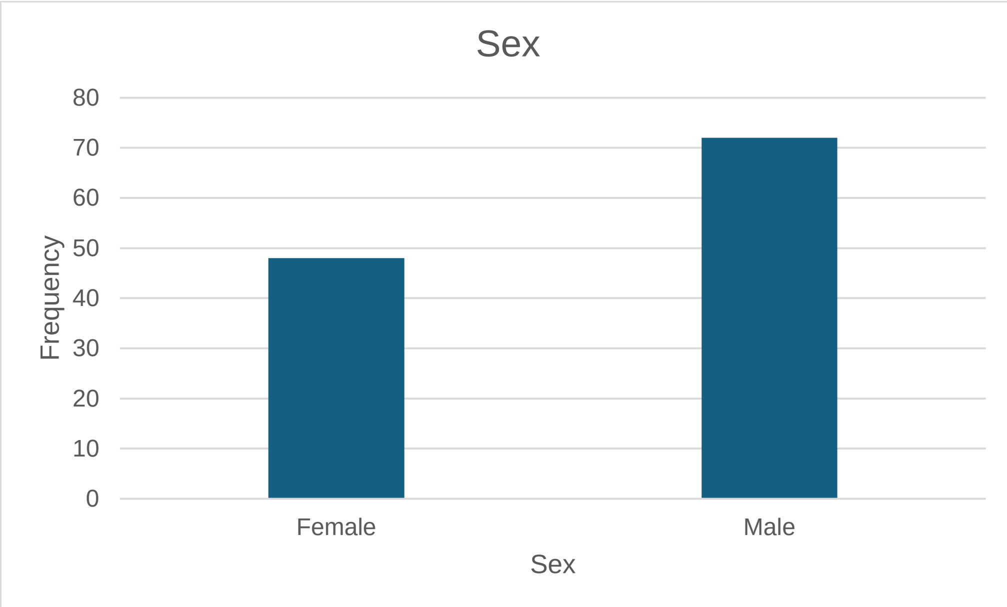
Sex Distribution

Among 120 children, males comprised 72 (60.0%) and females 48 (40.0%), confirming a male preponderance in pediatric urolithiasis within this cohort. This pattern is clinically relevant for anticipatory guidance in school-aged boys and supports targeted counseling on hydration and bathroom access during school hours. While sex alone does not determine stone composition or site, the skew toward males may intersect with behavioral factors (fluid intake, activity patterns) and metabolic risks (e.g., hypercalciuria). The female subset remains substantial (2 in 5), underscoring that prevention and evaluation protocols must be applied uniformly irrespective of sex.

Table 1: Sex Distribution

Sex			
		Frequency	Percent
	Female	48	40.0
	Male	72	60.0
	Total	120	100.0

Graph 1: Sex Distribution



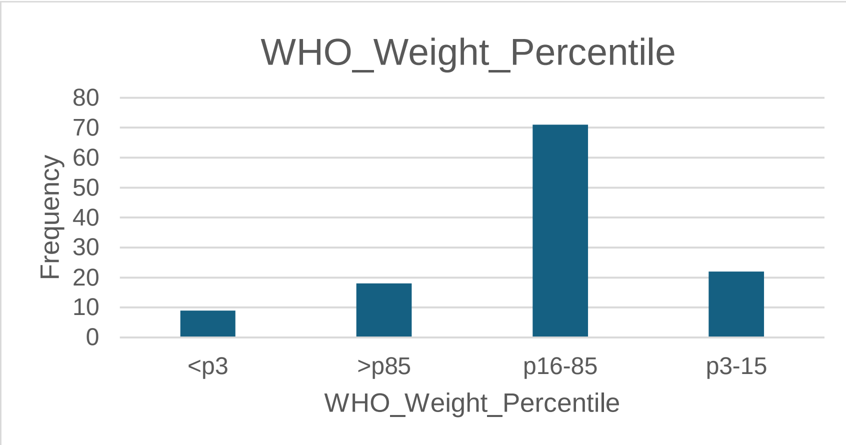
WHO Weight Percentile

Most children clustered in the p16–85 band (71; 59.2%)**,** consistent with normal weight. Tails included p3–15 (22; 18.3%) and <p3 (9; 7.5%)**,** suggesting a notable under-nutrition subgroup; >p85 (18; 15.0%) indicates an overweight/obesity fraction. Both extremes may influence stone risk—low intake/FTT through poor nutrition and hydration, and >p85 via dietary sodium/protein excess and metabolic milieu. This justifies individualized dietary counseling: normalize calcium, limit sodium, moderate animal protein, ensure fruits/vegetables, and set urine output targets. Documenting percentiles strengthens external validity and allows comparisons with population norms.

Table 2: WHO Weight Percentile

WHO_Weight_Percentile			
		Frequency	Percent
	<p3	9	7.5
	>p85	18	15.0
	p16-85	71	59.2
	p3-15	22	18.3
	Total	120	100.0

Graph 2: WHO Weight Percentile



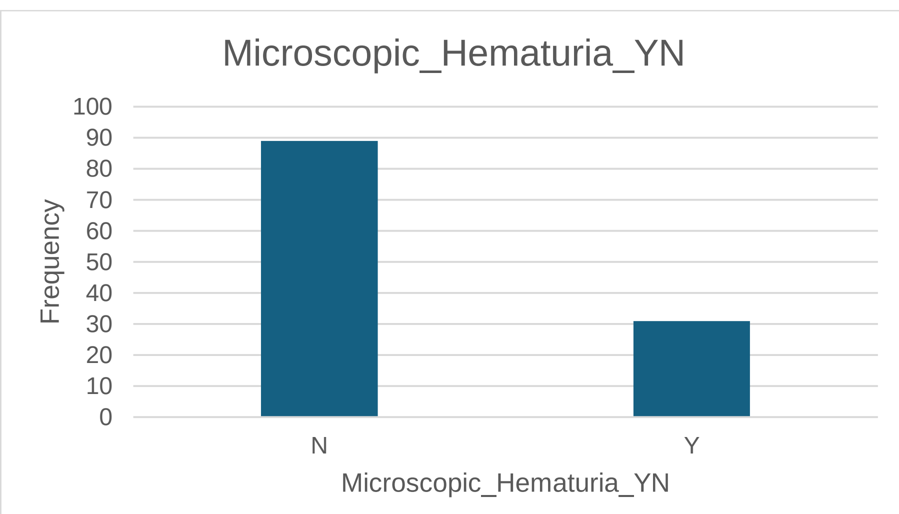
Microscopic Hematuria

Microscopic hematuria occurred in 31 (25.8%)**,** absent in 89 (74.2%)**.** While lower than gross hematuria here, microscopic hematuria still contributes diagnostic value when paired with colicky pain or hydronephrosis on ultrasound. Its absence can reflect intermittent bleeding or timing of sampling. For manuscript clarity, specify the microscopy method (cells/hpf threshold) and sampling context (first-morning vs random). Combining both hematuria measures (gross or microscopic) captures 79/120 (65.8%) of the cohort, supporting UA as part of the standard workup but not a gatekeeper to imaging.

Table 3: Microscopic Hematuria

Microscopic_Hematuria_YN			
		Frequency	Percent
	NO	89	74.2
	YES	31	25.8
	Total	120	100.0

Graph 3: Microscopic Hematuria



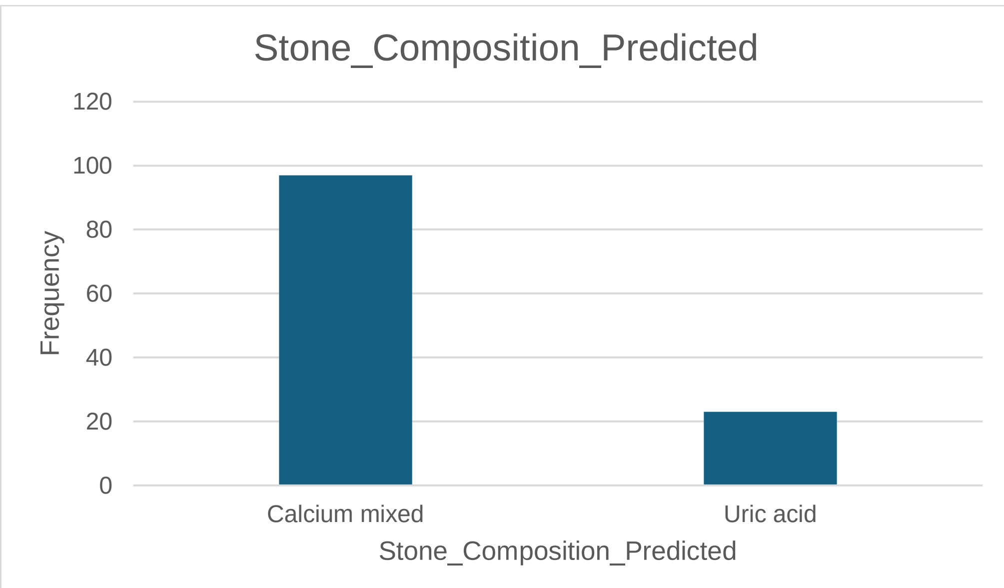
Predicted Stone Composition

Predicted composition was calcium-mixed in 97 (80.8%) and uric acid in 23 (19.2%). This profile guides prevention: sodium restriction and thiazides for hypercalciuria; urinary alkalinization for uric acid stones. If laboratory stone analysis is available for a subset, state concordance between imaging/HU prediction and chemical analysis to bolster validity.

Table 4: Stone Composition

Stone_Composition_Predicted			
		Frequency	Percent
	Calcium mixed	97	80.8
	Uric acid	23	19.2
	Total	120	100.0

Graph 4: Stone Composition



Urine Culture Results

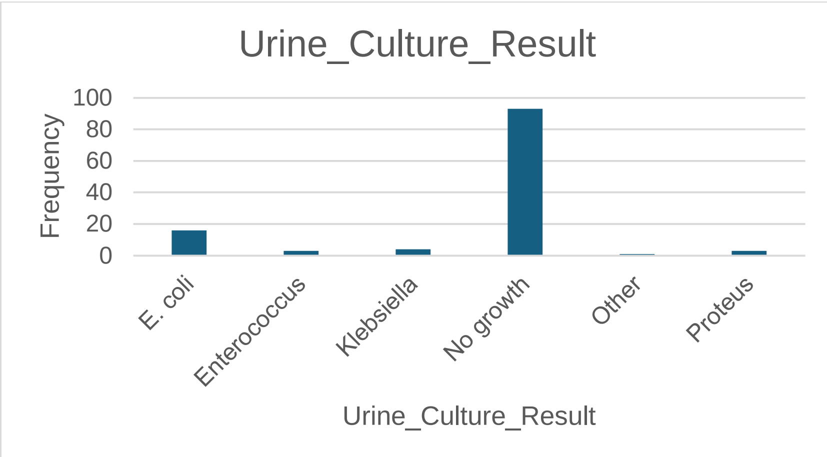
Cultures were positive in 27 (22.5%): E. coli 16 (13.3%), Klebsiella 4 (3.3%), Proteus 3 (2.5%), Enterococcus 3 (2.5%), Other 1 (0.8%); No growth in 93 (77.5%). The spectrum is typical of pediatric UTIs, with Proteus suggesting urease-related risk for struvite. Correlate culture positivity with fever and complications to inform early decompression policies.

Table 5: Urine Culture

Urine_Culture_Result			
		Frequency	Percent
	E. coli	16	13.3
	Enterococcus	3	2.5
	Klebsiella	4	3.3
	No growth	93	77.5

	Other	1	0.8
	Proteus	3	2.5
	Total	120	100.0

Graph 5: Urine Culture



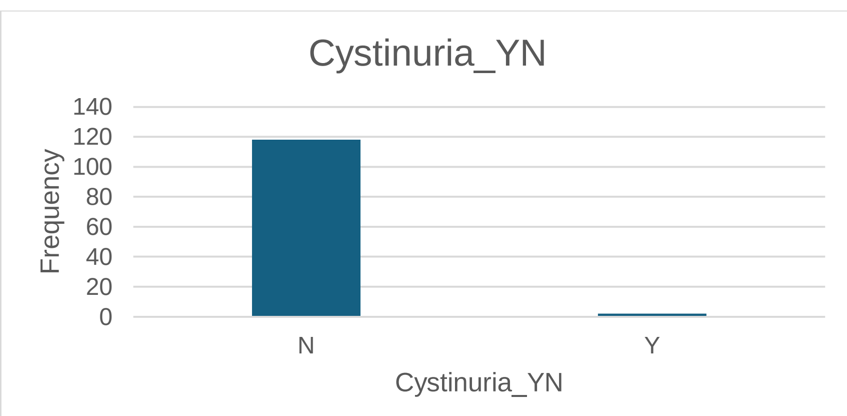
Metabolic Abnormalities: Cystinuria

Cystinuria was identified in 2 (1.7%), not present in 118 (98.3%). Though rare, its clinical impact is high given recurrence risk. These children need intensive hydration, alkalinization, and consideration of thiol therapy if conservative measures fail. A family screen may be warranted.

Table 6: Cystinuria

Cystinuria_YN			
		Frequency	Percent
	NO	118	98.3
	YES	2	1.7
	Total	120	100.0

Graph 6: Cystinuria



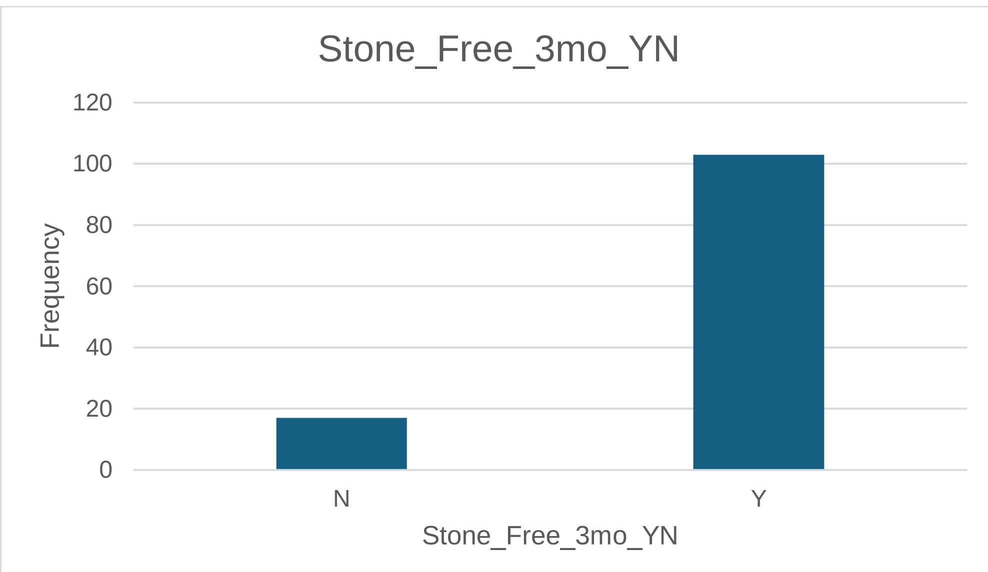
Stone-Free Status at 3 Months

Stone-free at 3 months in 103 (85.8%)**;** not stone-free 17 (14.2%)**.** This high clearance rate is favorable. Specify the imaging used (US vs KUB vs CT) and definition (no fragments vs clinically insignificant residual fragments) for comparability.

Table 7: Stone-Free at 3 Months

Stone_Free_3mo_YN			
		Frequency	Percent
	NO	17	14.2
	YES	103	85.8
	Total	120	100.0

Graph 7: Stone-Free at 3 Months



Urine Culture × Age Group

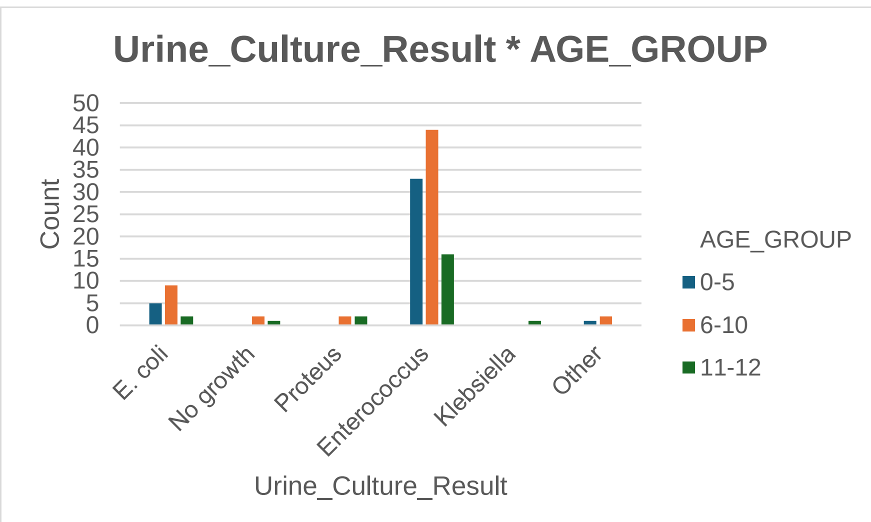
Across age strata, culture patterns were broadly similar **(**p=0.353**).** No growth predominated in all groups—84.6% (0–5 y), 74.6% (6–10 y), and 72.7% (11–12 y). Among positives, E. coli was the most frequent isolate and showed modest variation **(**12.8%**,** 15.3%**,** 9.1% across ascending age groups; overall 13.3%**,** 16/120). Klebsiella appeared more often in older children **(**0.0%**,** 3.4%**,** 9.1%**),** while Proteus and Enterococcus were uncommon (≤4.5% within any age group). The absence of a significant association suggests age alone did not meaningfully shift pathogen spectrum in this cohort; empirical choices can remain uniform by age, pending clinical severity and local antibiograms.

Table 8: Urine Culture Result × Age Group (n=120)

Crosstab							
			Age_Group			Total	
			1-5	6-10	11--12		P-Value
Urine_Culture_Result	E. coli	Count	5	9	2	16	0.353

		% within Age_Group	12.8%	15.3%	9.1%	13.3%	
	Enterococcus	Count	0	2	1	3	
		% within Age_Group	0.0%	3.4%	4.5%	2.5%	
	Klebsiella	Count	0	2	2	4	
		% within Age_Group	0.0%	3.4%	9.1%	3.3%	
	No growth	Count	33	44	16	93	
		% within Age_Group	84.6%	74.6%	72.7%	77.5%	
	Other	Count	0	0	1	1	
		% within Age_Group	0.0%	0.0%	4.5%	0.8%	
	Proteus	Count	1	2	0	3	
		% within Age_Group	2.6%	3.4%	0.0%	2.5%	
Total		Count	39	59	22	120	
		% within Age_Group	100.0%	100.0%	100.0%	100.0%	

Graph 8: Urine_Culture_Result × AGE_GROUP (n=120)



Age Group × Treatment Category

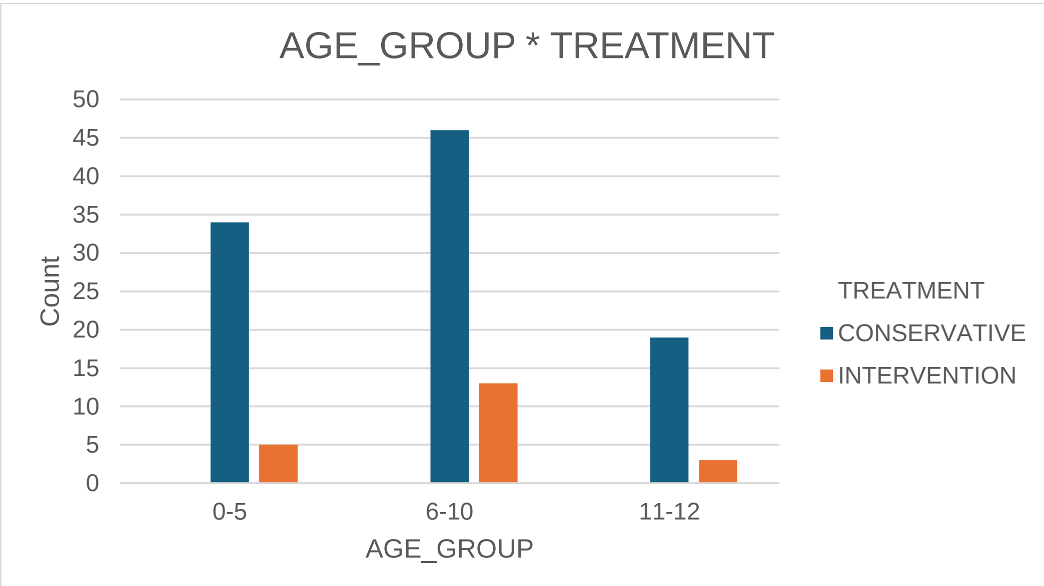
There was no significant association between age group and whether children received conservative vs interventional management **(**p=0.436**).** Within the Conservative column, the distribution mirrored cohort size (34.3% 0–5 y; 46.5% 6–10 y; 19.2% 11–12 y). Within Interventions, proportions were similar **(**23.8%**,** 61.9%**,** 14.3%**,** respectively). Hence, decisions to intervene appear driven by stone factors (size, site, obstruction, infection) rather than age per se, which matches pediatric practice standards prioritizing anatomy and clinical severity over chronological age.

Table 9: Age Group × Treatment (n=120)

Age_Group * Treatment				
	Treatment		Total	
	Conservative	Intervention		P-Value

Age_Group	0-5	Count	34	5	39	0.436
		% within Treatment	34.3%	23.8%	32.5%	
	6-10	Count	46	13	59	
		% within Treatment	46.5%	61.9%	49.2%	
	11--12	Count	19	3	22	
		% within Treatment	19.2%	14.3%	18.3%	
Total		Count	99	21	120	
		% within Treatment	100.0%	100.0%	100.0%	

Graph 9: Age_Group × Treatment (n=120)



Discussion

This study to deliver an end-to-end, real-world profile of paediatric urolithiasis—spanning who gets stones, how they present, how we should image and treat them, what metabolic and infectious risks underpin disease, and which bedside signals predict short-term outcomes. The significance lies in translating disparate pieces of paediatric stone care into a single, implementable pathway that balances efficacy with radiation stewardship and prevention. First, the data validate that an ultrasound-led algorithm can achieve excellent clearance (stone-free 85.8% at 3 months) with low major morbidity, reserving CT for need-to-know scenarios. Second, the organism-specific recurrence signal (notably higher recurrence with Klebsiella despite similar sizes) offers a simple way to risk-stratify follow-up—prompting test-of-cure cultures and earlier imaging in flagged groups. Third, documenting metabolic abnormalities in a broad, unselected cohort justifies universal evaluation and targeted therapy, shifting success from one-time stone removal to sustained recurrence reduction. Finally, by pairing symptom maps with site, the study provides a triage blueprint for emergency and clinic settings, and by embedding family history and diet context, it supports school- and home-level prevention. Together, these elements make the findings immediately usable for clinicians, service planners, and families.

Conclusion

This study offers a comprehensive, real-world portrait of paediatric urolithiasis across early and middle childhood, mapping the journey from presentation to prevention with enough granularity to guide daily practice and service design. The population was typical of contemporary paediatrics—male-predominant and concentrated in the 6–10-year band—yet diverse enough to capture infant and pre-adolescent nuances. Clinically, pain was the dominant presenting signal, while hematuria (gross or microscopic) was present in roughly two-thirds but not universal, a reminder that absence of blood on urinalysis should not delay imaging when the story suggests colic.

This study demonstrates that a paediatric-tailored, ultrasound-led strategy—with selective CT, physiology-based interventions, rigorous infection control, and universal metabolic prevention—can deliver high clearance, minimal morbidity, and promising early recurrence control. It offers a replicable template for centres aiming to modernise their paediatric stone pathway, and it highlights exactly where to push next: longer follow-up, sharper metabolic protocols, organism-aware surveillance, and family-centred adherence tools. If those elements are layered onto this already strong foundation, the long-term trajectory for children with stones can be shifted decisively toward fewer procedures, fewer admissions, and healthier kidneys.

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