Section: Paediatrics

Original Research Article

PROFILE OF RENAL TRACT ANOMALIES IN CHILDREN PRESENTING WITH URINARY TRACT INFECTION

A. Padmavathi[1], A. Selvi[2], P. Ananthi[3]

[1]Assistant Professor, Department of Paediatrics, Kilpauk Medical College Hospital, Tamilnadu, India.
[2]Assistant Professor, Department of Paediatrics, Stanley Medical College and Hospital, Tamilnadu, India.
[3]Assistant Professor, Institute of Social Paediatrics, Stanley Medical College and Hospital, Tamilnadu, India.

Received : 11/10/2025
Received in revised form : 01/12/2025
Accepted : 18/12/2025

Keywords:
Bacterial Infections; Child; Escherichia coli; Kidney Abnormalities; Urinary Tract Infections; Vesicoureteral Reflux.

Corresponding Author:
Dr. A.Padmavathi,
Email: doctorpadmavathi6681@gmail.com

DOI: 10.47009/jamp.2026.8.1.2

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2026; 8 (1); 7-11

ABSTRACT

Background: Urinary tract infections (UTI) are common in children and may be associated with underlying renal tract abnormalities that can lead to long-term kidney damage. Early identification of structural problems helps guide treatment and prevent complications. This study aimed to describe the pattern of renal tract anomalies in children with culture-proven UTI and to assess their distribution by age, sex, symptoms, and causative organisms. **Materials and Methods:** A prospective observational study was conducted at the Institute of Child Health and Hospital for Children, Chennai, involving 271 children aged one month to 18 years with confirmed urinary tract infections. All children underwent urine culture, ultrasonography, micturating cystourethrogram, and DMSA scan. Data were analysed using descriptive statistics and the chi-square test. **Result:** Of the 271 children, 148 (54.6%) were girls and 123 (45.4%) were boys. Renal tract anomalies were detected in 104 children (38.4%). Upper tract abnormalities were identified in 43 (41.3%), lower tract anomalies in 18 (17.3%), and vesicoureteric reflux in 42 (40.4%), with most cases being unilateral (83.3%). Younger children showed higher rates of vesicoureteric reflux (60%), while upper tract abnormalities were more frequent in older children (59.1%). First-episode infections were more common, affecting 205 children (75.6%). Fever was the leading symptom, present in 84 children (80.7%) with anomalies. *Escherichia coli* was the predominant organism, found in 57 children (54.8%) with anomalies and 94 (56.3%) without. **Conclusion:** A significant number of children with UTI had renal tract abnormalities, emphasising the need for early imaging to prevent long-term renal complications.

INTRODUCTION

Urinary tract infections (UTIs) are among the most common bacterial infections in children and can be either symptomatic or asymptomatic. Repeated infections can lead to renal scarring, hypertension, and later renal impairment. UTIs involve either the kidneys (pyelonephritis) or the bladder (cystitis) and may be classified as simple or complicated, and as first or recurrent episodes. Recurrent infections may occur due to incomplete treatment, persistent organisms, or reinfection with new strains.[1] A UTI is confirmed when significant bacterial growth is detected in a urine culture. Complicated infections present with high fever, persistent vomiting, dehydration, or flank pain, whereas simple infections are usually limited to dysuria, urgency, and mild fever.[2]

The incidence of UTI in children ranges between 2.4% and 2.8% annually.[1] The pattern varies with age and sex. Male infants below one year have a higher risk, mainly due to structural abnormalities, while females show increased prevalence after infancy because of shorter urethral length and greater periurethral colonisation.[3] Escherichia coli (E. coli) is the major pathogen across all age groups. Other Gram-negative and Gram-positive organisms may also cause infection in children, particularly those with structural urinary tract abnormalities, prior instrumentation, or recurrent episodes.[4] Most infections begin when bacteria move upward from the perineal region. Normal urine flow, acidic pH, and host defence proteins limit this ascent, whereas bacterial fimbriae and toxins promote attachment and invasion.[5]

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Congenital problems such as vesicoureteric reflux, ureteropelvic junction obstruction, posterior urethral valves, megaureter, and ectopic ureter increase susceptibility. Functional issues including neurogenic bladder, incomplete emptying, and constipation also contribute. Poor perineal hygiene and immunosuppression raise the risk in some children as well.[6] UTI symptoms vary with age. Infants may show non-specific features such as fever, irritability, diarrhoea, jaundice, or poor feeding. Older children are more likely to describe dysuria, urinary frequency, abdominal pain, or flank tenderness.[7] Signs such as poor growth, an abdominal mass, or elevated blood pressure can indicate renal involvement.

Accurate diagnosis depends on proper urine collection and culture. Suprapubic aspiration and catheterised specimens offer the most reliable samples. Urinalysis findings white cells, bacteria, leukocyte esterase, or nitrites support the diagnosis.[8] Imaging is used to detect underlying anatomical abnormalities, especially in young children or those with repeated infections. Ultrasound is performed first, and a micturating cystourethrogram or dimercaptosuccinic acid (DMSA) scan is added when indicated.[9] Management includes oral antibiotics for stable cases, while infants and children with complicated infections require parenteral therapy. Prophylactic antibiotics may be considered for children with reflux, renal scarring, or recurrent febrile UTIs.[10]

This study aimed to describe renal tract anomalies in children with culture-proven UTI, focusing on their incidence, age-sex patterns, presenting symptoms, causative organisms, and the value of imaging in detecting underlying abnormalities.

MATERIALS AND METHODS

This non-randomized, non-controlled prospective study was conducted on 271 children and was carried out in the Outpatient Department, Paediatric Ward, Laboratory Services, and Radiology Department of the Institute of Child Health and Hospital for Children, Chennai. Ethical approval was obtained, and informed consent was obtained from each child's parent or guardian.

Inclusion Criteria

Children aged 1 month to 18 years had a first or recurrent UTI, growth of a single organism on culture, and completed USG, MCU, and DMSA imaging were included.

Exclusion Criteria

Children had a hospital-acquired infection, immunosuppressed, negative cultures despite symptoms, already had major kidney problems, or, if their parents did not give consent, were excluded.

Methods

Data were recorded for symptoms including fever, irritability, poor feeding, vomiting, dysuria, and urine that was foul-smelling or unusually dark. Each child had a clinical examination, and blood pressure was measured as part of the assessment. Laboratory evaluation included urinalysis and renal function tests. Complete blood counts, ESR, and blood culture were done when clinically indicated.

Urine collection was performed according to the child's age. Children <3 years gave a clean-catch midstream sample. Younger children had samples taken by suprapubic aspiration, catheterisation, or clean-catch methods. Bag samples were avoided. Significant growth was defined as any growth in suprapubic samples, > 10^3 CFU/mL in catheter samples, and > 10^5 CFU/mL in clean-catch samples. A UTI was diagnosed when a single organism grew on culture.

Confirmed cases underwent ultrasonography, and voiding cystourethrography was performed after recovery or with antibiotic cover when necessary. Contrast was introduced using urograffin 30%, and reflux was graded using standard criteria. Treatment followed culture sensitivity, and children with abnormal imaging received 14 days of antibiotics.

Statistical Analysis

Data were analysed using IBM SPSS Statistics v27. Data were expressed as frequencies and percentages, and comparative analysis was done using the chi-square test, and a $p<0.05$ was taken as statistically significant.

RESULTS

Among the children, 148 (54.6%) were girls, and 123 (45.4%) were boys. Renal tract anomalies were identified in 104 children (38.4%), while 167 (61.6%) had no detectable abnormalities. Upper tract anomalies were the most common 43 (41.34%), VUR 42 (40.38%), lower tract 18 (17.3%), and combined 1 (0.96%). Fever was the main symptom, seen in 84 children (80.76%). Dysuria was reported in 5 children (4.8%), while smaller numbers had diarrhoea and pyuria in 3 children (2.88%) and irritability in 3 children (1.92%). [Table 1]

Table 1: Distribution of sex, renal tract anomalies, and symptoms in children with UTI

Parameter	Category	N (%)
Sex (n=271)	Male	123 (45.4%)
	Female	148 (54.6%)
Incidence of renal tract anomalies (n=271)	With	104 (38.4%)
	Without	167 (61.6%)
Type of anomaly (n=104)	Upper tract anomalies	43 (41.34%)
	Lower tract anomalies	18 (17.3%)
	Combined anomalies	1 (0.96%)
	Vesicoureteric reflux	42 (40.38%)

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Symptoms (n=104)	Fever	84 (80.76%)
	Irritability	3 (1.92%)
	Diarrhoea	3 (2.88%)
	Poor feeding	1 (0.96%)
	Vomiting	1 (0.96%)
	Dysuria/screaming	5 (4.8%)
	Increased frequency	1 (2.88%)
	Enuresis	1 (0.96%)
	Failure to thrive	2 (1.92%)
	Pyuria	3 (2.88%)

Children aged 1 month–3 years accounted for 55 cases (52.9%), while those aged 3–18 years comprised 49 cases (47.1%). By sex, upper tract anomalies were found in 18 boys (36.7%) and 25 girls (45.5%), while vesicoureteric reflux occurred in 19 boys (38.8%) and 23 girls (41.8%) ($p = 0.24$). First UTIs were more frequent, occurring in 95 boys (35.05%) and 110 girls (40.6%), while recurrent infections were less common, seen in 28 boys (10.3%) and 38 girls (14.02%). Among children with renal anomalies, first infections also predominated, affecting 38 boys (36.5%) and 41 girls (39.4%). [Table 2]

Table 2: Distribution of age, sex, anomaly type, and UTI pattern

Parameter	Category	Male	Female	P value
Age group (n=104)	1 month–3 years	24 (23.07%)	31 (29.8%)	-
	3–18 years	25 (24.04%)	24 (23.07%)	
Type of anomaly by sex (n=104)	Upper tract anomalies	18 (36.7%)	25 (45.5%)	0.24
	Lower tract anomalies	12 (24.5%)	6 (10.9%)	
	Combined anomaly	0	1 (1.8%)	
	Vesicoureteric reflux	19 (38.8%)	23 (41.8%)	
UTI type (n=271)	First	95 (35.05%)	110 (40.6%)	-
	Recurrent	28 (10.3%)	38 (14.02%)	
Children with renal anomalies (n=104)	First UTI	38 (36.5%)	41 (39.4%)	-
	Recurrent UTI	11 (10.61%)	14 (13.5%)	

Upper tract anomalies were more common in older children, with 29 cases (59.1%) compared with 14 cases (25.5%) in younger children. Vesicoureteric reflux was more frequent in younger children, affecting 33 (60%) compared with 9 (18.4%) older children ($p < 0.001$). [Table 3]

Table 3: Distribution of urinary tract anomalies by age group (n=104)

Anomalies		1 month - 3 years	3 years - 18 years	p value
Type of anomaly by age	Upper tract anomalies	14 (25.5%)	29 (59.1%)	<0.001
	Lower tract anomalies	7 (12.7%)	11 (22.4%)	
	Combined anomaly	1 (1.8%)	0	
	Vesicoureteric reflux	33 (60%)	9 (18.4%)	

Upper-tract anomalies were found in 43 children (41.3%), most commonly pelvi-ureteric junction obstruction, 29 cases (27.88%). Lower-tract anomalies occurred in 18 children (17.3%), mainly neurogenic bladder and posterior urethral valves, 8 cases each (7.69%). Vesicoureteric reflux was present in 42 children (40.4%), usually unilateral in 35 cases (83.3%). Only one child (0.96%) had a combined anomaly. [Table 4]

Table 4: Distribution of renal tract anomalies and their subtypes (n=104)

Category	Specific anomaly	N (%)
Upper tract anomalies (n=43)	Pelviureteric junction obstruction	29 (27.88%)
	Ectopic kidney	2 (1.92%)
	Duplex collecting system	2 (1.92%)
	Horseshoe kidney	1 (0.96%)
	Bilateral congenital dysplastic kidney	4 (3.84%)
	Unilateral congenital dysplastic kidney	2 (1.92%)
	VUJ calculus obstruction	2 (1.92%)
	Primary megaureter	1 (0.96%)
Lower tract anomalies (n=18)	Neurogenic bladder	8 (7.69%)
	Posterior urethral valve	8 (7.69%)
	Urethrocele	1 (0.96%)
	Urethral fistula	1 (0.96%)
Combined anomaly		1 (0.96%)
Vesicoureteric reflux (n=42)	Bilateral VUR	7 (16.66%)
	Unilateral VUR	35 (83.33%)

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Escherichia coli was the most frequent organism, identified in 57 children with renal anomalies (15.56%), respectively, and Pseudomonas in 13 (12.5%) and 24 (14.37%), while all other organisms appeared only in small numbers. [Table 5]

(54.8%) and 94 without anomalies (56.28%). Klebsiella was found in 23 (22.11%) and 26

Table 5: Distribution of microorganisms in children with and without renal anomalies (n=271)

Microorganism	Renal anomalies N (%)	
	With	Without
E. coli	57 (54.8%)	94 (56.28%)
Klebsiella	23 (22.11%)	26 (15.56%)
Pseudomonas	13 (12.5%)	24 (14.37%)
Staphylococcus	1 (0.96%)	2 (1.19%)
Enterococcus	1 (0.96%)	4 (2.39%)
Proteus	6 (5.76%)	13 (7.78%)
Candida	2 (1.92%)	3 (1.79%)
Citrobacter	1 (0.96%)	1 (0.59%)

DISCUSSION

This study aimed to investigate renal tract anomalies in children aged one month to 18 years who had culture-proven UTIs. Renal abnormalities were found in over one-third of the children, with upper tract problems reported most often. Vesicoureteric reflux was prevalent in younger children. Fever was the main presenting symptom, and E. coli was the leading pathogen. MCU showed more reliability than ultrasound in identifying reflux.

Our study shows that girls were a predominant that of the affected group than boys. Renal tract anomalies were found in a significant portion of the children, while the remainder showed no structural abnormalities. Similarly, Zorc et al. reported that, among febrile infants younger than 60 days, urinary tract infection occurred in 21.3% of uncircumcised boys, 5% of girls, and 2.3% of circumcised boys.[11] Verma, in a study, observed that, during the first six years of life, UTIs occur in about 2% of boys and 7% of girls.[12] Therefore, these studies showed higher UTI rates in uncircumcised infant boys and female predominance after infancy, consistent with our findings, highlighting girls' greater susceptibility and the need for timely evaluation and imaging in this group.

In our study, upper tract abnormalities appeared more often in older children, whereas vesicoureteric reflux was observed more frequently in younger children. When compared by sex, upper tract abnormalities and vesicoureteric reflux showed no difference between children. Similarly, Mattoo found that VUR was found in about 33% of children with UTI, occurring most often in younger children, who also had a higher chance of early renal scarring.[13] Wang et al. reported that VUR occurred in 14.3% of children with UTI, and the rate was higher in infants and toddlers under two years, reaching 17.2%, compared with older children.[14] Overall, these studies support our findings, showing that VUR predominates in younger children while other abnormalities appear later, this shows the need for early imaging to ensure timely detection and prevent renal damage.

In our study, first-episode UTIs were more common than recurrent infections in children. This pattern remained consistent among children with renal anomalies, where initial episodes also predominated across both sexes. Similarly, Lizama et al., in a study of 264 culture-positive cases, UTIs were 1.78 times more common in girls, supporting the predominance of first-episode presentations.[2] These findings show that first-time UTIs predominate in children, which indicates the need for thorough evaluation during the initial episode to guide early management.

In this study, upper tract abnormalities were most common, lower tract anomalies were less frequent, and vesicoureteric reflux was often present, usually affecting one side. Similarly, Ahmadzadeh and Askarpour in children presenting with a first culture-positive UTI, renal tract anomalies were found in about 40% of cases, and pelvi-ureteric junction obstruction was one of the common abnormalities identified, 8% in girls, none in boys.[6] Blumenthal found that vesicoureteric reflux is identified in roughly 25% to 40% of children who undergo imaging after a urinary tract infection.[15] Van Batavia et al. found that in 623 children, 207 had prior UTI and 64 underwent voiding cystourethrogram (VCUG), revealing VUR in 44 (69%). Reflux was particularly frequent in girls with febrile infections, emphasising the high prevalence of VUR in this group.[16] These findings show that upper tract abnormalities and VUR are commonly detected in children evaluated for UTI's. This emphasises the need for targeted imaging, particularly in children with febrile UTI, to detect significant upper-tract anomalies and VUR early.

Our study shows that fever was the most common presenting symptom. Dysuria, diarrhoea, and pyuria were reported less often, and other signs such as irritability, poor feeding, vomiting, and enuresis appeared only occasionally. Similarly, Anis-ur-Rehman et al. among the 1,000 children, 375 had culture-confirmed UTIs (37.5%). Fever was the most frequent symptom, occurring in 91% of cases, followed by dysuria in 65% and failure to thrive in 40%.[17] Overall, these studies show that fever is the

ISSN (O): 2687-5365; ISSN (P): 2753-6556

key presenting sign, which shows a need to evaluate for UTI in children with unexplained fever.

In our study, E. coli was the primary organism in both groups, with Klebsiella and Pseudomonas occurring next, while other pathogens appeared only rarely. Similarly, Hanna-Wakim et al. found that E. coli accounted for most infections, representing 79.4% of isolates. Klebsiella species were identified in 7.9% and Proteus species in 3.9% of cases. Pseudomonas, Enterococcus, and Enterobacter appeared only infrequently.[18] Sohail et al. among the 392 culture-positive samples, E. coli was the leading pathogen, identified in 62% of cases. Enterococcus faecalis and Candida accounted for 15% and 14%, respectively, while Pseudomonas (6%) and Klebsiella species (1%) were encountered less often.[19] Together, these studies confirm E. coli as the predominant pathogen, highlighting the need for empiric therapy that provides reliable coverage against this organism.

Clinical impact

The study used a prospective design, complete imaging for every child, clear diagnostic criteria, and strong statistical methods. These ensured accurate detection of renal anomalies and reliable comparisons across age and sex.

Limitations

This study was limited by its single-centre setting, absence of long-term follow-up, and possible variation in imaging interpretation. Excluding culture-negative symptomatic children and relying mainly on hospital-based cases may also restrict how widely the findings can be applied.

CONCLUSION

This study demonstrates that a significant proportion of children with UTIs have underlying renal tract abnormalities, with vesicoureteric reflux particularly common in younger age groups. Fever emerged as the most frequent presenting feature, and E. coli was the predominant pathogen across cases. Upper tract abnormalities were more often seen in older children, while most infections represented first-episode presentations. These findings highlight the importance of immediate evaluation during the initial illness to detect structural issues early and reduce the risk of long-term renal damage. Strengthening early diagnostic practices may improve outcomes and help prevent recurrent infections. Future studies should identify long-term outcomes and conduct in larger multi-centre groups, and build predictive tools to improve early imaging and targeted care for children with urinary tract anomalies.

REFERENCES

1. Chang SL, Shortliffe LD. Pediatric urinary tract infections. Pediatr Clin North Am 2006;53:379–400, vi. https://doi.org/10.1016/j.pcl.2006.02.011.
2. Lizama C M, Luco I M, Reichhard T C, Hirsch B T. Urinary tract infection in a pediatric emergency department: frequency and clinical parameters. Rev Chilena Infectol 2005;22:235–41. https://doi.org/10.4067/s0716-10182005000300003.
3. Bonacorsi S, Lefèvre S, Clermont O, Houdouin V, Bourrillon A, Loirat C, et al. Escherichia coli strains causing urinary tract infection in uncircumcised infants resemble urosepsis-like adult strains. J Urol 2005;173:195–7; https://doi.org/10.1097/01.ju.0000148606.07267.7d
4. Qureshi AM. Organisms causing urinary tract infection in pediatric patients at Ayub Teaching Hospital, Abbottabad. J Ayub Med Coll Abbottabad 2005;17:72–4. https://pubmed.ncbi.nlm.nih.gov/15929535/.
5. Flores-Mireles AL, Walker JN, Caparon M, Hultgren SJ. Urinary tract infections: epidemiology, mechanisms of infection and treatment options. Nat Rev Microbiol 2015;13:269–84. https://doi.org/10.1038/nrmicro3432
6. Ahmadzadeh A, Askarpour S. Association of urinary tract abnormalities in children with first urinary tract infection. Pak J Med Sci. 2007;23(1):88–91. https://www.pjms.com.pk/issues/janmar07/pdf/uti.pdf.
7. Robinson JL, Finlay JC, Lang ME, Bortolussi R, Canadian Paediatric Society, Infectious Diseases and Immunisation Committee, Community Paediatrics Committee. Urinary tract infections in infants and children: Diagnosis and management. Paediatr Child Health 2014;19:315–25. https://doi.org/10.1093/pch/19.6.315.
8. Cheng Y-W, Wong S-N. Diagnosing symptomatic urinary tract infections in infants by catheter urine culture. J Paediatr Child Health 2005;41:437–40. https://doi.org/10.1111/j.1440-1754.2005.00662.x.
9. Dacher J-N, Hitzel A, Avni FE, Vera P. Imaging strategies in pediatric urinary tract infection. Eur Radiol 2005;15:1283–8. https://doi.org/10.1007/s00330-005-2702-4.
10. Nickavar A, Sotoudeh K. Treatment and prophylaxis in pediatric urinary tract infection. Int J Prev Med 2011;2:4–9. https://pmc.ncbi.nlm.nih.gov/articles/PMC3063462/.
11. Zorc JJ, Levine DA, Platt SL, Dayan PS, Macias CG, Krief W, et al. Clinical and demographic factors associated with urinary tract infection in young febrile infants. Pediatrics 2005;116:644–8. https://doi.org/10.1542/peds.2004-1825.
12. Verma A. Urinary tract infections in infants and children - Walter Bushnell healthcare foundation. Walterbushnell.com 2018. https://wbhf.walterbushnell.com/publications/pedia-flash/item/389-urinary-tract-infections-in-infants-and-children?utm_source=chatgpt.com (accessed November 20, 2025).
13. Mattoo TK. Vesicoureteral reflux and reflux nephropathy. Adv Chronic Kidney Dis 2011;18:348–54. https://doi.org/10.1053/j.ackd.2011.07.006.
14. Wang Z, Xu H, Liu H-M, Rao J, Shen Q, Cao Q. Clinical analysis of 139 cases of primary vesicoureteric reflux in children. Zhonghua Er Ke Za Zhi 2008;46:518–21.
15. Blumenthal I. Vesicoureteric reflux and urinary tract infection in children. Postgrad Med J 2006;82:31–5. https://doi.org/10.1136/pgmj.2005.036327.
16. Van Batavia JP, Ahn JJ, Fast AM, Combs AJ, Glassberg KI. Prevalence of urinary tract infection and vesicoureteral reflux in children with lower urinary tract dysfunction. J Urol 2013;190(Suppl 4):1495–9. https://doi.org/10.1016/j.juro.2013.02.016.
17. Anis-ur-Rehman, Jahanzeb M, Siddiqui TS, Idris M. Frequency and clinical presentation of UTI among children of Hazara Division, Pakistan. J Ayub Med Coll Abbottabad 2008;20:63–5. https://pubmed.ncbi.nlm.nih.gov/19024189/.
18. Hanna-Wakim RH, Ghanem ST, El Helou MW, Khafaja SA, Shaker RA, Hassan SA, et al. Epidemiology and characteristics of urinary tract infections in children and adolescents. Front Cell Infect Microbiol 2015;5:45. https://doi.org/10.3389/fcimb.2015.00045.
19. Sohail M, Khurshid M, Saleem HGM, Javed H, Khan AA. Characteristics and antibiotic resistance of urinary tract pathogens isolated from Punjab, Pakistan. Jundishapur J Microbiol 2015;8:e19272. https://doi.org/10.5812/jjm.19272v2.

ISSN (O): 2687-5365; ISSN (P): 2753-6556