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Study on Prevalence, Clinical Profile, Risk Factors and Laboratory Parameters of Urinary Tract Infection in Children Admitted with Fever in Pediatric Ward of a Tertiary Care Centre in Central Kerala, India

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ABSTRACT

Background: Urinary tract infection (UTI) is a common bacterial illness in febrile infants and young children, with a prevalence of 4.1% to 7.5%. Early diagnosis and treatment are crucial to prevent long-term complications, especially in children under two years. This study aimed to assess the prevalence, clinical profile, and risk factors of UTI in febrile children admitted to a tertiary care center and analyze the culture and sensitivity patterns of causative organisms.

Methods: A prospective study was conducted at Jubilee Mission Medical College, Thrissur, over 18 months, enrolling 504 febrile children aged over one month. Urine samples were analyzed using standard methods, with culture as the gold standard for UTI diagnosis. Exclusion criteria included lack of consent, absence of urine analysis, and treatment discontinuation. Routine investigations were performed for all UTI patients, with specialized imaging reserved for selected cases. Data obtained were statistically analysed.

Results: The prevalence of UTI among febrile children was 11.3% ($p<0.000$). The mean age was 2.57 years (SD 1.64), with most cases in children aged 1–5 years and a female predominance. Common risk factors included constipation, phimosis, poor hygiene, diaper usage, and worm infestation. Clinical features included pain during micturition (68.4%), vomiting (22.8%), and decreased urine output (7%). *E. coli* (87.7%) was the most common causative organism, sensitive to most antibiotics.

Conclusion: The significant prevalence of UTI in febrile children requires high clinical suspicion, prompt evaluation, and awareness to prevent renal complications.

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Introduction

Fever is a common presenting symptom in pediatric outpatient clinics, with urinary tract infection (UTI) being one of the most frequent bacterial illnesses in febrile infants and young children. Despite a global prevalence ranging from 2–20%, pediatric UTIs often remain underdiagnosed, particularly in infants, due to the absence of specific symptoms and signs (1). Prompt diagnosis and treatment of UTI are crucial to reducing the risk of complications such as renal scarring and hypertension.

UTI is defined as the growth of a significant number of organisms of a single species in the urine, accompanied by symptoms. Significant bacteriuria, indicative of UTI, is characterized by a colony count $>10^5$ in ml in a midstream clean-catch urine sample (2). The most common causative organisms include *E. coli* and *Klebsiella*, although emerging pathogens such as *Enterococcus* species, yeasts, and *Staphylococcus aureus* have gained prominence in recent years (3, 4).

Key risk factors for UTI include age, gender, renal anomalies, phimosis, vulval anomalies, constipation, improper perineal hygiene, diaper usage, and recent catheterization (5). In infants, urinary complaints are rare and non-specific, whereas older children often present with the classic triad of abdominal pain, vomiting, and fever accompanied by chills, rigors, or suprapubic pain. Fever with significant bacteriuria and pyuria in the absence of other infection sources should raise suspicion for pyelonephritis, which poses a substantial risk of renal scarring and subsequent complications, such as hypertension and end-stage renal disease (ESRD). Studies have highlighted unexplained renal scarring as a leading cause of ESRD and a major public health concern (6).

Urine culture remains the gold standard for confirming UTI. In symptomatic children, a colony count >50,000 Colony Forming Unit (CFU)/ml in catheterized or suprapubic aspirate samples with evidence of pyuria or bacteriuria confirms the diagnosis. Additionally, tests such as ultrasonography, voiding cystourethrography (VCUG), and radionuclide imaging are recommended after the first UTI episode to evaluate underlying anomalies (7).

The growing prevalence of antimicrobial resistance among urinary pathogens worldwide underscores the critical need for appropriate antibiotic use. Early identification of UTI-specific clinical patterns and timely, targeted treatment are essential to prevent renal complications and long-term sequelae. This study aims to evaluate the prevalence, clinical profile, and risk factors of UTI in febrile children, and analyze the culture and sensitivity patterns of causative organisms, providing valuable insights for effective diagnosis and management strategies.

Materials and Methods

This prospective study was conducted in the Paediatric Ward of Jubilee Mission Medical College and Research Institute, Thrissur, over an 18-month period, after obtaining Institutional Ethics Committee approval.

The sample size was calculated as 504, based on the prevalence of urinary tract infections (UTI) in the study "Clinical, Etiological, and Antimicrobial Susceptibility Profile of Pediatric Urinary Tract Infections in a Tertiary Care Hospital in Nepal," (1) using a 95% confidence level and a 20% relative allowable error.

Inclusion Criteria

Febrile children above 1 month of age admitted in the pediatrics ward with axillary temperature ≥37.8 °C or rectal ≥38.3 °C.

Exclusion Criteria

Children whose urine examination was not done, those who did not provide consent or who discontinued treatment.

Data Collection

All febrile children meeting inclusion criteria were investigated for UTI after obtaining parental consent and child assent. Demographic and clinical details were recorded using a structured proforma, and clinical profiles of UTI-diagnosed children were documented and analyzed. UTI was defined as the growth of a significant number of organisms of a single species in urine, accompanied by symptoms (8).

Collection, Storage and analysis of urine sample

Urine samples from 504 participants were collected after cleaning the genital area, using midstream collection or alternative methods like catheterization or suprapubic puncture when necessary. Samples were promptly transported to the lab or stored at 4 °C. Microscopic analysis (using SYSMEX and IRIS systems) and culture sensitivity testing on CLED and MacConkey agar were performed using a 0.004 ml calibrated wire loop and incubated aerobically at 37 °C for 24 hours. Blood tests and renal function tests were done as needed, and all UTI cases underwent ultrasound for KUB anomalies, with additional imaging like MCU, renogram and IVP performed when indicated.

Outcome Measurement

Clinical data included demographic details, risk factors (e.g., renal anomalies, phimosis, constipation), symptoms of UTI, urine analysis, USG findings, history of previous UTI, antibiotics used, and outcomes (cured, expired, or hospital stay duration). Cure was defined as being asymptomatic with urine microscopy showing <10 WBCs/HPF. Repeat urine cultures were done only if clinically indicated.

Data Analysis

Descriptive statistics were used to analyze the prevalence and clinical profile of febrile UTI in children over one month of age, with frequency and percentages for categorical variables and means and standard deviations for numerical variables. Chi-square tests were applied to assess associations between clinical profiles and UTI prevalence.

Results

In this study, around 11.3% of the patients admitted with fever have UTI and 88.7% of the cases have no UTI. This shows that the prevalence of UTI among febrile children was significant in our study.

In this study, the average age of children with UTI was 2.57 years (SD ±1.64), with ages ranging from 5 months to 7 years. A statistically significant difference in UTI prevalence was observed across age groups ($p < 0.05$). Notably, UTI prevalence was highest among females aged 1–5 years (63.2%), highlighting a significant age and gender association (Fig 1).

Table 2 highlights significant risk factors for UTI, including phimosis (3.5%), back-to-front perineal cleaning (8.8%), diaper usage (14.0%), and worm infestation (21.1%). While constipation (52.6%) and reduced water intake (38.6%) were associated with higher UTI prevalence, these factors did not reach statistical significance.

Table 3 shows that UTI prevalence was significantly associated with clinical features such as pain during micturition (68.4%), vomiting (22.8%), dribbling of urine (5.3%), decreased urine output (7.0%), chills and rigor (8.8%), irritability (3.5%), and diarrhea (3.5%). However, increased frequency of micturition was not found to be a statistically significant clinical feature.

Table 4 reveals a strong association between fever characteristics and UTI prevalence. Severe fever was significantly more prevalent in children

Table 1. Study definition of UTI in this study.

Method of collection	Colony count	Probability of infection
Suprapubic aspiration	Any number of pathogens	99%
Urethral Catheterization	>5 . 10^4 CFU/mL	95%
Midstream clean catch	>10^5 CFU/mL	90 - 95%

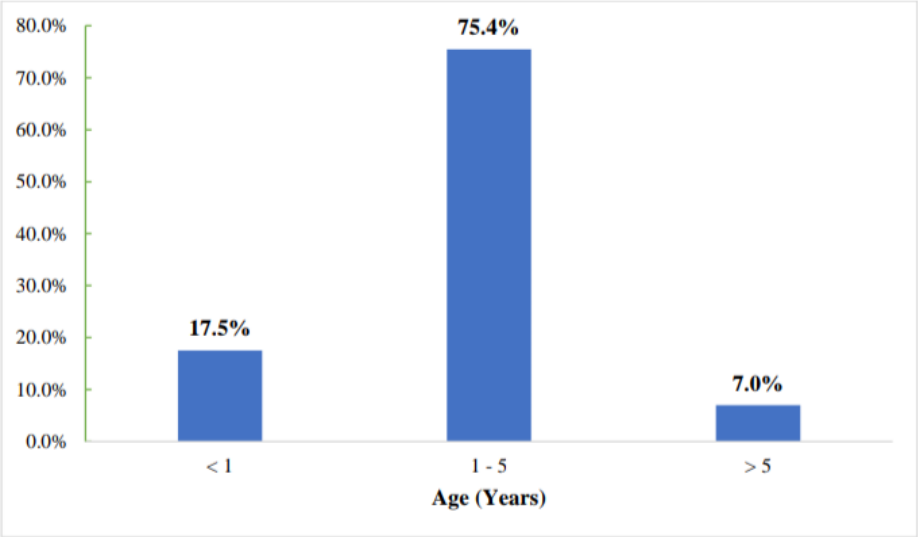

Fig 1. Age wise distribution of UTI in the study population.

Table 2. Risk factors associated with UTI.

Risk Factors	Freequency	Percentage (%)	p value
Constipation	30	52.6	0.691
Decreased water intake	22	38.6	0.085
Worm infestation	12	21.1	0.000
Diaper usage	8	14	0.000
Cleaning of perineum back to front	5	8.8	0.000
Phimosis	2	3.5	0.000

Table 3. Clinical features associated with UTI.

Clinical features	Freequency	Percentage (%)	p value
Pain During Micturition	39	68.4	0.005
Increased Frequency of Micturition	31	54.4	0.508
Vomiting	13	22.8	0.000
Chills and Rigor	5	8.8	0.000
Decreased Urine Output	4	7	0.000
Dribbling of Urine	3	5.3	0.000
Diarrhoea	2	3.5	0.000
Irritability	2	3.5	0.000

Table 4. Depicting the correlation between different variables and the prevalence of UTI.

Variables	Freequency	Percentage (%)	p value
Fever Grade			
Low/Mild	8	14	0.000
Moderate	16	28.1	
Severe	33	57.9	
Fever Duration (hours)			
<24	11	19.3	0.000
>24	46	80.7	
Circumcision Status			
Circumcised	2	22.2	0.096
Uncircumcised	7	77.8	
Male External Genitalia			
Normal	7	77.8	

Phimosis	2	22.2	0.096
Female External Genitalia			
Normal	46	95.8	0.000
Vulval adhesions	2	4.2	
Total Count			
<10,000	15	26.3	0.000
10,000 - 20,000	36	63.2	
>20,000	6	10.5	
Urine pus cells			
5-50	11	19.3	0.003
50-100	15	26.3	
>100	31	54.4	
Bacteriuria			
Present	49	86	0.000
Absent	8	14	
Organisms isolated			
Ecoli	50	87.7	0.000
Kleibsiela	5	8.8	
Proteus	2	3.5	
MCU			
Normal	6	75	0.044
VUR	1	12.5	
PUV	1	12.5	

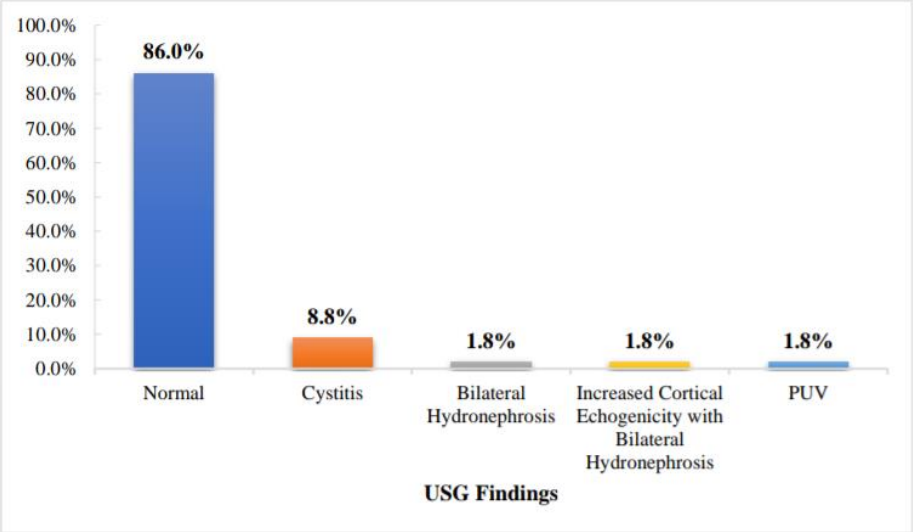

Fig 2. The comparison of USG findings and prevalence of UTI.

with UTI (57.9%) compared to mild (14%) and moderate fever (28.1%). Similarly, prolonged fever lasting more than 24 hours was strongly associated with UTI (80.7%) compared to fever lasting less than 24 hours (19.3%). Febrile seizures, however, were not a significant clinical feature, as most UTI cases occurred in children without seizures.

The prevalence of UTI was higher among uncircumcised males (77.8%) compared to circumcised males (22.2%), though this finding was not statistically significant, likely due to the small sample size. Phimosis was the most common male genital abnormality, but it lacked statistical significance. Conversely, vulval adhesions in females were a significant anomaly associated with UTI. These findings underscore the role of genital abnormalities, particularly in female children, in predisposing to UTI (Table 4).

Children with total WBC counts of 10,000-20,000 cells/mm³ showed the highest UTI prevalence (63.2%), significantly more than those with counts above 20,000 (10.5%) or below 10,000 (26.3%). Similarly, UTI prevalence correlated with higher pus cell counts, with 54.4% of cases having >100 pus cells per high-power field. The presence of bacteriuria was also significantly associated with UTI (p=0.000) (Table 4).

The most common pathogen isolated was *E. coli* (87.7%), followed by *Klebsiella* (8.8%) and *Proteus* (3.5%). *E. coli* demonstrated high sensitivity to ceftriaxone, amikacin, meropenem, and piperacillin-tazobactam, and moderate sensitivity to nitrofurantoin and amoxicillin-clavulanic acid. Resistance was highest against cotrimoxazole, ciprofloxacin, cefotaxime, and ampicillin. Notably, no ESBL-producing strains were detected. *Klebsiella* showed sensitivity to meropenem, amikacin, and piperacillin-tazobactam, with resistance to ceftriaxone, nitrofurantoin, ciprofloxacin, and cotrimoxazole. *Proteus* was isolated in a minority of cases and showed sensitivity to ceftriaxone, amikacin, meropenem, and piperacillin-tazobactam, while displaying resistance to lower-spectrum antibiotics

such as cotrimoxazole, ciprofloxacin, ampicillin, and nitrofurantoin.

Although the number of children with USG abnormalities was low in our study, these abnormalities showed a statistically significant association with UTI prevalence (Fig. 2). The proportion of babies with vesicoureteral reflux (VUR) and posterior urethral valves (PUV) was equally low at 12.5% each, compared to the significantly higher proportion (75.0%) of children with normal USG findings who presented with UTI (Table 4).

Discussion

Urinary tract infection (UTI) is a common pediatric issue, often presenting with nonspecific symptoms, particularly in children under six years. If untreated, UTIs can result in renal scarring and significantly increase the risk of end-stage renal disease.

This study aimed to assess the prevalence, clinical profile, risk factors, and laboratory parameters of UTI in 504 febrile children admitted to the pediatric ward at Jubilee Mission Medical College, Thrissur, between January 2021 and June 2022.

The overall UTI prevalence was 11.3%, consistent with previous studies reporting rates between 8.4% and 16%. The average age of affected children was 2.57 years (SD ±1.64), aligning with findings by O'Brien et al (9). A significant age-based difference in UTI prevalence was observed, with higher rates in younger children. In the 1–5 years age group, females had a higher prevalence, while rates were comparable between genders in children over five. These findings align with Schlager et al (10), who reported a higher UTI prevalence (3%) in girls aged 1–5 years.

In our study, constipation was the most common risk factor for UTI, observed in 52.6% of children. This aligns with findings from Twaij M et al (11) and Inan M et al (12). The most frequent symptoms were cry/pain during micturition (68.4%), increased frequency of micturition (54.4%), and vomiting (22.8%), similar to Vaidya SS et al.'s observations (13). High-grade fever showed a significant correlation with UTI (p=0.000), consistent with El Radhi AS et al (14). Prolonged fever (>24 hours) was significantly associated with UTI (80.7%, p=0.000), mirroring findings from McCarthy PL et al (15).

Although UTI prevalence was higher in uncircumcised boys (77.8%), this was not statistically significant due to a small sample size. Studies by Eisenberg ML et al (16) and D. Singh Grewal et al (17). reported circumcision significantly reduces UTI risk. Phimosis was associated with higher UTI prevalence, as noted by Jee Shim et al (18). Among females, vulval adhesions were significantly linked to UTI (4.2%, p=0.000), corroborating Rubinstein AV et al.'s findings (19).

In our study, 63.2% of children with UTI had a total WBC count between 10,000-20,000 cells/mm³, consistent with Ayazi P et al.'s findings, where 71% of cases showed WBC counts >10,000 (20). Significant pyuria correlated strongly with culture-positive UTI, aligning with Lohr JA et al.'s study (21). Additionally, bacteriuria was significantly associated with UTI (p=0.000), as highlighted by Pradip P Choudari et al., who emphasized the diagnostic value of bacteriuria and pyuria in young children (22).

E. coli was the predominant causative organism (87.7%), followed by *Klebsiella* (8.8%) and Proteus (3.5%). These results are in line with previous studies. Antibiotic resistance patterns observed were comparable to studies by Rachel S Edlin et al (23), showing high resistance to trimethoprim-sulfamethoxazole (24%) but lower resistance to nitrofurantoin (<1%) and cephalothin (15%). *Klebsiella* isolates showed resistance to multiple antibiotics, as noted in Akram Hassan Mekki et al.'s study (24), while *Proteus* showed sensitivity to ceftriaxone, cefotaxime,

ciprofloxacin, and ofloxacin, consistent with G. K. Rai et al.'s findings (25).

Renal and bladder ultrasounds were normal in 86% of cases, similar to findings by Alon and Sowmya Ganapathy (84.7%) (26). Voiding cystourethrography (MCU) was performed in 8 cases, detecting vesicoureteral reflux (VUR) in 1 child. While VUR prevalence is typically 30-50% in UTI cases as reported by other studies, our limited sample size prevented definitive conclusions.

Conclusion

Clinicians should consider urinary tract infection (UTI) as a potential cause of fever in febrile children and routinely include urine culture in the diagnostic workup, especially in cases with no apparent source of infection. In this study, females were more commonly affected, with constipation identified as the most frequent risk factor. Pain or crying during micturition and increased frequency of micturition were the most common symptoms apart from fever. Pyuria >5 WBC/HPF proved to be a strong predictor for UTI and can aid in presumptive diagnosis. Although ultrasound abnormalities were noted in some cases, routine ultrasound is recommended for all culture-proven UTI cases. The study's findings could have been more robust if micturating cystourethrogram and dimercaptosuccinic acid (DMSA) scans were performed universally, but economic constraints limited their use, affecting the study's overall validity.

Funding Information

There was no extramural funding received for conducting this study.

Ethics approval and consent to participate

The ethical clearance was taken from the institutional ethical committee of Jubilee Mission Medical College and Research Institute, Thrissur with clearance number 06/21/IEC/JMMC&RI. All febrile children meeting inclusion criteria were investigated for UTI after obtaining parental consent and child assent.

Conflict of interest

The authors report no conflict of interest.

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