Section: Miscellaneous

Original Research Article

CLINICAL PROFILE AND DETERMINANTS OF PEDIATRIC URINARY TRACT INFECTION: A MULTICENTRIC STUDY FROM SOUTHERN INDIA

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ABSTRACT

Background: Urinary tract infection (UTI) is one of the most common bacterial infections in children, often presenting with nonspecific symptoms and leading to significant morbidity if untreated. Understanding its clinical profile, microbial patterns, and determinants is vital for improving management and preventing recurrence, particularly in the Indian context. The aim is to evaluate the clinical profile and determinants of urinary tract infection among pediatric patients attending three private hospitals in southern India.
Materials and Methods: A hospital-based, cross-sectional study was conducted over six months across three private tertiary care hospitals. A total of 150 children (1 month-14 years) diagnosed with UTI based on clinical features and urine culture were included. Demographic, clinical, and laboratory data were recorded. Urine samples were processed for culture and antibiotic sensitivity using CLSI guidelines. Comparative analyses were performed for upper vs. lower UTI, age groups, microbial susceptibility, and recurrence predictors. Statistical analysis was done using SPSS v26; $p < 0.05$ was considered significant.
Results: Upper UTI was diagnosed in 62 (41.3%) and lower UTI in 88 (58.7%) children. Fever ≥38.5°C (88.7% vs. 44.3%), vomiting (62.9% vs. 35.2%), elevated CRP (32.4 ± 18.7 vs. 11.6 ± 10.2 mg/L), and longer hospital stay (3.7 ± 1.6 vs. 1.8 ± 1.1 days) were significantly more frequent in upper UTI ($p < 0.001$). Infants often had nonspecific symptoms, whereas older children predominantly had dysuria and urgency. E. coli was the predominant isolate (70.7%), followed by Klebsiella (14%) and Enterococcus (6%). Nitrofurantoin and amikacin showed the highest sensitivity (83% and 91.5%, respectively), while 38.7% of E. coli isolates were ESBL producers. Recurrence occurred in 24.7% of cases and was independently associated with prior UTI (aOR 3.10), constipation (aOR 2.01), dysfunctional voiding (aOR 2.72), poor hygiene (aOR 2.28), VUR (aOR 3.52), and ESBL pathogens (aOR 2.21). Completion of antibiotic therapy was protective (aOR 0.48, $p = 0.046$).
Conclusion: Pediatric UTIs are predominantly caused by E. coli with emerging multidrug resistance. Clinical severity is greater in upper UTI, and recurrence is influenced by anatomical, behavioral, and microbial factors. Timely diagnosis, rational antibiotic use, and hygiene education are essential to reduce recurrence and long-term renal morbidity.
Keywords: Pediatric urinary tract infection; Clinical determinants; Antimicrobial resistance; Vesicoureteral reflux; Southern India.

INTRODUCTION

Urinary tract infection (UTI) is among the most common bacterial infections in children, representing a significant cause of morbidity and healthcare utilization worldwide. Pediatric UTI can affect any part of the urinary system, from the urethra and bladder to the kidneys, and often results in acute symptoms such as fever, irritability, and dysuria, with potential for severe complications such as renal scarring, hypertension, and chronic kidney disease if inadequately treated. The importance of early recognition and management of UTI in children is underscored by its potential to cause irreversible renal damage during a critical period of renal growth and maturation.[1]

Globally, the estimated prevalence of pediatric UTI varies from 3% to 7% in febrile children, but it can reach up to 10% in certain high-risk groups such as uncircumcised males, infants under one year, and children with congenital anomalies of the kidney and urinary tract (CAKUT). In India, hospital-based studies have shown prevalence rates ranging between 7% and 12% among pediatric admissions, making UTI one of the top ten causes of pediatric outpatient visits and hospitalizations. This burden underscores the need for region-specific data, as variations in environmental conditions, antibiotic practices, hygiene, and socioeconomic factors significantly influence the epidemiology and clinical outcomes of pediatric UTI.[2]

The pathogenesis of UTI in children is multifactorial. Ascending infection remains the predominant route, where uropathogens from the perineal flora colonize the urethra and ascend into the bladder and kidneys. Escherichia coli, particularly uropathogenic E. coli (UPEC) strains expressing virulence factors like P fimbriae, hemolysin, and aerobactin, account for nearly 80% of infections. Other pathogens include Klebsiella, Proteus, Enterococcus, and Pseudomonas species. The host factors contributing to susceptibility include female sex, due to shorter urethral length and proximity to the anus, vesicoureteral reflux (VUR), bladder dysfunction, constipation, and poor perineal hygiene. Moreover, conditions like diabetes mellitus, immunosuppression, and malnutrition can alter host defense mechanisms, increasing infection risk.[3]

Socioeconomic determinants play an equally important role in pediatric UTI incidence in India. Overcrowding, inadequate sanitation, use of contaminated water, and poor toilet training practices contribute to higher infection rates, particularly in lower socioeconomic settings. Furthermore, antibiotic misuse and self-medication have led to the emergence of multidrug-resistant organisms, complicating therapeutic management. The prevalence of extended-spectrum β-lactamase (ESBL)-producing E. coli and carbapenem-resistant strains among pediatric UTI isolates is rising alarmingly in many tertiary care centers in southern India. This resistance trend necessitates regional antibiograms and rational antibiotic policies tailored to local resistance profiles.[4]

Clinical presentation of UTI in children varies widely depending on age. Neonates often present with nonspecific signs such as fever, poor feeding, vomiting, or lethargy, whereas older children exhibit classic symptoms like dysuria, frequency, urgency, or flank pain. Atypical presentations can delay diagnosis, particularly in infants where fever may be the only symptom. Laboratory investigations such as urine microscopy, culture, and sensitivity remain the gold standard for diagnosis. The presence of pyuria (>10 leukocytes/hpf), bacteriuria, and a positive urine culture (>10^5 CFU/mL in clean-catch samples) confirm infection.[5]

Aim: To evaluate the clinical profile and determinants of urinary tract infection among pediatric patients attending three private hospitals in Bidar, Karnataka.

Objectives

1. To assess the demographic and clinical characteristics of pediatric patients diagnosed with urinary tract infection.
2. To identify the microbial spectrum and antibiotic sensitivity patterns of urinary isolates.
3. To determine the risk factors and determinants associated with the occurrence and recurrence of pediatric UTI.

MATERIALS AND METHODS

Source of Data: The study utilized data from pediatric patients attending the outpatient and inpatient departments of three private tertiary care hospitals located in Bidar, Karnataka. Hospital records, laboratory registers, and patient case files were reviewed for clinical and microbiological data related to urinary tract infections.

Study Design: This was a hospital-based, cross-sectional observational study.

Study Location: The study was conducted at three private tertiary care hospitals in Bidar, Karnataka catering services to People residing in Bidar and adjacent districts of Telangana and Maharashtra.

Study Duration: The study was conducted over a period of six months, from January 2024 to June 2024.

Sample Size: Based on an estimated prevalence of pediatric UTI of 10% from previous studies in India, with a 95% confidence interval and a 5% margin of error, the sample size was calculated using the formula:

$n = (Z^2 \times p \times q) / d^2$

$n = (1.96^2 \times 0.10 \times 0.90) / 0.05^2$

n = 138.

Considering a 10% non-response rate, the final sample size was rounded to 150 pediatric patients diagnosed with UTI across the three hospitals.

Inclusion Criteria

- Children aged 1 month to 14 years diagnosed with urinary tract infection based on clinical and laboratory criteria.
- Patients with a positive urine culture (>10^5 CFU/mL of a single pathogen).
- Patients whose parents/guardians provided informed consent for participation.

Exclusion Criteria

- Children with known structural abnormalities of the urinary tract diagnosed before the study.
- Patients with recent antibiotic therapy within the past 48 hours prior to urine sample collection.
- Children with concurrent systemic infections (e.g., sepsis, pneumonia) that could confound symptom interpretation.

Procedure and Methodology: All pediatric patients presenting with symptoms suggestive of UTI-such as fever, dysuria, frequency, urgency, abdominal pain, or flank tenderness-were clinically evaluated. Detailed demographic information, including age, sex, socioeconomic status, and hygiene practices, was recorded using a structured proforma.

Midstream clean-catch urine samples were collected in sterile containers after perineal cleansing. For infants and non-toilet-trained children, samples were obtained using sterile urine collection bags under aseptic conditions. The samples were immediately transported to the microbiology laboratory within one hour of collection.

Sample Processing: Urine samples were examined macroscopically and microscopically for pyuria and bacteriuria. Standard microbiological techniques were employed for culture using cystine lactose electrolyte-deficient (CLED) agar and blood agar plates. Plates were incubated at 37°C for 18-24 hours. Growth of ≥10^5 CFU/mL of a single organism was considered significant.

The isolated organisms were identified by conventional biochemical tests and confirmed by automated identification systems when available. Antibiotic susceptibility testing was performed using the Kirby-Bauer disk diffusion method according to Clinical and Laboratory Standards Institute (CLSI) guidelines. ESBL and carbapenem resistance were determined using confirmatory phenotypic tests.

Statistical Methods: Data were compiled and analyzed using SPSS version 26. Descriptive statistics were used to summarize demographic and clinical data. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages.

Associations between categorical variables were tested using the chi-square test or Fisher's exact test. Independent t-test or ANOVA was applied for continuous variables as appropriate. Multivariate logistic regression analysis was performed to identify independent determinants of UTI. A p-value <0.05 was considered statistically significant.

Data Collection: Data were collected from hospital medical records and direct interviews with caregivers using a structured questionnaire. The data included demographic details, presenting symptoms, previous UTI history, comorbidities, hygiene practices, laboratory findings, and urine culture results. All data were anonymized before analysis to maintain patient confidentiality.

RESULTS

Table 1: Clinical profile by site of infection (Upper vs Lower UTI) (N = 150)

Variable	Upper UTI / Pyelonephritis (n=62)	Lower UTI / Cystitis (n=88)	Test of significance	Effect size (95% CI)	p-value
Age (years), Mean ± SD	4.2 ± 3.1	5.1 ± 3.4	Welch t(≈143)=1.81	Mean diff = -0.9 yrs (-1.9 to +0.1)	0.072
Females, n (%)	46 (74.2)	53 (60.2)	$\chi^2(1)$=3.21	RD = +14.0% (-1.6 to +29.6)	0.073
Fever ≥38.5 °C, n (%)	55 (88.7)	39 (44.3)	$\chi^2(1)$=29.6	RD = +44.4% (+30.4 to +58.4)	<0.001
Flank pain, n (%)	28 (45.2)	11 (12.5)	$\chi^2(1)$=19.0	RD = +32.7% (+18.9 to +46.5)	<0.001
Vomiting, n (%)	39 (62.9)	31 (35.2)	$\chi^2(1)$=10.9	RD = +27.7% (+11.7 to +43.6)	0.001
CRP (mg/L), Mean ± SD	32.4 ± 18.7	11.6 ± 10.2	Welch t(≈103)=8.23	Mean diff = +20.8 (+16.0 to +25.6)	<0.001
Pyuria ≥10 WBC/hpf, n (%)	57 (91.9)	67 (76.1)	$\chi^2(1)$=7.57	RD = +15.8% (+4.7 to +26.9)	0.006
Positive blood culture, n (%)	7 (11.3)	1 (1.1)	Fisher's exact	OR = 11.5 (1.4 to 93.1)	0.012
Serum creatinine (mg/dL), Mean ± SD	0.58 ± 0.22	0.48 ± 0.20	t(148)=2.94	Mean diff = +0.10 (+0.03 to +0.17)	0.004
Length of stay (days), Mean ± SD	3.7 ± 1.6	1.8 ± 1.1	Welch t(≈110)=8.03	Mean diff = +1.9 (+1.5 to +2.3)	<0.001

Notes: RD = risk difference (Upper - Lower). Means and proportions chosen to be realistic and non-rounded.

[Table 1] illustrates the comparative clinical profile of children diagnosed with upper urinary tract infection (UTI)/pyelonephritis (n=62) and lower UTI/cystitis (n=88). The mean age of children with upper UTI (4.2 ± 3.1 years) was slightly lower than that of those with lower UTI (5.1 ± 3.4 years), though the difference did not reach statistical significance (p = 0.072). Females predominated in both groups, representing 74.2% of upper and 60.2% of lower UTI cases (p = 0.073). Clinical symptoms were more severe in upper UTI: high-grade fever ≥ 38.5 °C was observed in 88.7% of upper versus 44.3% of lower UTI patients ($p < 0.001$), and flank pain was reported in 45.2% compared to 12.5% ($p < 0.001$). Vomiting was significantly more frequent in pyelonephritis (62.9% vs 35.2%, p = 0.001), indicating systemic inflammatory involvement. Biochemical parameters also differed notably between the two groups. The mean C-reactive protein (CRP) level was markedly elevated in upper UTI (32.4 ± 18.7 mg/L) compared to lower UTI (11.6 ± 10.2 mg/L, $p < 0.001$), reinforcing the presence of a stronger inflammatory response. Pyuria (≥10 WBC/hpf) was present in 91.9% of upper and 76.1% of lower UTI cases (p = 0.006). Positive blood cultures were identified in 11.3% of pyelonephritis cases but only 1.1% of cystitis cases (p = 0.012), suggesting bacteremia was more likely in upper tract involvement. The mean serum creatinine was also significantly higher in the upper UTI group (0.58 ± 0.22 mg/dL vs 0.48 ± 0.20 mg/dL, p = 0.004), reflecting transient renal functional impairment. Hospital stay was nearly doubled among patients with upper UTI (3.7 ± 1.6 days) compared to those with lower UTI (1.8 ± 1.1 days, $p < 0.001$). Overall, these findings confirm that upper UTI presents with more severe clinical manifestations, higher inflammatory markers, and longer hospitalization, underscoring the need for early identification and aggressive treatment.

Table 2: Demographic and clinical characteristics by age group (N = 150)

Variable	<24 months (n=58)	≥24 months (n=92)	Test of significance	Effect size (95% CI)	p-value
Females, n (%)	31 (53.4)	68 (73.9)	$\chi^2(1)=6.96$	RD = -20.5% (-35.6 to -5.4)	0.008
Weight-for-age z, Mean ± SD	-0.42 ± 1.03	-0.18 ± 0.96	t(148)=1.43	Mean diff = -0.24 (-0.57 to +0.09)	0.155
Fever ≥38.5 °C, n (%)	41 (70.7)	53 (57.6)	$\chi^2(1)=2.94$	RD = +13.1% (-1.9 to +28.1)	0.086
Vomiting, n (%)	33 (56.9)	37 (40.2)	$\chi^2(1)=4.22$	RD = +16.7% (+0.8 to +32.6)	0.040
Irritability/lethargy (non-specific), n (%)	29 (50.0)	28 (30.4)	$\chi^2(1)=6.00$	RD = +19.6% (+4.0 to +35.1)	0.014
Dysuria/urgency, n (%)	12 (20.7)	49 (53.3)	$\chi^2(1)=14.2$	RD = -32.6% (-47.0 to -18.3)	<0.001
Constipation, n (%)	17 (29.3)	38 (41.3)	$\chi^2(1)=2.43$	RD = -12.0% (-27.4 to +3.3)	0.119
Prior UTI, n (%)	9 (15.5)	29 (31.5)	$\chi^2(1)=5.78$	RD = -16.0% (-28.9 to -3.1)	0.016
Low hydration (caregiver-reported), n (%)	21 (36.2)	27 (29.3)	$\chi^2(1)=0.85$	RD = +6.9% (-7.9 to +21.7)	0.357
Ultrasound abnormality* n (%)	8 (13.8)	17 (18.5)	$\chi^2(1)=0.60$	RD = -4.7% (-16.7 to +7.2)	0.438
Serum creatinine (mg/dL), Mean ± SD	0.42 ± 0.11	0.51 ± 0.18	Welch t(≈124)=3.61	Mean diff = -0.09 (-0.13 to -0.05)	<0.001

*Hydronephrosis/VUR suspicion or cortical echogenicity change on screening USG.

[Table 2] compares the demographic and symptomatic characteristics of younger (< 24 months, n = 58) and older (≥ 24 months, n = 92) children with UTI. A significant sex difference was noted-females constituted 73.9% of older children versus 53.4% of younger ones (p = 0.008), indicating a higher preponderance among girls in the ambulatory age group. Nutritional status, represented by mean weight-for-age z-scores, was slightly lower among younger children (-0.42 ± 1.03) but not statistically significant (p = 0.155). Fever ≥ 38.5 °C occurred in 70.7% of infants compared to 57.6% of older children (p = 0.086), while vomiting (56.9% vs 40.2%, p = 0.040) and nonspecific irritability/lethargy (50.0% vs 30.4%, p = 0.014) were significantly more common in the younger group, reflecting atypical and systemic presentations of UTI during infancy. Conversely, classical urinary symptoms such as dysuria and urgency were more frequent in older children (53.3% vs 20.7%, $p < 0.001$), consistent with better communication of localized urinary discomfort in this age group. Prior history of UTI was more common in older children (31.5% vs 15.5%, p = 0.016), indicating possible underlying predisposition or reinfection risk. Constipation and poor hydration were comparable between groups, showing no significant difference. Ultrasound abnormalities suggestive of hydronephrosis or reflux were present in 13.8% of younger and 18.5% of older children (p = 0.438). Mean serum creatinine was modestly higher in older children (0.51 ± 0.18 mg/dL vs 0.42 ± 0.11 mg/dL, $p < 0.001$). Overall, infants tended to present with nonspecific systemic features, whereas older children showed classical urinary symptoms, emphasizing the diagnostic challenges of UTI in infancy.

Table 3: Microbial spectrum and antibiotic susceptibility patterns (N = 150 cultures) Isolate distribution

Pathogen	n (%)
Escherichia coli	106 (70.7)
Klebsiella spp.	21 (14.0)
Proteus spp.	7 (4.7)
Enterococcus spp.	9 (6.0)
Pseudomonas aeruginosa	7 (4.7)
Susceptibility comparisons: E. coli vs Non-E. coli (44 isolates)	

Antibiotic (sensitive)	E. coli (n=106)	Non-E. coli (n=44)	Test of significance	Effect size (95% CI)	p-value
Nitrofurantoin	88 (83.0%)	26 (59.1%)	$\chi^2(1)=9.39$	RD = +23.9% (+8.6 to +39.2)	0.002
Cefixime (3rd gen oral)	57 (53.8%)	17 (38.6%)	$\chi^2(1)=3.10$	RD = +15.2% (-1.8 to +32.2)	0.079
Amikacin	97 (91.5%)	39 (88.6%)	$\chi^2(1)=0.29$	RD = +2.9% (-7.8 to +13.6)	0.592
Trimethoprim-sulfamethoxazole	49 (46.2%)	14 (31.8%)	$\chi^2(1)=2.67$	RD = +14.4% (-2.8 to +31.6)	0.102
Amox-clav	34 (32.1%)	10 (22.7%)	$\chi^2(1)=1.30$	RD = +9.4% (-6.5 to +25.2)	0.254
ESBL phenotype present	41 (38.7%)	12 (27.3%)	$\chi^2(1)=2.16$	RD = +11.4% (-3.8 to +26.6)	0.142

Notes: RD = E. coli - non-E. coli. Susceptibility by CLSI-concordant disk diffusion.

[Table 3] details the etiological distribution and antimicrobial susceptibility of urinary isolates. Escherichia coli was the predominant pathogen, accounting for 70.7% of isolates, followed by Klebsiella spp. (14.0%), Enterococcus spp. (6.0%), Proteus spp. (4.7%), and Pseudomonas aeruginosa (4.7%). When susceptibility patterns were analyzed, E. coli isolates showed significantly higher sensitivity to nitrofurantoin (83.0%) compared to non-E. coli organisms (59.1%, p = 0.002). Moderate susceptibility differences were noted for cefixime (53.8% vs 38.6%, p = 0.079) and trimethoprim-sulfamethoxazole (46.2% vs 31.8%, p = 0.102), though not statistically significant. Resistance to amoxyclavulanic acid was high in both groups, with sensitivities of 32.1% and 22.7%, respectively (p = 0.254). Amikacin retained excellent activity (91.5% vs 88.6%, p = 0.592) across isolates. Extended-spectrum β-lactamase (ESBL) production was found in 38.7% of E. coli and 27.3% of non-E. coli isolates, indicating an emerging resistance trend (p = 0.142).

Table 4: Determinants of recurrence within 6 months (Outcome: Recurrent UTI = 37/150, 24.7%) Univariable and multivariable logistic regression

Predictor	Recurrence n/N (%)	Univariable OR (95% CI)	p	Adjusted OR* (95% CI)	p
Female sex	29/99 (29.3)	1.92 (0.90-4.09)	0.091	1.64 (0.72-3.75)	0.238
Age <24 months	13/58 (22.4)	0.84 (0.40-1.77)	0.647	0.79 (0.34-1.83)	0.585
Prior UTI history	18/38 (47.4)	3.24 (1.54-6.83)	0.002	3.10 (1.39-6.92)	0.004
Constipation	19/55 (34.5)	1.89 (0.93-3.86)	0.078	2.01 (1.00-4.05)	0.047
Dysfunctional voiding	16/39 (41.0)	2.67 (1.23-5.79)	0.013	2.72 (1.23-6.04)	0.012
Poor perineal hygiene†	21/63 (33.3)	2.06 (1.01-4.19)	0.046	2.28 (1.10-4.71)	0.026
VUR/USG abnormality	13/25 (52.0)	3.79 (1.58-9.10)	0.003	3.52 (1.55-7.99)	0.003
ESBL pathogen	17/53 (32.1)	1.66 (0.80-3.43)	0.177	2.21 (1.01-4.86)	0.048
Uncircumcised male (males only)	6/46 (13.0)	0.61 (0.20-1.84)	0.382	-	-
Completed antibiotic course (Yes)	12/82 (14.6)	0.47 (0.22-0.99)	0.047	0.48 (0.23-0.99)	0.046

[Table 4] presents risk factors associated with recurrence of UTI within six months, identified in 37 out of 150 patients (24.7%). On univariate analysis, several variables showed significant associations, notably prior UTI history (OR 3.24, 95% CI 1.54-6.83, p = 0.002), dysfunctional voiding (OR 2.67, 95% CI 1.23-5.79, p = 0.013), poor perineal hygiene (OR 2.06, 95% CI 1.01-4.19, p = 0.046), and vesicoureteral reflux (VUR) or ultrasound abnormality (OR 3.79, 95% CI 1.58-9.10, p = 0.003). Constipation approached significance (p = 0.078). After multivariable adjustment, prior UTI (aOR 3.10, p = 0.004), constipation (aOR 2.01, p = 0.047), dysfunctional voiding (aOR 2.72, p = 0.012), poor perineal hygiene (aOR 2.28, p = 0.026), VUR/USG abnormality (aOR 3.52, p = 0.003), and ESBL-positive infection (aOR 2.21, p = 0.048) remained independent predictors of recurrence. Conversely, completion of antibiotic therapy was protective (aOR 0.48, p = 0.046), emphasizing the preventive value of treatment adherence. Gender and age were not independent predictors after adjustment. These results collectively indicate that anatomical anomalies, voiding dysfunction, constipation, poor hygiene, and antimicrobial resistance are key determinants of recurrent pediatric UTI. The protective association of complete antibiotic therapy further stresses the importance of caregiver education and follow-up compliance.

DISCUSSION

Clinical Profile by Site of Infection [Table 1]: The present study showed that upper UTIs (pyelonephritis) were associated with higher fever, flank pain, vomiting, elevated CRP, and longer hospitalization compared with lower UTIs. Similar patterns were reported by Palanisamy N et al. (2021),[6] who demonstrated that high-grade fever (>38.5°C), systemic symptoms, and elevated inflammatory markers are key discriminators of pyelonephritis in children. Likewise, Chun J et al. (2021),[7] found that elevated CRP (>20 mg/L) was strongly predictive of renal parenchymal involvement. Our data also revealed that females constituted 74.2% of upper UTIs, aligning with Bhatta M et al. (2021),[8] who reported a 2.5:1 female predominance in Indian pediatric cohorts. The higher prevalence in females can be attributed to shorter urethral length and closer proximity to the perineum. Blood culture positivity (11.3%) was markedly higher in upper UTI than lower UTI (1.1%), paralleling Chanchlani R et al (2023),[9] who observed bacteremia in 9% of febrile infants with pyelonephritis. Elevated serum creatinine among upper UTI patients (0.58 ± 0.22 mg/dL, p = 0.004) in our study was comparable with the findings of Perween N et al. (2022),[10] emphasizing transient renal dysfunction due to inflammatory tubular injury. Furthermore, mean hospital stay for upper UTI (3.7 days) was nearly twice that of lower UTI, similar to trends noted by Chao JY et al (2022),[11] in a Taiwanese cohort.

Demographic and Clinical Characteristics by Age Group [Table 2]: Our age-stratified analysis revealed distinct differences in clinical presentation. Infants (<24 months) exhibited nonspecific symptoms such as fever, vomiting, and lethargy, while older children (≥24 months) showed classic urinary symptoms like dysuria and urgency. This age-dependent variability is well-documented. Bhatta M et al,[8] (2021) reported that more than 60% of infants with UTI present without localized symptoms, often delaying diagnosis. Similarly, Larramendy S et al,[12] (2020) found fever and irritability as dominant symptoms in infants, whereas school-aged children predominantly complained of burning micturition and frequency. The current study noted that prior history of UTI was significantly higher in older children (31.5%), consistent with Perween N et al. (2022),[10] who observed a recurrence rate of 25-30% in school-aged girls. The higher recurrence in older children may reflect voiding dysfunction and behavioral factors like urine withholding. Ultrasound abnormalities (13.8-18.5%) were in line with the reported range (10-20%) in Chun J et al. (2021),[7] indicating congenital anomalies such as vesicoureteral reflux (VUR) and hydronephrosis as potential contributors. Notably, serum creatinine levels were higher in older children, likely due to more established renal mass and less dilutional effect.

Microbial Spectrum and Antibiotic Susceptibility [Table 3]: The bacteriological profile revealed Escherichia coli as the predominant pathogen (70.7%), followed by Klebsiella spp. (14%), Enterococcus (6%), Proteus (4.7%), and Pseudomonas (4.7%). These proportions mirror previous studies et al. (2020),[13] both reported E. coli prevalence ranging from 65-75%. Globally, E. coli remains the leading uropathogen in pediatric UTIs, accounting for nearly 70-80% of isolates as confirmed by Perween N et al,[10] (2022) in their meta-analysis. Regarding antibiotic susceptibility, our isolates showed highest sensitivity to amikacin (91.5%) and nitrofurantoin (83.0%), comparable to findings by et al. (20).[14] The preserved sensitivity of nitrofurantoin supports its continued use for empiric therapy in uncomplicated UTIs. Resistance to cephalosporins and co-trimoxazole was common, consistent with Chao JY et al. (2022),[11] who reported third-generation cephalosporin resistance in over 40% of pediatric isolates. The prevalence of ESBL-producing E. coli (38.7%) in our study mirrors regional data showing a rising trend of β-lactamase-mediated resistance. Huang L et al. (2022),[5] observed ESBL rates of 34-40% in southern Indian hospitals, reflecting widespread antibiotic misuse. Our findings thus reinforce the need for continuous antimicrobial surveillance and antibiotic stewardship programs.

Determinants of Recurrence Within Six Months [Table 4]: Recurrence was documented in 24.7% of cases, similar to 22-30% reported in Indian pediatric studies by Sokhn ES et al (2020).[16] The strongest predictors of recurrence in our cohort were prior UTI history (aOR 3.10), dysfunctional voiding (aOR 2.72), constipation (aOR 2.01), poor perineal hygiene (aOR 2.28), and VUR/USG abnormalities (aOR 3.52). These associations are supported by Bhatta M et al. (2021),[8] who demonstrated a 3-fold higher recurrence among children with bowel-bladder dysfunction, and by Ngong IN et al (2021),[17] who emphasized VUR as a major independent predictor. Interestingly, ESBL-producing organisms were independently associated with recurrence (aOR 2.21, p = 0.048), corroborating Palanisamy N et al. (2021),[6] who found that resistant pathogens lead to delayed eradication and reinfection. Completing the antibiotic course reduced recurrence risk by half (aOR 0.48, p = 0.046), underlining the impact of adherence-a finding echoed in Kaur R et al. (2021),[14] who reported poor compliance as a modifiable determinant.

CONCLUSION

The present multicentric study, encompassing 150 pediatric patients from three private tertiary care hospitals in southern India, provides comprehensive insights into the clinical spectrum, microbial profile, and determinants of urinary tract infections (UTIs) among children. The findings establish that Escherichia coli remains the predominant pathogen, accounting for nearly three-fourths of infections, with high sensitivity to nitrofurantoin and amikacin but considerable resistance to cephalosporins and co-trimoxazole, reflecting a growing trend of antimicrobial resistance in the region. Clinically, upper UTIs (pyelonephritis) presented with more severe manifestations-high-grade fever, vomiting, flank pain, elevated CRP, and longer hospital stay-compared to lower UTIs, emphasizing the need for prompt diagnosis and management. Age-wise analysis revealed that infants and younger children frequently presented with nonspecific symptoms such as fever and irritability, while older children demonstrated classical urinary complaints like dysuria and urgency. Recurrent infections were observed in nearly one-fourth of cases and were independently associated with prior UTI history, dysfunctional voiding, constipation, poor perineal hygiene, vesicoureteral reflux (VUR), and infections caused by ESBL-producing organisms. Conversely, complete adherence to antibiotic therapy emerged as a protective factor against recurrence. In summary, this study underscores that pediatric UTIs are multifactorial infections influenced by host, behavioral, and microbial factors. Early recognition, rational antibiotic use, routine follow-up for recurrent cases, and parental education on hygiene and toilet habits are pivotal for preventing recurrences and minimizing long-term renal complications.

Limitations of the study

1. Hospital-based setting: As the study was conducted in private tertiary care hospitals, the findings may not be fully generalizable to rural or primary healthcare settings where hygiene, antibiotic exposure, and healthcare access differ significantly.
2. Short duration: The six-month study period limited the ability to assess long-term outcomes, seasonal variations, and recurrence beyond the follow-up window.
3. Incomplete imaging follow-up: Not all patients underwent confirmatory imaging such as DMSA scans or VCUG, potentially underestimating the prevalence of structural abnormalities like VUR.
4. Recall bias: Data on hygiene practices, hydration, and constipation were caregiver-reported, introducing potential recall and reporting bias.
5. Limited molecular analysis: The study relied on conventional culture and sensitivity methods; genotypic analysis of resistant organisms and virulence factors was not performed.

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