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PREVALENCE OF SONOGRAPHIC FINDINGS IN PEDIATRIC PATIENTS PRESENTING WITH URINARY TRACT INFECTION IN LAHORE WITH POSITIVE LABORATORY FINDINGS

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Abstract

Urinary tract infection (UTI) is among the most prevalent bacterial infections in children and, when diagnosis and treatment are delayed, may progress to kidney complications. This study aimed to determine the prevalence of sonographic findings in pediatric patients presenting with UTI supported by positive laboratory findings. A cross-sectional observational study was conducted over three months at Suraiya Azeem Hospital and Children Hospital, Lahore. Using convenient sampling, 87 symptomatic pediatric patients under twelve years of age with laboratory-confirmed UTI were enrolled; presenting features included fever, dysuria, vomiting, increased urinary frequency, lethargy, poor feeding, and flank pain. Patients older than twelve years and those with trauma, unconfirmed UTI, or a history of renal or urinary tract surgery were excluded. Renal and bladder ultrasound was performed and correlated with laboratory-confirmed UTI. The majority of participants were girls (69.0%), and the most affected age group was one month to two years (64.4%). Normal renal ultrasound findings were observed in 81.6% of patients, whereas

18.4% showed abnormalities, with mild hydronephrosis the most common abnormal finding. Bladder wall thickening was seen in 26.4% of children. The associations between age group and renal or bladder findings were statistically non-significant. These results indicate that pediatric UTI does not always manifest with ultrasound abnormalities; nevertheless, sonography remains a valuable, non-invasive, radiation-free first-line tool for identifying structural anomalies that could otherwise go undetected and for guiding closer follow-up

INTRODUCTION

Urinary tract infection (UTI) is one of the most common infectious diseases encountered across the human lifespan and one of the most frequent bacterial infections in the pediatric population (Foxman, 2014). It develops when microorganisms proliferate within the urinary tract and trigger an inflammatory response, with bacteria representing the predominant causative agents. Escherichia coli, a commensal of the bowel, is responsible for the majority of cases (Pico, 2024). The term UTI encompasses microbial infection of any segment of the urinary system — kidneys, ureters, bladder, and urethra — and may present as cystitis, pyelonephritis, or asymptomatic bacteriuria. Involvement of the lower urinary tract produces cystitis, whereas involvement of the upper tract results in pyelonephritis (Aggarwal & Leslie, 2025).

After upper respiratory tract infection, UTI ranks as the second most common bacterial illness in children. Its clinical presentation varies with age and becomes progressively less specific the younger the child; in neonates and infants an unexplained fever may be the sole presenting feature, whereas older, toilet-trained children more often report dysuria, urgency, increased frequency, and suprapubic or flank pain (Shaikh, Morone, Bost, & Farrell, 2008). When diagnosis and treatment are delayed, pediatric UTI can lead to serious short- and long-term sequelae including renal scarring, hypertension, impaired renal function, and end-stage renal disease, so timely recognition and adequate management are critical (Mattoo, 2011).

The etiology of pediatric UTI is multifactorial, involving bacterial invasion, anatomical anomalies, urinary stasis, and inadequate hygiene. Escherichia coli accounts for approximately 80% of infections and is more common in females owing to their shorter urethra, whereas uncircumcised male infants are at greater risk during the neonatal period (SIREESHA & SWAMY, 2025). Pseudomonas aeruginosa, Proteus, Enterococcus, and Klebsiella are other frequently implicated pathogens (Brandström & Hansson, 2022). Recognized risk factors include congenital anomalies of the kidney and urinary tract (CAKUT), vesicoureteral reflux, constipation, dysfunctional voiding, urinary obstruction, catheterization, and neurogenic bladder disorders. Recurrent episodes are clinically significant because repeated infection can injure the renal parenchyma, and the resulting chronic scarring may eventually give rise to hypertension and renal insufficiency (Silva, Oliveira, & Mak, 2020).

Globally, roughly 8% of girls and 2% of boys experience at least one UTI episode before the age of seven, with prevalence varying by age, gender, circumcision status, socioeconomic conditions, and access to healthcare. Among febrile infants younger than two years, prevalence ranges from 5% to 7%, and female predominance becomes more pronounced beyond infancy (Öztürk & Murt, 2020). In malnourished children, reported UTI prevalence is even higher, ranging from 8% to 35%, and rises markedly as malnutrition becomes more severe (He et al., 2025). Antimicrobial resistance is a growing

concern, with Escherichia coli and Klebsiella pneumoniae most strongly linked to resistance-related mortality (Mehmood, Saddique, & Iqbal).

In Pakistan, UTI ranks among the most common bacterial infections in children and contributes substantially to hospital admissions and outpatient visits, with the persistently high burden attributed to delayed diagnosis, poor hygiene, malnutrition, and limited access to healthcare (Iqbal, Rai, & Akhter, 2020 & Zafar et al., 2025). A cross-sectional study in Dera Ismail Khan reported an overall pediatric UTI prevalence of 10.22%, with female children affected significantly more often than males, and the highest prevalence among infants. In Lahore, pediatric hospitals such as Children's Hospital Lahore and Mayo Hospital regularly report UTI among febrile children and neonates. Because recurrent UTIs are closely linked to congenital urinary tract abnormalities such as vesicoureteral reflux, hydronephrosis, and posterior urethral valves — conditions frequently identified through ultrasound — sonographic evaluation remains an important diagnostic tool in this population (Haqiqullah et al., 2024).

Ultrasound is one of the most widely used imaging technologies in medicine, valued for its portability, absence of radiation risk, and relatively low cost. It is particularly suitable as a first-line modality in children, in whom minimizing radiation exposure is crucial. In the renal tract, the kidneys and bladder are examined in longitudinal and axial planes, providing information on kidney size, parenchymal abnormalities, and dilatation of the renal pelvis, calyces, or ureter. A key strength of ultrasound is its capacity to evaluate the bladder before and after voiding, allowing measurement of residual urine as an indicator of incomplete emptying, and to visualize bladder wall thickening, trabeculation, and ureteric jets (Zafar et al., 2025; Benn & Leslie, 2025).

Biochemical markers hold particular value in pediatric UTI given that children frequently present with nonspecific symptoms. Urine culture remains the gold-standard biomarker, since it directly identifies pathogenic bacteria and permits antibiotic-sensitivity testing, although results typically take 24 to 48 hours. Traditional markers include pyuria, leukocyte esterase, nitrite testing, C-reactive protein (CRP), and white blood cell (WBC) count, while newer markers such as procalcitonin, interleukins, neutrophil gelatinase-associated lipocalin (NGAL), and kidney injury molecule-1 (KIM-1) offer earlier and more precise localization of renal injury (Bhansali, Inbaraj, George, Norman, & Care, 2020).

It is anticipated that determining the prevalence of sonographic findings in children with positive laboratory results will clarify the role of ultrasonography in the early assessment of UTI, help clinicians identify prevalent renal and bladder abnormalities, and support prompt diagnosis, adequate treatment, and appropriate referral. The objective of this study was to assess the sonographic findings in pediatric patients presenting with UTI in Lahore and to correlate them with laboratory findings.

METHODOLOGY

This cross-sectional observational study was carried out over a period of three months at the Radiology Department of Suraiya Azeem Hospital and Children Hospital, Lahore. A total of 87 pediatric patients who presented with complaints associated with UTI were enrolled using a convenient sampling technique based on availability and eligibility.

Patients under twelve years of age of either gender who were symptomatic — presenting with fever, dysuria, vomiting, increased urinary frequency, lethargy, poor feeding, or flank pain — and who had laboratory-confirmed UTI were included. Patients presenting with trauma and those with a history of renal or urinary tract surgery were excluded, as were patients older than twelve years and those with unconfirmed UTI. Laboratory confirmation was based on urine culture positivity, raised white blood cell count, raised C-reactive protein, and abnormal urinalysis, as recorded on the study questionnaire.

For each patient, a renal and bladder ultrasound examination was performed. The patient lay comfortably on the examination couch and a coupling gel was applied to the abdomen, after which the sonographer moved the transducer gently over the abdomen to examine the kidneys and bladder. The transducer was selected according to the patient's build, and Doppler and harmonic imaging were used as appropriate. The kidneys and bladder were assessed in both longitudinal and axial planes for kidney size, parenchymal abnormalities, renal pelvic or calyceal dilatation, bladder wall thickness, and, where possible, post-void residual urine. Each examination was painless, involved no ionizing radiation, and typically took 15 to 30 minutes. Sonographic findings verified alongside laboratory and clinical assessment were recorded, and the data were analyzed for frequency and percentage distributions, with cross-tabulation and the chi-square test used to examine associations between age group and sonographic findings.

RESULTS

This section reports the demographic profile, clinical presentation, and sonographic findings of the 87 pediatric patients with laboratory-confirmed UTI. Frequency and percentage distributions are presented in Tables 1–7, associations between age group and sonographic findings in Tables 8–10, and the overall prevalence of normal and abnormal findings in Tables 11 and 12.

Table 1. ***Frequency and percentage of age.***

Age	Frequency	Percent
Birth to 1 month	4	4.6
1 month–2 years	56	64.4
3–6 years	16	18.4
7–12 years	11	12.6
Total	**87**	**100.0**

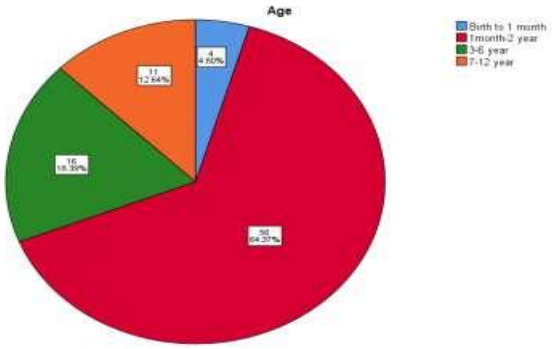


Figure 1. Frequency and percentage of age.

The vast majority of the sample comprised young children aged between one month and two years, accounting for 56 participants (64.4%). Newborns (birth to one month) represented the smallest subset with 4 participants (4.6%). Children aged 3 to 6 years constituted 16 participants (18.4%), followed by those aged 7 to 12 years, who made up 11 participants (12.6%). The distribution was therefore heavily concentrated in early childhood.

Table 2. ***Frequency and percentage of gender.***

Gender	Frequency	Percent
Girl	60	69.0
Boy	27	31.0
Total	**87**	**100.0**

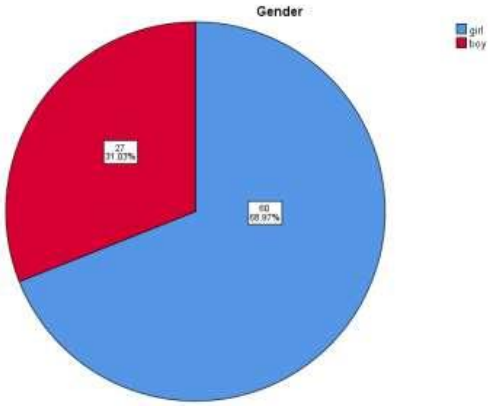


Figure 2. Frequency and percentage of gender.

Girls outnumbered boys in the study population: there were 60 girls (69.0%) and 27 boys (31.0%), so the bulk of participants were female.

Table 3. ***Frequency and percentage of sonographic findings in the right kidney.***

Right kidney findings	Frequency	Percent
Renal cortical thickening	2	2.3
Mild hydronephrosis	7	8.0
Moderate hydronephrosis	2	2.3

Right kidney findings	Frequency	Percent
Renal pelvic dilation	2	2.3
Increased renal echogenicity	3	3.4
Normal	71	81.6
Total	**87**	**100.0**

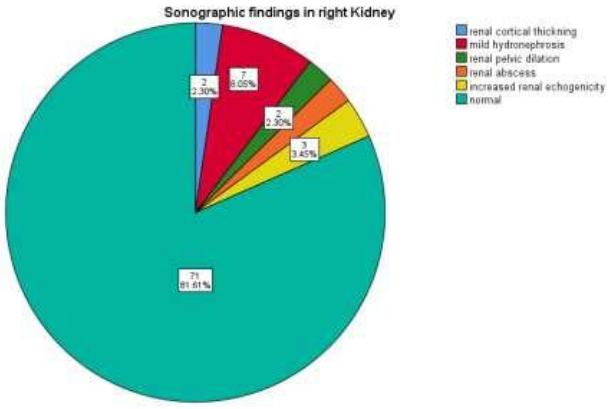


Figure 3. Frequency and percentage of sonographic findings in the right kidney.

Most children had normal right kidney findings (71, 81.6%). The most common abnormality was mild hydronephrosis (7, 8.0%), while increased renal echogenicity (3, 3.4%), renal cortical thickening, moderate hydronephrosis, and renal pelvic dilation (2 each, 2.3%) were uncommon.

Table 4. ***Frequency and percentage of sonographic findings in the left kidney.***

Left kidney findings	Frequency	Percent
Renal cortical thickening	2	2.3
Mild hydronephrosis	5	5.7
Moderate hydronephrosis	1	1.1
Renal pelvic dilation	5	5.7
Increased renal echogenicity	1	1.1
Small renal stone	2	2.3
Normal	71	81.6
Total	**87**	**100.0**

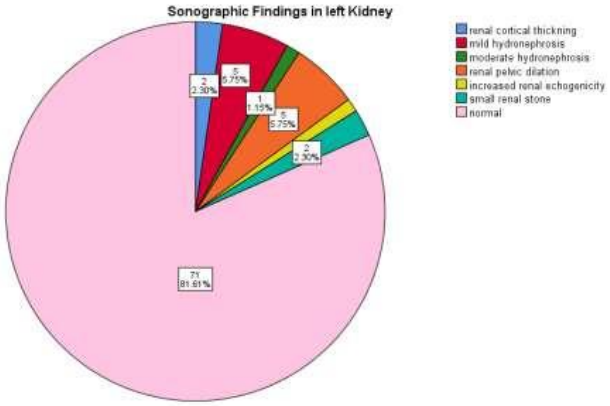


Figure 4. Frequency and percentage of sonographic findings in the left kidney.

The majority of children (71, 81.6%) had normal left kidney findings. Mild hydronephrosis and renal pelvic dilatation were each seen in 5 children (5.7%), while renal cortical thickening and small renal stone (2 each, 2.3%) and moderate hydronephrosis and increased renal echogenicity (1 each, 1.1%) were less frequent.

Table 5. *Frequency and percentage of bladder wall thickness.*

Bladder wall thickness	Frequency	Percent
Yes	23	26.4
No	64	73.6
Total	**87**	**100.0**

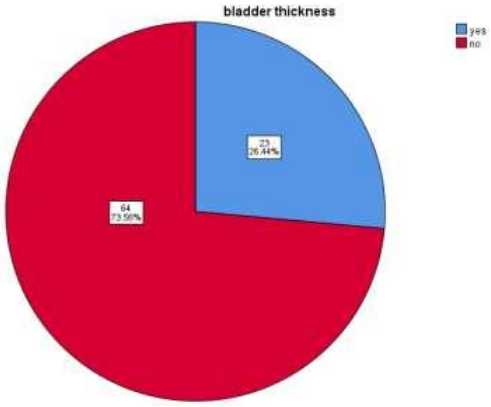


Figure 5. Frequency and percentage of bladder wall thickness.

Most children (64, 73.6%) did not exhibit bladder wall thickening, whereas 23 (26.4%) did.

Table 6. ***Frequency and percentage of duration of symptoms.***

Duration of symptoms	Frequency	Percent
< 4 days	33	37.9
< 1 week	33	37.9
< 2 weeks	18	20.7

Duration of symptoms	Frequency	Percent
< 3 weeks	3	3.4
Total	**87**	**100.0**

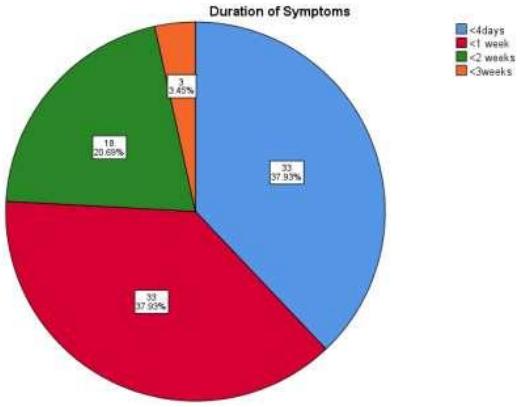


Figure 6. Frequency and percentage of duration of symptoms.

The majority of children had symptoms for less than a week, with 33 (37.9%) reporting symptoms for less than four days and a further 33 (37.9%) for less than one week. Symptoms lasting less than two weeks were reported in 18 children (20.7%) and less than three weeks in 3 children (3.4%).

Table 7. ***Distribution of clinical symptoms among participants.***

Symptom	Present	Absent	Total
Fever	85	2	87
Flank pain	78	9	87
Dysuria	82	5	87
Vomiting	70	17	87
Increased urinary frequency	80	7	87
Lethargy	71	16	87
Poor feeding	78	9	87

The most prevalent symptom was fever (85), followed by dysuria (82), increased urinary frequency (80), flank pain and poor feeding (78 each), and lethargy (71). Vomiting was the least frequent symptom, affecting 70 children.

Cross-tabulation and Chi-square Tests

Table 8. ***Cross-tabulation and chi-square of age and right kidney findings (p = 0.117).***

Findings	Birth–1 mo	1 mo–2 y	3–6 y	7–12 y	Total
Renal cortical thickening	0	1	1	0	2
Mild hydronephrosis	1	5	0	1	7

Findings	Birth–1 mo	1 mo–2 y	3–6 y	7–12 y	Total
Renal pelvic dilation	0	2	0	0	2
Renal abscess	0	0	0	2	2
Increased renal echogenicity	0	2	0	1	3
Normal	3	46	15	7	71
Total	**4**	**56**	**16**	**11**	**87**

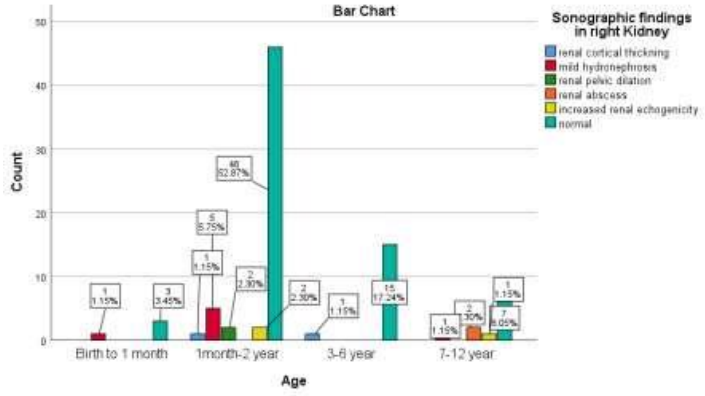


Figure 7. Cross-tabulation of age and right kidney findings.

Normal findings predominated across all age groups (71 children). Renal abscess was seen only in the 7–12-year group. The association between age group and right kidney findings was not statistically significant (p = 0.117).

Table 9. ***Cross-tabulation and chi-square of age and left kidney findings (p = 0.227).***

Findings	Birth–1 mo	1 mo–2 y	3–6 y	7–12 y	Total
Renal cortical thickening	0	1	0	1	2
Mild hydronephrosis	0	4	1	0	5
Moderate hydronephrosis	0	1	0	0	1
Renal pelvic dilation	0	5	0	0	5
Increased renal echogenicity	0	1	0	0	1
Small renal stone	0	0	0	2	2
Normal	4	44	15	8	71
Total	**4**	**56**	**16**	**11**	**87**

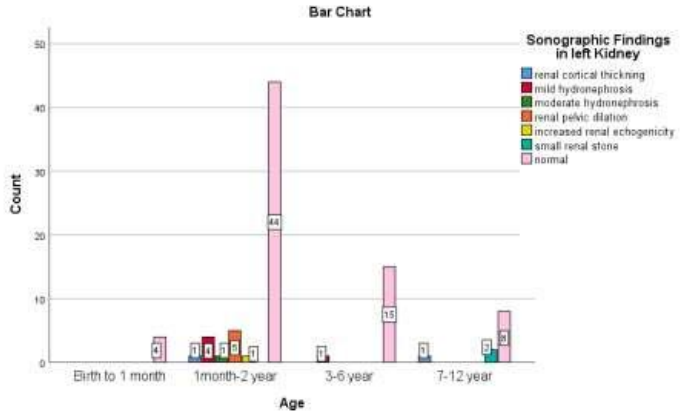


Figure 8. Cross-tabulation of age and left kidney findings.

Normal results were again most prevalent across every age category (71 children). Children aged one month to two years showed the most renal pelvic dilatation, whereas small renal stones occurred only in the 7–12-year group. The association was not statistically significant (p = 0.227).

Table 10. ***Cross-tabulation and chi-square of age and bladder wall thickness (p = 0.662).***

Bladder thickness	Birth–1 mo	1 mo–2 y	3–6 y	7–12 y	Total
Yes	0	16	4	3	23
No	4	40	12	8	64
Total	**4**	**56**	**16**	**11**	**87**

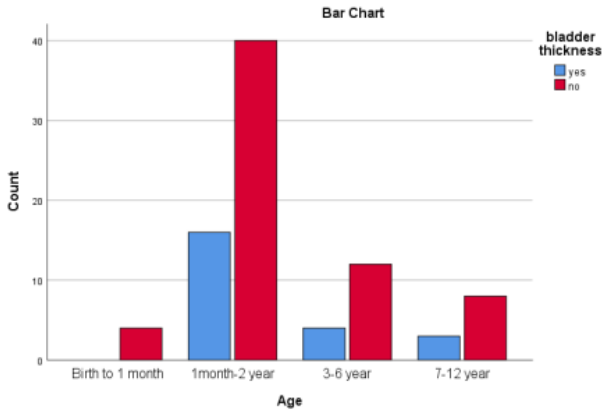


Figure 9. Cross-tabulation of age and bladder wall thickness.

Absence of bladder wall thickening was the most prevalent observation across all age groups (64 children). The association between age group and bladder wall thickness was not statistically significant (p = 0.662).

Prevalence of Normal and Abnormal Findings

Among the 87 children, 71 (81.6%) had normal sonographic findings in both kidneys, while 16 (18.4%) had abnormal findings. The prevalence of normal and abnormal findings was identical for the right and left kidneys, suggesting a similar distribution between the two sides. Prevalence was calculated as the number of cases divided by the total number of participants, multiplied by 100.

Table 11. ***Prevalence of normal and abnormal sonographic findings of the right and left kidney.***

Sonographic findings	Normal	Abnormal
Prevalence (%)	81.6	18.4

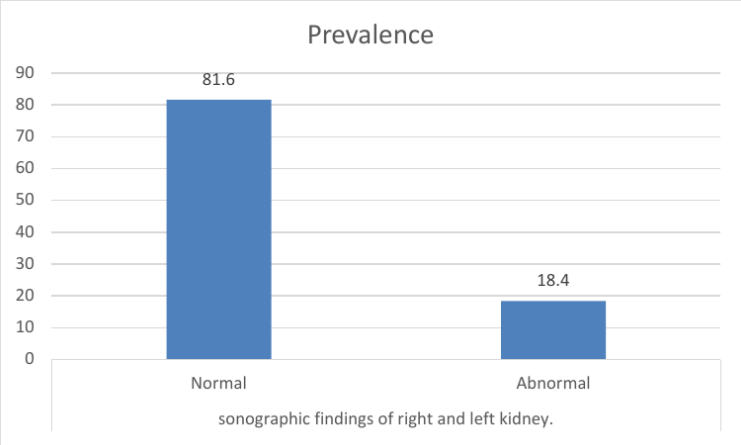


Figure 10. Prevalence of normal and abnormal sonographic findings of the right and left kidney.

Table 12. ***Abnormal sonographic findings of the right and left kidney.***

Abnormal finding	Right kidney (%)	Left kidney (%)
Renal cortical thickening	2.3	2.3
Mild hydronephrosis	8.0	5.7
Moderate hydronephrosis	2.3	1.1
Renal pelvic dilation	2.3	5.7
Increased renal echogenicity	3.4	1.1
Small renal stone	—	2.3

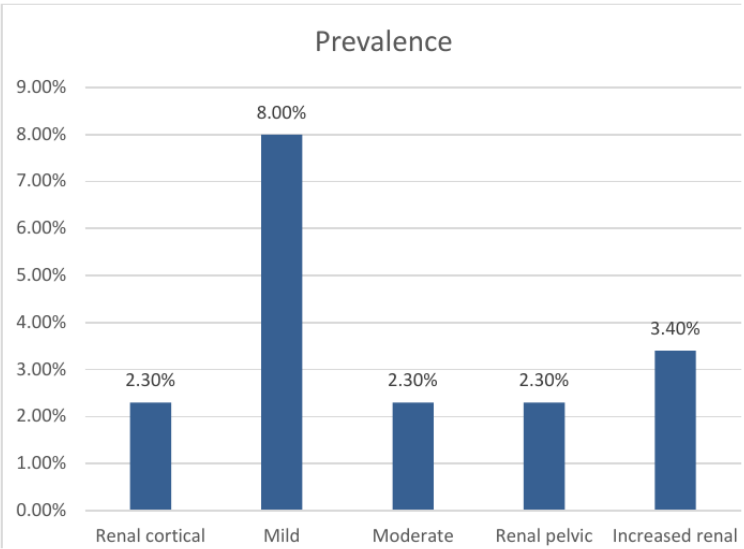


Figure 11. Abnormal sonographic findings of the right kidney.

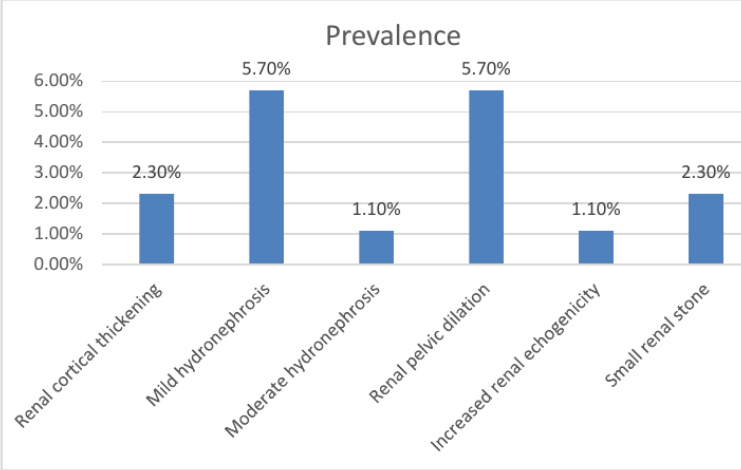


Figure 12. Abnormal sonographic findings of the left kidney.

Among the abnormal findings, mild hydronephrosis was the most common abnormality in the right kidney (8.0%), while renal cortical thickening, renal pelvic dilation, and small renal stone (2.3% each) were the more frequent findings in the left kidney. Overall, abnormal renal sonographic findings were uncommon among the study participants.

Representative Ultrasound Cases

The following images illustrate representative sonographic findings observed among study participants.

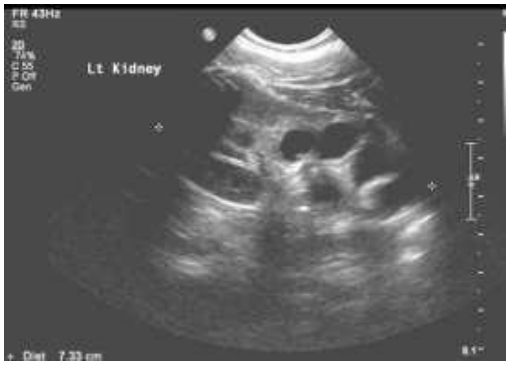
Case 1



Mild Hydronephrosis

Mild widening of the renal pelvis with minimal involvement of the collecting system.

Case 2



Renal Pelvic Dilation

The renal pelvis appears enlarged and fluid-filled, indicating dilatation of the central collecting system.

Case 3

Moderate-to-Marked Hydronephrosis

Extensive dilatation of the renal pelvis and calyceal system.



Increased Renal Echogenicity

The renal parenchyma appears relatively brighter than expected on the grayscale ultrasound examination.

DISCUSSION

This study was conducted to determine the prevalence of sonographic findings among children with laboratory-confirmed UTI and to characterize the pattern of renal and bladder abnormalities observed on ultrasound. The majority of children had structurally normal renal ultrasound findings, while a smaller subset exhibited identifiable abnormalities including hydronephrosis, cortical thickening, and bladder wall changes. These results suggest that a positive laboratory diagnosis does not necessarily correspond to a detectable structural abnormality, indicating that laboratory and sonographic findings capture distinct aspects of the disease process.

In this study, 81.6% of children exhibited normal renal ultrasound findings, whereas 18.4% demonstrated some form of abnormality. This is anticipated, as laboratory tests identify infection

through urinalysis and culture, whereas ultrasound detects structural or functional changes that may not always be present. Despite this, ultrasound remains a valuable first-line tool owing to its non-invasive nature, absence of radiation exposure, and ability to detect underlying congenital or structural anomalies that could otherwise go undetected.

Compared with the 5.7% reported by Hakkola et al., abnormal ultrasonography results were found in 18.4% of the pediatric UTI patients in the present study. Most patients (64.4%) were between one month and two years of age, and the highest proportion of abnormalities occurred in this age range. In contrast to the earlier study, the present study detailed several distinct types of renal abnormality, including bladder wall thickening, renal pelvic dilatation, and moderate hydronephrosis. The higher proportion of abnormalities may be explained by differences in study population, sample size, inclusion criteria, and the sonographic abnormalities evaluated (Hakkola et al., 2025).

While Mohammad et al. reported 31.8% abnormal renal ultrasonography findings, the present study reported 18.4%. Children with febrile UTI showed increased renal echogenicity in both investigations; increased echogenicity was detected in 3.4% of right kidneys and 1.1% of left kidneys in the current study, although a greater number of echogenicity changes were observed in the earlier analysis. Differences in sample size, study duration, and evaluation criteria may account for the discrepancy. Both studies confirm that renal ultrasound can detect structural renal abnormalities in pediatric UTI patients (Mohammad, Farooqi, & Mattoo, 2022).

Hydronephrosis was the most frequently observed abnormality, present in mild form in 8.0% of right kidneys and 5.7% of left kidneys, with fewer moderate cases on each side. Renal pelvic dilatation, cortical thickening, and increased echogenicity were each identified in a minority of cases, and a single small renal stone was detected on the left side. The predominance of hydronephrosis is consistent with previous pediatric UTI literature, in which collecting-system dilatation is reported as the most common ultrasound finding. Bladder wall thickening was observed in 26.4% of children; thickening during active infection typically reflects mucosal inflammation rather than a chronic condition, consistent with the expectation that cystitis frequently accompanies laboratory-confirmed UTI in children.

A distinguishing feature of this study is the reporting of both normal and abnormal sonographic findings, rather than limiting the analysis to abnormal cases as is common in the existing literature. In summary, although most children with laboratory-confirmed UTI have normal renal and bladder ultrasound findings, a significant minority exhibit detectable structural changes, most commonly hydronephrosis and bladder wall thickening. Ultrasound thus remains essential to the routine evaluation of pediatric UTI — not because it detects abnormalities in every case, but because it reliably identifies children who may require closer clinical follow-up.

CONCLUSION

This study revealed the prevalence of normal and abnormal ultrasound findings in children with confirmed UTI, in which the majority had normal ultrasound findings. Hydronephrosis was the most common abnormal finding. Pediatric UTI therefore does not always show abnormalities on ultrasound,

and the most affected age group was one month to two years. Ultrasound nonetheless remains an important, non-invasive first-line investigation for identifying the minority of children with underlying structural anomalies who require closer follow-up.

Limitations of the Study

As the study involved pediatric patients, obtaining parental or guardian consent was challenging. In addition, younger children were often unable to accurately describe their symptoms, which may have affected the collection of clinical information.

Recommendations

To increase the dependability and generalizability of the results and to assess long-term outcomes and UTI recurrence, prospective or longitudinal studies with larger samples should be carried out.

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