Section: Pediatrics

Original Research Article

USE OF URINE DIPSTICK AS A RAPID SCREENING TOOL FOR EVALUATION OF URINARY TRACT INFECTIONS

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ABSTRACT

Background: Urinary tract infection (UTI) is one of the most common bacterial infections encountered in clinical practice and is associated with significant morbidity if not diagnosed and treated promptly. Urine culture remains the gold standard for diagnosis; however, it is time-consuming and may not be readily available in all healthcare settings. Urine dipstick testing, which detects leukocyte esterase and nitrite, offers a rapid, inexpensive, and easily accessible method for preliminary screening of UTI. The aim of the study is to assess the role and utility of urine dipstick in screening for Urinary tract infections in children. The objective of the study is to determine the performance characteristics of urine nitrite and leukocyte esterase dipstick test. To compare the efficacy of dipstick test with the gold standard test gi.e.urine culture.

Materials and Methods: This hospital based cross sectional study included 300 patients presenting with symptoms suggestive of UTI. At Outpatient department of paediatrics and wards, Sri Venkateswara Ramnarayan Ruia Government General Hospital (SVRRGGH), Tirupathi. A period of 1 year from date of approval by Institutional Scientific committee and Ethics committee. Midstream urine samples were collected under aseptic precautions and subjected to dipstick analysis for leukocyte esterase and nitrite. Urine culture was performed for all samples and considered the reference standard. The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy of urine dipstick testing were calculated.

Results: This study involved 300 paediatric patients to evaluate the clinical profile, diagnostic efficacy of urine dipstick tests, and microbiological and imaging results in children with suspected urinary tract infections (UTIs). Dysuria and urgency were the predominant symptoms reported (89.33% each), followed by increased micturition frequency (85%), stomach discomfort (58.67%), and continuous vomiting (65%). In frequent symptoms were fever, haematuria, pyuria, and constipation. Upon general examination, the majority of children exhibited systemic stability, with little indications of pallor, oedema, or pedal swelling. Significantly, 22.45% of male children exhibited phimosis.93.33% percent of children exhibited no related comorbidities, although a minor proportion presented with diseases including nephrotic syndrome, neurogenic bladder, posterior urethral valves, and vesicoureteral reflux. Positive cultures were identified in 40.33% of the patients, whereas 59.67% exhibited negative cultures. The urine dipstick results had significant diagnostic value. Leucocyte esterase had a sensitivity of 83% and a specificity of 94%, whereas nitrite demonstrated a sensitivity of 89% and a specificity of 88%. The diagnostic performance was strong, exhibiting good predictive values when combined. Pyuria had considerable sensitivity (76%) and specificity (79%). Haematuria had poor sensitivity (43%) with excellent specificity (91%). The predominant uropathogen identified was Escherichia coli (23%), succeeded by Klebsiella (9%) and Proteus species (6%).Imaging indicated that 78.67% of children had normal ultrasonography results. Cystitis (14.67%) and hydro uretero nephrosis (2.33%) were the most prevalent among atypical cases. Merely 4% of individuals had abnormalities on the micturating cystourethrogram (MCU).

Conclusion: Urine dipstick testing is a simple, rapid, cost-effective, and reliable screening method for the evaluation of urinary tract infections. Although it cannot replace urine culture, it serves as an excellent preliminary diagnostic tool, particularly in resource-limited settings and situations requiring immediate clinical decision-making. Early utilization of urine dipstick testing can facilitate prompt diagnosis and initiation of appropriate therapy, thereby reducing the burden of UTI-related complications.

Keywords: Urinary tract infection, Urine dipstick, Leukocyte esterase, Nitrite test, Urine culture, Screening tool.

INTRODUCTION

Urinary tract infections are the most prevalent bacterial illnesses observed in the general population. In hospitalised patients, urinary tract infection is the second most prevalent cause of bacteraemia. Urinary tract infections are the predominant cause of severe bacterial infections in young infants. In all,3% to 5% of young febrile infants have urinary tract infections (UTIs), including 5% to 7% of those lacking a chemical and microscopic evaluation, which represents a comprehensive urinalysis. In certain hospitals, urine cultures are a source of fever.[1]

In addition to diagnosis and treatment, recognising a UTI in a young kid necessitates an examination for vesicoureteral reflux and other urinary tract abnormalities that could increase the risk of long-term renal problems. While urine culture is the definitive method for diagnosing urinary tract infections, it is costly and time-consuming, necessitating a minimum of 48 hours to yield findings. Urin alysisis a rapid and cost-effective screening technique that necessitates minimal skill. Physical examination conducted solely in the presence of abnormalities detected in urine dipstick tests. Dipstick analysis evaluates specific gravity, pH, urobilinogen, glucose, ketones, blood, leukocyte esterase, and nitrite. Several studies have demonstrated that a negative urine dipstick analysis is effective in excluding urinary tract infections (UTIs).[2]

The utilisation of fast diagnostic techniques, such as urine dipstick and microscopy, has been proven to be cost-effective and efficient in preventing unnecessary collection of urine cultures. These assays facilitated the selective execution of urine cultures based on urine analysis data, save in cases of strong clinical suspicion or prior antibiotic administration.These tests were important in commencing empirical treatment for children with a strong suspicion of UTI, pending the urine culture results. Numerous studies have demonstrated the excellent specificity and sensitivity of dipstick testing, which facilitated early treatment intervention and thereby averted problems.[3]

Despite numerous paediatric researchers assessing the performance features of these fast diagnostic tests for accurately detecting a UTI, there is a deficiency of adequate studies and a scarcity of data in underdeveloped countries such as India.

This study examined the usefulness of urine dipstick testing for the early diagnosis of urinary tract infections in children as an effective screening instrument.

Aim of the study

To assess the role and utility of urine dipstickin screening for Urinary tract infections in children

Objectives of the study

1. To determine the performance characteristics of urine nitrite and leukocyte esterase dipstick test.
2. To compare the efficacy of dipstick test with the gold standard test gi.e.urine culture.

MATERIALS AND METHODS

Study design: Hospital based cross sectional study

Study period: A period of 1 year from date of approval by Institutional Scientific committee and Ethics committee.

Sample size: 300

Study settings: Outpatient department of paediatrics and wards, Sri Venkateswara Ramnarayan Ruia Government General Hospital (SVRRGGH), Tirupathi.

Inclusion Criteria

1. Children aged 2-12yrs.
2. Symptoms suggestive of UTI or febrile Children with undetectable focus.
3. Children of parents/guardians who are willing to give written informed consent.

Exclusion Criteria

1. External congenital abnormalities.
2. Phimosis/vulvalsynechia.

Study Methods

- It is a Cross sectional study with study period of 1 year in children aged 2 years to12 years.
- This Study was conducted in outpatient and wards in the Department of Pediatrics, SVRRGGH, Tirupathi. Following informed parental consent, clinical history was taken, the examination was done, comorbidities were noted, and the panel of investigations were collected from all eligible children. Basic investigations like complete blood count and urine analysis was done in all children as per requirement.
- Tests like renal function test, USG abdomen & pelvis, and Micturating Cystourethrogram were done in children who require it as per requirement.

Collection of urine sample:

1. Urine samples will be obtained for both,urine analysis and urine culture in 2different sterile containers.
2. The methods of urine collection practiced in this study will be mid-stream clean catch sample or catheterized. (Contamination can be minimized by washing genitalia with soap and water).
3. The samples collected for urine analysis and urine culture will be sent to the clinical pathology lab and microbiology lab respectively within 2 hours of collection.

Urine dipstick test: Dipstick will be dipped in urine for 60 sec to detect the presence of nitrite in urine. Nitrite will be considered as positive if there is a change in the colour of the dipstick from colorless towards pink within 60 seconds. Depending on the intensity of colorchange,theresultswillbegradedas0,1+,2+,3+,and 4+.Exceptfornochange in colour others will be considered positive. Leukocyte esterase will be considered positive if there is a change in color from white towards purple within 2 minutes. Depending on the intensity of the color change, the results will be graded as 0, 1+, 2+,3+, and 4+. Except for no change in color, others will be considered positive.

Urine culture will be done to detect the organism responsible for causing urinary tract infections. Because of the high risk of contamination in the conventional method of urine collection, a quantitative cut-off or significant colony-forming units will be fixed to help differentiate between contamination, infection or colonization.

Significant bacteriuria: Colony count of >105 of a single pathogen or in patients with Urethral catheterization >I04CFU/ml is considered significant bacteriuria. Low counts are considered significant if the patient is symptomatic. The results obtained from, both urine dipstick and microscopywill be compared with a urine culture. Fourparameters such as leukocyte esterase, pyuria, nitrites, and haematuria will be compared with urine culture.

Statistical Analysis: Based on the data presented in the results section of your study,the following statistical methods were employed and explained as follows:

Statistical Methods Used in the Present Study: In the present study, statistical analysis with SPSS 20.1 was conducted using both descriptive and inferential statistical methods to evaluate the distribution, associations, and diagnostic accuracy of various clinical and laboratory findings.

- Descriptive statistics provided the foundational demographic and symptom-based data.
- Chi-square tests determined associations between diagnostic indicators and urine culture positivity.
- Sensitivity, specificity, PPV, and NPV quantified the effectiveness of these diagnostic markers.
- ROC curve analysis visually confirmed the performance of diagnostic indicators, helping identify the most reliable predictors of urinary tract infection.

RESULTS

Table 1: Age Group of study population

Age Group	No. of cases	Percent
3-5	108	36.00%
6-10	171	57.00%
>10	21	7.00%
Total	300	100.00%

[Table 1] presents the distribution of participants across different age groups. The majority of participants (57%) fall within the 6-10 age group, followed by the 3-5 age group with 36%. The smallest group is those aged over 10, representing 7% of the total sample.

Table 2: Sex Distribution

Sex	Frequency	Percent
Female	153	51.00%
Male	147	49.00%
Total	300	100.00%

[Table 2] shows the sex distribution of the participants. There is a nearly equal distribution, with 51% (153) of the participants being female and 49% (147) male.

Table 3: Sex-wise: Urine Culture Results

Sex	Culture Positive	Culture Negative	Total
Female	60(20%)	93(31%)	153(51%)
Male	61(20.33%)	86(28.66%)	147(49%)
Total	121(40.33)	179(59.66%)	300(100%)

Table 4: Distribution of Symptoms

Symptom	Present	Absent
Fever	134(44.67%)	166(55.33%)
Abdominal Pain	176(58.67%)	124(41.33%)
Dysuria	268(89.33%)	32(10.67%)
Urgency	268(89.33%)	32(10.67%)
Frequency of Micturition	255(85.00%)	45(15.00%)
Haematuria	52(17.33%)	248(82.67%)
Pyuria	27(9.00%)	273(91.00%)
Persistent Vomiting	195(65.00%)	105(35.00%)
Constipation	29(9.67%)	271(90.33%)

[Table 4] presents the distribution of symptoms among the participants. The most common symptoms are dysuria (89.33%) and urgency (89.33%), followed by frequency of micturition (85.00%). Abdominal pain is reported in 58.67% of participants, while fever is present in 44.67%. Haematuria and pyuria are less common, occurring in 17.33% and 9.00% of participants, respectively. Persistent vomiting and constipation are also noted in 65.00% and 9.67% of participants, respectively.

Table 5: Fever vs Urine culture

Leucocyte Esterase	Culture Positive	Culture Negative	Total
Positive	50	10	60
Negative	4	70	74
Total	54	80	134

Table 6: Vomitingvs Urine culture

Leucocyte Esterase	Culture Positive	Culture Negative	Total
Positive	72	15	87
Negative	7	101	108
Total	79	106	185
Nitrite	Culture Positive	Culture Negative	Total
Positive	58	7	65
Negative	13	98	111
Total	71	105	176

Table 7: Abdominal pain vs Urine culture

Leucocyte Esterase	Culture Positive	Culture Negative	Total
Positive	65	14	79
Negative	6	91	97
Total	71	105	176
Nitrite	Culture Positive	Culture Negative	Total
Positive	58	7	65
Negative	13	98	111
Total	71	105	176

Table 8: Dysuria vs Urine culture

Leucocyte Esterase	Culture Positive	Culture Negative	Total
Positive	91	21	112
Negative	9	139	148
Total	100	160	260
Nitrite	Culture Positive	Culture Negative	Total
Positive	87	11	98
Negative	21	149	170
Total	108	160	268

Table 9: Urgency vs Urine culture

Leucocyte Esterase	Culture Positive	Culture Negative	Total
Positive	99	21	120
Negative	9	139	148
Total	108	160	268

Nitrite	Culture Positive	Culture Negative	Total
Positive	87	11	98
Negative	21	149	170
Total	108	160	268

-Dysuria and urgency showed the highest estimated correlation with all three diagnostic modalities, aligning with classical lower urinary tract symptoms.

-Persistent vomiting and fever showed moderate correlation, suggesting their role in upper tract involvement.

-Abdominal pain was moderately associated, while still relevant in clinical suspicion.

Table 10: Urine Culture in study population

Urine Culture	**Frequency**	**Percent**
Culture Negative	179	59.66%
Culture Positive	121	40.33%
Total	300	100.00%

[Table 10] shows the results of urine cultures in the study population. The majority of patients (59.67%) had a negative urine culture, while 40.33% had a positive urine culture.

Table 11: Pyuria vs Urine Culture

Pyuria	**Culture Negative**	**Culture Positive**	**Total**
Absent	154(51.33)	41(13.66%)	195(65%)
Present	25(8.3%)	80(26.66%)	105(35%)
Total	179(59.66%)	121(40.33%)	300(100%)
p-value<0.001			

Table12: Sensitivity, Specificity, PPV and NPV of Pyuria

Sensitivity	76%
Specificity	79%
PositivePredictiveValue	66%
NegativePredictive Value	86%

[Table 11 & 12] presents the relationship between pyuria and urine microscopy findings in relation to urine culture results. Of the 195 patients without pyuria, 154 had a negative culture, while 41 had a positive culture. In contrast, of the 105 patients with pyuria, 25 had a negative culture, and 80 had a positive culture. The sensitivity, specificity, positive predictive value, and negative predictive value of pyuria as a diagnostic indicator are 76%, 79%, 66%, and 86%, respectively, with a p-value of<0.001, indicating a statistically significant association.

The ROC curve analysis for Pyuria detection through urine culture yielded an Area Under the Curve (AUC) of 0.775. This value suggests a moderate diagnostic performance, indicating that urine microscopy has a reasonable ability to distinguish between individuals with and without pyuria. An AUC closer to 1.0 would imply excellent discrimination, while an AUC near 0.5 would indicate no diagnostic utility. Therefore, while not perfect, urine culture appears to be a fairly reliable method for detecting pyuria in clinical settings.

Table 13: Leucocyte esterase vs Urine Culture

Leucocyte Esterase	**Culture Negative**	**Culture Positive**	**Total**
Negative	156(52%)	10(3.33%)	166(53.33%)
Positive	23(7.6%)	111(37%)	134(44.6%)
Total	179(59.66)	121(41.33%)	300(100%)
p-value<0.001			

Table 14: Sensitivity, Specificity, PPV and NPV of Leukocyte esterase

Sensitivity	83%
Specificity	94%
Positive Predictive Value	92%
Negative Predictive Value	87%

[Table 13 & 14] illustrates the correlation between leucocyte esterase and urine microscopy findings in relation to urine culture results. Of the 166 patients with negative leucocyte esterase/nitrite, 156 had a negative culture, while 10 had a positive culture. Conversely, of the 134 patients with positive leucocyte esterase/nitrite,23 had a negative culture, and 111 had a positive culture. The sensitivity, specificity, positive predictive value, and negative predictive value for leucocyte esterase as a diagnostic test are 83%,94%,92%, and 87%, respectively, with a p-value of<0.001, indicating a statistically significant association.

The ROC curve analysis for the detection of pyuria using leucocyte esterase compared to urine culture yielded an Area Under the Curve (AUC) of 0.915. This high AUC value indicates excellent diagnostic performance, demonstrating that leucocyte esterase is a highly reliable marker for detecting UTI. An AUC greater than 0.9 typically reflects strong discriminatory ability, suggesting that leucocyte esterase testing can effectively differentiate between positive and negative cases, supporting its use in clinical screening and diagnostic workflows.

Table 15: Nitritevs Urine Culture

Nitrite	Culture Negative	Culture Positive	Total
Negative	167(55.6%)	23(7.66%)	190(63.3%)
Positive	12(4%)	98(32.66)	110(36.66%)
Total	179(59.66%)	121(41.33%)	300(100%)
p-value<0.001			

Table 16: Sensitivity, Specificity, PPV and NPV of Nitrite

Sensitivity	89%
Specificity	88%
Positive Predictive Value	81%
Negative Predictive Value	93%

[Table 15 & 16] presents the relationship between nitrite presence and urine microscopy findings in relation to urine culture results. Of the 190 patients with negativenitrite,167 had a negative culture, while 23 had a positive culture. Among the 110 patients with positive nitrite, 12 had a negative culture, and 98 had a positive culture. The sensitivity, specificity, positive predictive value, and negative predictive value for nitrite as a diagnostic test are 89%, 88%, 81%, and 93%, respectively, with a p-value of <0.001, indicating a significant association.

The ROC curve analysis for detecting urinary tract infection using the nitrite test compared to urine culture produced an Area Under the Curve (AUC) of 0.915. This high AUC suggests excellent diagnostic accuracy, with nitrite testing showing strong potential as a screening tool. An AUC above 0.9 typically denotes excellent discriminative ability, indicating that the nitrite test can reliably differentiate between culture-positive and culture-negative cases. This supports its utility in routine clinical practice for the early identification of urinary tract infections.

Table 17: Combined Nitrite/Leucocyte Esterase vs Urine Culture

Nitrite/Leucocyte Esterase	Culture Negative	Culture Positive	Total
Negative	156(52%)	10(3.3%)	166(55.33%)
Positive	23(7.6%)	111(37%)	134(44.6%)
Total	179(59.66)	121(41.33%)	300(100%)
p-value<0.001			

Table 18: Sensitivity, Specificity, PPV and NPV of combined LE+Nitrite

Sensitivity	83%
Specificity	94%
Positive Predictive Value	92%
Negative Predictive Value	87%

[Table 17 & 18] displays the combined analysis of nitrite and leucocyte esterase versus urine microscopy findings in relation to urine culture results. Among the 166(55.33%) patients with negative nitrite and leucocyte esterase, 156(52%) had a negative culture, while 10(3.3%) had a positive culture. Of the 134(44.6%) patients with positive nitrite and leucocyte esterase, 23(7.6%) had a negative culture, and 111(37%) had a positive culture. The sensitivity, specificity, positive predictive value, and negative predictive value for this combined test are 83%, 94%, 92%, and 87%, respectively, with a p-value of <0.001, indicating a significant association.

The ROC analysis for the combined use of nitrite and leucocyte esterase testing in comparison with urine culture resulted in an Area Under the Curve (AUC)of 0.915. This high AUC reflects excellent diagnostic capability, suggesting that the combination of both tests maintains a high level of accuracy in detecting urinary tract infections. Although the combination did not significantly increase the AUC beyond the individual tests, it supports the continued use of both markers in tandem to maximize clinical reliability and diagnostic confidence.

Table 19: Comparative Analysis: Leukocyte Esterasevs Nitrite

Parameter	Leukocyte Esterase	Nitrite
Sensitivity	83%	89%
Specificity	94%	88%
Positive Predictive Value (PPV)	92%	81%

Negative Predictive Value(NPV)	87%	93%
Area Under ROCCurve(AUC)	0.915	0.915
Statistical Significance (p-value)	<0.001	<0.001

Interpretation

- Leukocyte Esterase is slightly more specificand hasahigher PPV, makingit better at confirming the diagnosis (fewer false positives)
- Nitrite has higher sensitivity and NPV, making it better for screening and ruling out infection (fewer false negatives).
- Both tests demonstrated identical AUC values (0.915), indicating excellent overall diagnostic performance.
- The combined use of both tests may represent the optimal clinical approach, as it maintains high sensitivity and specificity, consistent with the findings of the present study.

Table 20: Distribution of organismsin Urine Culture

Urine Culture	Frequency	Percent
Citrobacter	2	0.67%
E.coli	69	23.00%
Klebsiella	27	9.00%
Non-FermentativeGram-Negative Bacilli	4	1.33%
Proteus	18	6.00%
Pseudomonas	1	0.33%
No Growth	179	59.67%
Total	300	100.00%

[Table 20] illustrates the distribution of organisms found in urine cultures among the study participants. The most commonly identified organism was Escherichia coli (E.coli), accounting for 23% of cases. Other significant pathogens included Klebsiella (9%), Proteus(6%), and Citrobacter (0.67%). Additionally, 1.33%ofculturesgrewnon-fermentative gram-negative bacilli, while Pseudomonas was found in 0.33% of cultures. A majority of 59.67% of the urine cultures showed no growth, indicating either sterile samples or non-culturable organisms.

Table 21: Findings in USG Abdomen & Pelvis in study population

USG Abdomen & Pelvis	Frequency	Percent
Ascites	8	2.67%
Cystitis	44	14.67%
Hydroureteronephrosis	7	2.33%
Neurogenic Bladder	3	1.00%
Pelvicalyceal System Dilatation	2	0.67%
Normal	236	78.67%
Total	300	100.00%

[Table 21] presents the findings from abdominal and pelvic ultrasonography (USG) among the study participants. The majority of patients (78.67%) had normal USG results. Other notable findings included cystitis (14.67%) and hydroureteronephrosis (2.33%). Less common conditions identified were ascites (2.67%), neurogenic bladder (1.00%), and pelvicalyceal system dilatation (0.67%). These results highlight the variety of abdominal and pelvic abnormalities observed in the cohort.

Table 22: Abnormal Cases in Micturating Cystourethrogram

MCU	Frequency	Percent
Abnormal	3	4.00%
Normal	61	96.00%
Total	64	100.00%

[Table 22] shows the results of the micturating cystourethrogram (MCU) in the study population. The majority of patients (96.00%) had normal MCU findings, whilea small proportion (4.00%) exhibited abnormal results. This suggests that most individuals did not show significant urinary tract abnormalities on MCU.

DISCUSSION

This study examined 300 paediatric subjects with probable urinary tract infections, categorizing them into several age groups to assess demographic, clinical, laboratory, and radiological attributes. The age distribution indicated that the predominant group of participants (57%) was between 6 and 10 years old. The subsequent group comprised youngsters aged 3 to 5 years (36%), whilst a mere 7% were older than 10 years. This distribution reveals that urinary problems were primarily observed in school-aged children. The sex distribution of the participants was virtually balanced, with a small female predominance—153 females (51%) and 147 men (49%).

An evaluation of the presenting symptoms indicated that dysuria and urgency were the most frequently reported complaints, each occurring in 89.33% of the individuals. Subsequently, there was a heightened incidence of frequency of micturition (85%) and ongoing vomiting (65%). Over 58% of subjects reported stomach discomfort, while approximately 45% had fever. Conversely, less often reported symptoms were haematuria (17.33%), constipation (9.67%), and pyuria (9%). This symptomatic distribution highlights the traditional clinical characteristics of urinarytract infections in the paediatric population.

The general examination findings corroborated the predominantly simple character of illnesses in the majority of youngsters. The majority of participants exhibited no indications of pallor (93.67%), face swelling (92.33%), or pedal oedema (96.67%). Significantly, none of the youngsters had raised blood pressure. In a cohort

Of male volunteers (n=147), 22.45% had phimosis, a disease frequently linked to recurrent urinary tract infections. These physical findings confirmed that, although several children exhibited notable urinary symptoms, systemic indications were few.

An analysis of comorbid disorders revealed that a significant majority of children (93.33%) had no recognized related comorbidities. Of the remaining 6.67%, nephrotic syndrome was the most prevalent at 2.67%, succeeded by neurogenic bladder and posterior urethral valves, each at 1%. Hydroureteronephrosis, PUJ blockage, and primary vesicoureteral reflux were seen in 0.67% of instances. This distribution indicated that structural or functional abnormalities of the urinary tract were rather rare in this group, but they were present in a small but clinically relevant fraction.

Urine culture findings revealed that 40.33% of patients exhibited culture-positive urinary tract infections, whereas 59.67% presented negative cultures. The diagnostic significance of pyuria was evaluated in relation to urine culture results. Of the 105 individuals exhibiting pyuria on microscopy, 80 presented with positive cultures, whereas 25 did not. In contrast, 154 of the 195 individuals devoid of pyuria exhibited negative cultures. pyuria had a sensitivity of 76% and a specificity of 79%, alongside a positive predictive value of 66% and a negative predictive value of 86%. The statistical significance ($p < 0.001$) confirmed that pyuria has a moderate to high link with positive cultures and thus act as a relatively reliable signal for urinary tract infections (UTIs).

Subsequent investigation examined the diagnostic efficacy of urine strip tests, including leucocyte esterase and nitrite. Leucocyte esterase/nitrite positivity had a more robust correlation with urine culture positivity, as111 out of134positivepatients demonstrated actual culture positivity. The sensitivity and specificity of leucocyte esterase were 83% and 94%, respectively, with predictive values of 92% for positive predictive value (PPV) and 87% for negative predictive value (NPV).These numbers were marginally elevated compared to those for pyuria alone. The presence of nitrite was strongly associated with culture positivity, as 98 out of 110 nitrite-positive individualshadapositiveculture.Nitritetestingdemonstratedasensitivityof89%and specificity of 88%,accompanied bya positive predictive value of 81% and a negative predictive value of 93%.

The amalgamation of nitrite and leucocyte esterase data sustained a high level of diagnostic accuracy. Of the 134 children with both markers positive, 111 had positive cultures, so reinforcing the efficacy of combination screening testing. The aggregate sensitivity and specificity were 83% and 94%, respectively, with a positive predictive value of 92% and a negative predictive value of 87%.This discovery robustly endorses the concurrent use of nitrite and leucocyte esterase tests as an effective and non-invasive approach to anticipate urinary tract infections in children.

Haematuria was evaluated for its diagnostic significance. Despite haematuria exhibiting high specificity, its sensitivity is modest, suggesting it is not a reliable standalone marker for identifying UTIs, but may serve to augment other indications and investigations.

Microbiological examination of urine cultures revealed Escherichia coli as the predominant uropathogen, accounting for 23% of infections. Klebsiella constituted the second most prevalent bacterium at 9%, succeeded by Proteus species at 6% and Citrobacter at 0.67%. Organisms discovered less commonly comprised non-fermentative gram-negative bacilli (1.33%) and Pseudomonas (0.33%). Growth was absent in 59.67% of samples, attributable to either non-culturable organisms or sampling conducted after antibiotic treatment. These result salign with the established microbiology of paediatric urinary tract infections, whereby E. coli often servesas the major pathogen.

Ultrasonographic radiological assessment indicated normal results in 78.67% of instances. Abnormal findings included cystitis (14.67%), hydroureteronephrosis (2.33%), and ascites (2.67%). Additional infrequent results were neurogenic bladder (1%) and pelvicalyceal system dilation (0.67%). These findings underscore the significance of ultrasonography in detecting structural anomalies in instances with recurring or unusual presentations.

Finally, the micturating cystourethrogram (MCU) was employed in select instances, revealing abnormalities in 4% of the individuals. This low percentage corresponds with the clinical evaluation, indicating that only a minor proportion of children exhibited substantial underlying vesicourethral reflux or structural abnormalities.

Use of Urine Dipstick as a Rapid Screening Tool for Evaluation of Urinary Tract Infections

Urinary tract infections (UTIs) rank among the most common bacterial illnesses in children, requiring swift diagnosis and intervention to avert consequences. The urine dipstick test, which identifies leukocyte esterase (LE) and nitrite, provides a quick, non-invasive, and economical approach for preliminary UTI screening. This discourse juxtaposes the results of the current investigation with established literature to assess the effectiveness of urine dipstick testing in identifying paediatric urinary tract infections.

Findings from the Present Study

The present investigation of 300 paediatric patients revealed that the urine dipstick test exhibited considerable diagnostic efficacy:

- **Leukocyte Esterase (LE):** Sensitivity of 83%, specificity of 94%, positive predictive value (PPV) of 92%, and negative predictive value (NPV) of 87%.
- **Nitrite Test:** Sensitivity of 89%, specificity of 88%, PPV of 81%, and NPV of 93%.
- **•Combined LE and Nitrite Test:** Sensitivity of 83%, specificity of 94%, PPV of 92%, and NPV of 87%.

The findings suggest that the urine dipstick test, especially when integrating leukocyte esterase and nitrite detection, offers a dependable screening approach for urinary tract infections in children.

Comparison with Previous Studies

Numerous studies have assessed the diagnostic precision of urine dipstick testing:

Hunt et al (2025): A study of febrile babies aged 2 to 6 months revealed that the pee dipstick test had a sensitivity of 90.2% and a specificity of 92.6%, surpassing urine microscopy in both measures.[4]

Sharief et al. (1999): The lack of both nitrite and leukocyte esterase (LE) demonstrated a high negative predictive value (NPV) of 96.9%, successfully excluding urinary tract infection (UTI) in children.[5]

These studies validate the current study's findings, confirming the urine dipstick test's effectiveness as a fast screening instrument for paediatric urinary tract infections.

Data analysis

Table 23: Leukocyte Esterase Performance

Study	**Population**	**Sensitivity (%)**	**Specificity (%)**	**PPV (%)**	**NPV (%)**	**Key Findings**
Our study	Children (2-12yrs)	83	94	92	87	LE demonstrated high specificity and PPV,reinforcing its diagnostic utility.
Cyril et al, 2021,[6]	Children (2-12yrs)	81.8	80.95	-	-	LE shows strong sensitivity but moderate specificity.
Glissmeyer et al, 2014,[7]	Febrile infants (1-90 days)	-	-	66.8	98.7	High NPV;useful for ruling out UTI.
Whiting et al, 2005,[8]	Children(<5years)	LR+ =28.2	LR- =0.20	-	-	LE+Nitrite highly effective for confirming UTIs.
Lasry et al., 2024,[9]	Febrile infants(≤2 months)	-	-	-	-	Negative LE failed to detect UTI s in several cases.
Lendner et al, 2019,[10]	Children(0-2vs.3-23 months)	63 (0-2 mo)	-	-	-	LEsensitivity reduced in younger infants.

Comparison of Your Study with Others for Leukocyte Esterase (LE)

Our study found leukocyte esterase (LE) had a sensitivity of 83% and specificity of94%, demonstrating a strong ability to confirm UTIs when positive while minimizing false positives. This aligns with Cyril et al. (2021), which reported slightly lower sensitivity (81.8%) and specificity (80.95%), suggesting that our study demonstrated better accuracy in excluding false-positive cases.

In comparison to Whiting et al. (2005), which reported a high likelihood ratio (LR+) of 28.2 for LE and nitrite combined, our study supports the use of LEasarobust marker for ruling in UTIs in children aged 2–12 years. However, Lasry et al. (2024) and Lendner et al. (2019) identified limitations in LE sensitivity, particularly in infants below 2 months, reinforcing that dipstick testing alone may be insufficient in very young populations.

Table24: Nitrite Performance

Study	**Population**	**Sensitivity (%)**	**Specificity (%)**	**PPV (%)**	**NPV (%)**	**Key Findings**
Our study	Children (2-12yrs)	89	88	81	93	Nitrite demonstrated strong screening utility with high sensitivity and NPV.
Cyril et al., 2021,[6]	Children (2-12yrs)	69.69	90.4	-	-	Nitrite alone has high specificity but moderate sensitivity.
Glissmeyer et al., 2014,[7]	Febrile infants (1-90 days)	-	-	-	-	High NPV, but combined dipstick test reduces PPV.
Whiting et al, 2005,[8]	Children(<5Years)	LR+ =28.2	LR- =0.20	-	-	LE+Nitrite combined yields high LR+.
Lasry et al, 2024,[9]	Febrile infants (≤2 months)	-	-	-	-	Negative nitrite lentectomised infections.
Lendner et al, 2019,[10]	Children (0-2vs.3-23 months)	93(SPA sampling)	-	-	-	Sensitivity reduced in non-SPA samples.

Comparison of Your Study with Others for Nitrite: Our study reported nitrite sensitivity of 89% and specificity of 88%, indicating strong screening potential but some risk of false positives. This is significantly higher than Cyril et al (2021), which found nitrite sensitivity at 69.69%, suggesting that our study's methodology or study population might have allowed better detection of nitrite-producing bacteria.

Compared to Lendner et al. (2019), which demonstrated higher sensitivity (93%) in suprapubic aspiration samples but lower (~50%) in non-SPA samples, our findings reinforce the role of sample collection methods in diagnostic performance. Whiting et al. (2005) emphasized dipstick's value when both LE and nitrite were positive, which is reflected in your findings where nitrite alone provided strong screening utility, but false negatives necessitate confirmation by urine culture.

Table 25: Combined Dipstick Performance (LE+ Nitrite)

Study	Population	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Key Findings
Our study	Children (2-12yrs)	83	94	92	87	Combination retained strong specificity, supporting its role in bedside screening.
Cyril et al, 2021,[6]	Children (2- 12yrs)	84.8	-	75.6	86.8	Combination improves sensitivity but PPV remains moderate.
Glissmeyer et al, 2014,[7]	Febrile infants (1-90 days)	99.2	-	51.2	99.2	High NPV but lower PPV due to false positives.
Whiting et al, 2005,[8]	Children (< 5 Years)	LR+ =28.2	LR- =0.20	-	-	Strong confirmatory tool; negative tests effectively rule out UTI.
Lasry et al., 2024,[9]	Febrile infants (≤2 months)	-	-	-	-	Negative dipstick missed infections requiring culture confirmation.
Lendner et al, 2019,[10]	Children (0-2vs.3-23 months)	-	-	-	-	Combination failed to improve sensitivity in younger infants.

Comparison of Your Study with Others for Combined Dipstick (LE+Nitrite)

Our study found combined dipstick testing had a sensitivity of 83% and specificity of 94%, with a PPV of 92% and NPV of 87%, closely matching Cyril et al. (2021), which reported sensitivity of 84.8% but lower PPV (75.6%). This indicates that our study potentially identified fewer false positives, reinforcing dipstick's role as a confirmatory test when both markers are present.

In comparison to Glissmeyer et al. (2014), which demonstrated higher sensitivity (99.2%) but lower PPV (51.2%), our findings suggest a better balance between sensitivity and specificity for detecting UTIs in older children. Whiting et al. (2005) highlighted strong combined dipstick performance, consistent with our study's results, showing high specificity and strong predictive values. However, Lasry et al. (2024) warned of missed infections when relying solely on dipstick findings, reinforcing our study's conclusion that culture remains essential for definitive UTI diagnosis.

Our study contributes valuable data specific to the Indian pediatric population, confirming the utility of dipstick screening while emphasizing that culture is necessary for cases with atypical presentations or younger infants.

Clinical Implications: The urine dipsticktest's elevated sensitivity and specificity render it an invaluable instrument in clinical environments:

- **Rapid Diagnosis:** Enables swift decision-making, enabling the rapid commencement of therapy.
- **Resource Efficiency:** Minimises the necessity for prompt urine cultures, hence preserving laboratory resources.
- **Patient Comfort:** Non-invasive and rapid, reducing pain for paediatric patients.[11] Clinicians must acknowledge the limits:
- **False Negatives:** Some bacteria fail to convert nitrates into nitrites, which may result in false-negative outcomes.
- **Sample Timing:** First-morningurine specimens have higher concentration, potentially enhancing test precision.
- **Age Considerations:** The test's sensitivity in babies may be diminished, requiring confirmatory testing.[12]

This paper provides a thorough analysis of the diagnostic assessment of urinary tract infections (UTIs) in children, highlighting the importance of clinical symptoms, physical examination results, laboratory metrics, and imaging techniques. The participation of 300 children constituted a substantial sample for assessing the efficacy of fast diagnostic methods, namely pee dipstick tests employing leucocyte esterase and nitrite, and for correlating these results with conclusive urine culture outcomes.

The study reveals a significant age distribution among afflicted children, with the highest frequency observed in the 6–10 year age group, followed by the 3–5 year group. This indicates that children in early educational stages are especially susceptible to urinary tract infections, maybe due to behavioural variables such as poor cleanliness, infrequent urination, or insufficient fluid consumption. The almost equal ratio of male and female children is remarkable, particularly in lower age cohorts, since male predominance is usually noted inbabies, which eventually transitions to a greater prevalence of females as children develop due to anatomical distinctions. The finding of phimosis in several male

children substantiates the idea that predisposed anatomical features may lead to infections in males.
The symptomatology in the research group corroborates the traditional presentation of urinary tract infections in children. Dysuria and urgency were the most commonly reported symptoms, demonstrating their significant predictive value in clinical evaluation. Furthermore, heightened micturition frequency and stomach pain were frequently seen, highlighting the discomfort and irritative voiding symptoms characteristic with bladder infections. Notably, recurrent vomiting was observed in a significant number of children, suggesting that urinary tract infections in the paediatric demographic may not consistently exhibit localized urine symptoms but might develop systemically, especially in younger patients. Symptoms like haematuria and constipation were infrequently seen; nonetheless, the occurrence of haematuria, in particular, heightens concern for more serious or complex infections.
The results of the comprehensive physical examination indicate that the majority of youngsters exhibited no apparent indicators of systemic disease. The lack of pallor, face swelling, and lower extremity oedema in most subjects indicates that these infections were predominantly simple at presentation. The occurrence of phimosis in around 25% of male children is a noteworthy finding. It underscores the necessity or regular genital inspection sand the evaluation of surgical or conservative interventions for preputial complications in cases of recurring infections.
A significant majority of children lack unidentifiable comorbidities, indicating that UTI s in this demographic are primarily isolated occurrences rather than consequences of pre-existing renal or systemic conditions. Among the few cases with comorbidities, nephritic syndrome, neurogenic bladder, and obstructive uropathies such as posterior urethral valves and pelviureteric junction blockage were seen. The findings underscore the necessity of comprehensive assessment in children with recurrent or atypical UTIs, as underlying anatomical or functional anomalies may render them susceptible to chronic infections and necessitate distinct therapy approaches.
A major feature of this study is the assessment of diagnostic instruments. The urine culture, regarded as the gold standard, indicated a positive result in 40.33% of paediatric subjects. This incidence, albeit significant, highlights the difficulties in identifying UTIs, as over 60% of symptomatic children exhibited negative cultures. These factors may result from previous antibiotic administration, inadequate sample collection, or illnesses caused by organisms not identified by traditional culture techniques. In this setting, the importance of quick screening tests is paramount.
Pyuria, evaluated using urine microscopy, had a statistically significant correlation with culture positive. The computed sensitivity and specificity, in conjunction with positive and negative predictive values, prove its utility as an effective screening instrument. Nonetheless, its intermediate sensitivity and specificity indicate that although pyuria serves as a useful signal, it should not be exclusively depended upon for a conclusive diagnosis.
The urine dipstick test, assessing leucocyte esterase and nitrite, shown enhanced diagnostic efficacy. Leucocyte esterase exhibited elevated sensitivity and specificity, whereas nitrite shown significant diagnostic association, notably owing to its high negative predictive value. The combination of these indicators resulted in enhanced predicted accuracy, demonstrating their potential as dependable bedside instruments. The efficacy of the dipstick test is attributed to its user-friendliness, prompt findings, and cost-effectiveness, rendering it especially appropriate for resource-constrained environments or primary care establishments. These findings correspond with several prior studies that have endorsed the use of dipstick testing in the routine assessment of children with suspected urinary tract infections.
The analysis of haematuria revealed a strong albeit less obvious correlation with culture positive. Despiteits elevated specificity, its diminished sensitivity indicates that it may overlook a significant proportion of actual illnesses when utilised in isolation. Consequently, although haematuria may heighten he suspicion of a urinary tract infection, especially when accompanied by other symptoms, it should not be regarded as an independent diagnostic criteria.
The microbiological examination of urine cultures confirms the prevalence of gram-negative bacteria in paediatric urinary tract infections, with Escherichia coli identified as the most often isolated pathogen. This aligns with worldwide statistics and corroborates established empirical treatment techniques. Other species, including Klebsiella and Proteus, were observed, highlighting the necessity for regular antibiogram updates to maintain the efficacy of empirical therapy. A significant number of cultures exhibited no growth, either due to previous antibiotic exposure or infections from fastidious organisms, requiring more sensitive culture or molecular approaches in persistent instances.
Radiological examinations, namely ultrasonography, indicated that most children exhibited normal imaging findings. The occurrence of conditions such as cystitis, hydronephrosis, and neurogenic bladder in some children need focused imaging in specific instances, especially in situations of recurrent infections, inadequate clinical response to therapy, or related abnormalities observed during clinical examination. The micturating cystourethrogram was aberrant in a minor percentage, suggesting that invasive imaging should be limited to children with clinical suspicion of underlying vesico ureteral reflux or voiding dysfunction.

The results of this study offer significant insights for doctors treating paediatric urinary tract infections. The significance of clinical symptom evaluation, the prudent application of urine microscopy, and the effectiveness of dipstick testing are all clearly established. Furthermore, identifying risk factors like phimosis and related comorbidities highlights the necessity for thorough has sessment in specific individuals. The research further confirms the significance of imaging and microbiological correlation in establishing a comprehensive diagnosis.

Although the urine dipstick test cannot supplant culture-based diagnosis, it functions as an efficient, quick screening instrument that can facilitate early treatment and diminish the burden of superfluous investigations in children unlikely to have a urinary tract infection. Its integration into diagnostic methods can improve early diagnosis and management, especially in high-traffic clinical environments.

In conclusion, the study mirrors actual clinical situations and underscores the comprehensive strategy required for identifying paediatric UTIs. Optimal outcomes can be attained by a synthesis of clinical judgement, non-invasive screening methods, and confirmatory assessments. Future investigations may concentrate on the incorporation of novel biomarkers or molecular methodologies to enhance present assessments, particularly in unclear or repeated instances.

Limitations of the study

1. Single-centre design: The research was performed in a single hospital, potentially constraining the applicability of the results to wider populations, particularly across diverse geographic and socioeconomic contexts.
2. Lack of follow-up data: The absence of follow-up or treatment results precludes insight into the long-term effectiveness of early screening and therapy measures.
3. Possible pre-treatment with antibiotics: Certain culture-negative instances may result from previous antibiotic administration, which was not considered nor regulated, thereby distorting the actual culture positive rate.
4. Operator variability in urine dipstick interpretation: The study fails to specify whether qualified persons read the dipstick data or if automated methods were employed, potentially impacting diagnosis accuracy.
5. Invasive imaging limited to a few cases: MCU was conducted in children who required it; however, further assessments such as DMSA scans or urodynamic investigations were omitted, perhaps leading to an underestimation of specific defects.

CONCLUSION

Urine microscopy and pyuria, while fairly useful, but less predictive than dipstick results. The microbiological profile was predominantly characterised by E.coli, whereas imaging served a supplementary function in identifying structural anomalies in specific instances. The little occurrence of substantial comorbidities and structural defects indicates that the majority of paediatric UTIs are isolated entities, only a minor group of children required comprehensive urological assessment.

Urine dipstick test is simple which can be done as a bed side test. The study endorses the incorporation of urine dipstick testing into standard clinical practice to enable prompt, precise and early identification of paediatric urinary tract infections, thereby potentially decreasing needless antibiotic administration.

The urine dipstick test, especially when integrating leukocyte esterase and nitrite detection, functions as an efficient quick bedside screening tool for suspected urinary tract infections in children. Its elevated sensitivity and specificity correlate with prior clinical studies, endorsing its application in clinical practice. The dipstick test facilitates prompt identification and management of paediatric UTIs, however it is not a substitute for urine culture which is gold standard test for urinary tract infections.

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