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ORIGINAL ARTICLE

Diagnostic test accuracy of dipstick urinalysis for diagnosing urinary tract infection in febrile infants attending the emergency department.

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ABSTRACT… Objective: To assess the diagnostic accuracy of dipstick urinalysis for diagnosing urinary tract infection in febrile infants taking urine culture as gold standard. **Study Design:** Cross sectional, validation. **Setting:** Pediatric Department, Dr. Akbar Niazi Teaching Hospital, Islamabad. **Period:** October 2024 to March 2025. **Material and Methods:** After fulfilling the inclusion criteria, 336 patients were enrolled in the study. A urine sample was collected and then divided into two portions. One was tested with a dipstick and other sent for culture. Infants were labelled positive or negative based on each result. Data is analyzed using SPSS version 25. **Results:** The mean age of the patients was 12.23±6.74 months, 176(52.4%) patients were male and 160(47.6%) patients were females and 130(38.7%) patients were from rural area and 206(61.3%) were from urban area. The sensitivity, specificity, PPV, NPV and diagnostic accuracy of dipstick method for detection of UTI was 95.21%, 93.24%, 94.71%, 93.88% & 94.35% respectively taking urine culture as gold standard. **Conclusion:** Dipstick urinalysis is reliable and useful method with high diagnostic value for diagnosing urinary tract infection in febrile infants taking urine culture as gold standard.

Key words: Dipstick Method, Urine Culture, Urinary Tract Infection.

INTRODUCTION

Patients treated in a variety of therapeutic settings, including the emergency room, frequently suffer from urinary tract infections (UTIs). Reducing the morbidity linked to this illness requires prompt diagnosis and effective treatment.[1] However, diagnosis is still challenging, most likely due to the fact that it presents nonspecifically and similarly to other prevalent disorders.[2] When a UTI diagnosis is being contemplated, urine dipstick testing for leukocyte esterase and nitrite is frequently utilized to support clinical decision making.[3] Among symptomatic infants, 15.5% had UTI.[4] UTIs make about 80% to 90% of all bacterial illnesses in this age group, making them the most prevalent kind of bacterial infection. Young babies with UTIs often have non-specific symptoms such as fever, vomiting, lethargy, irritability, and poor feeding.[5,6]

The National Institute for Health and Care Excellence (NICE) provides guidelines for the diagnosis and treatment of UTIs in the United Kingdom. The clinical guideline CG54 "Urinary tract infection in under 16s: diagnosis and management" advises referring all infants under three months old who have a suspected UTI to a pediatric specialist for evaluation.[5,7]

Among other techniques, dipstick urinalysis and/or centrifuged urine microscopy are examples of UTI screening techniques. The Clinical Laboratory Improvement Amendment exempts urine dipsticks, a quick and low-cost screening test that may be used in outpatient departments and other labs. It has been demonstrated that dipstick works effectively as a UTI screening tool for kids ≥2 years old.[8] Research on the effectiveness of dipsticks in treating UTIs has been published.

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However, there aren't many research on the pediatric population, particularly with young infants.[9,10]

The purpose of this study is to evaluate the diagnostic precision of dipstick urinalysis in identifying UTI in babies who are febrile presenting at the emergency room. Dipstick is a non-invasive and cost-effective procedure. Literature showed that diagnostic accuracy of dipstick urinalysis varies in different studies for diagnosis of UTI. Moreover, limited local evidence exist in literature, as in Pakistan, healthcare facilities are limited and still urine culture is in use which is expensive and time consuming method. So, cheap and accessible methods are required to be explored. Therefore, this study is aimed to assess the magnitudes in local population and to attain a reliable medium for diagnosis of UTI, especially in emergency department. In the future, we will use the dipstick approach to diagnose UTIs in the pediatric population, which will help us advance our understanding and practice. Diagnostic accuracy of dipstick urinalysis varies in different studies for diagnosis of UTI. Early UTI diagnosis might minimize the need for more invasive treatments like lumbar puncture. Therefore, using urine culture as the gold standard, the purpose of this study was to assess the diagnostic accuracy of dipstick urinalysis in detecting UTIs in neonates with fevers.

METHODS

This was cross sectional validation study which was carried out at Pediatric Department, Dr. Akbar Niazi Teaching Hospital, Islamabad after approval from ethical committee (111/IMDC/IREB-2023). The duration of the study was six months from October 2024 to March 2025.

In this study, urinary tract infection was labeled if leucocytes and nitrites "≥+1" were present. On culture of urine sample, it was considered as positive if bacterial growth of "≥100,000 cfu/ml" and presence of pyuria (>5 WBC per high-power field). Total 336 patients were enrolled in this study.

The sample size was calculated by using sensitivity & specificity calculator. Confidence interval was 95%, percentage of UTI i.e. 15.5%[4] with sensitivity of dipstick i.e. 93% with 7% margin of error and specificity 91%, with 9% margin of error.[11] All the patients were enrolled by applying non-probability consecutive sampling technique. Infants aged 2-24 months of both genders presenting with symptoms i.e. fever >99°F for >2 days, abdominal pain (on clinical examination) - fall within inclusion criteria and children presenting with recurrent urinary tract infections, already received antibiotic treatment for other reasons (as indicated in the medical record) and those with congenital renal disorder (per medical record) - fall under exclusion criteria. Data was recorded by on duty doctors on specially designed Proforma after informed consent of caretakers, of patients. Urine samples (5ml) were collected via midstream for >1 year, catheter aspirated/collecting bag for 2 months to 1 year. Samples were divided in two parts. In step 1, urine dipstick was dipped in urine for 1 second, after 60 seconds color of the detection pad of the strip was compared with the color scale on the test strip vial. Results were noted, and infants were labeled as positive or negative accordingly. In Step II second part of sample was sent to the hospital laboratory for urine culture. Similarly, infants were categorized as positive or negative on the basis of urine culture report. Infants with urinary tract infection were managed as per standard protocol. The dipstick test was provided by the investigator, and its results were compared with the urine culture results, which were performed at the hospital.

All the collected data was entered and analyzed on SPSS version 25. Numeric variables like age, weight, duration of symptoms, were presented as mean and standard deviation. Categorical variables like gender, socioeconomic status, residence, and urinary tract infection were presented as frequency and percentage. A 2x2 tables were generated to calculate sensitivity, specificity, positive and negative predictive value and diagnostic accuracy of dipstick urinalysis taking culture as gold standard. Data was stratified for age, gender, duration of symptoms, weight, socioeconomic status, and residence.

Post-stratification, 2x2 tables were generated to calculate sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of dipstick urinalysis for each stratum, using culture as the gold standard.

RESULTS

In this study total 336 patients were enrolled. The mean age of the patients was 12.23±6.74 months, the mean weight and duration of symptoms of the patients was 9.59±3.08 kg and 5.04±1.38 respectively. Among 336 patients 176(52.4%) patients were male and 160(47.6%) patients were females. According to this study 130(38.7%) patients were from rural area and 206(61.3%) were from urban area. Patients from low socio-economic group were 127(37.8%) while 144(42.9%) & 65(19.3%) were from middle and high socio-economic group. Dipstick method diagnosed UTI in 189(56.3%) patients and urine culture diagnosed positive UTI among 188(56%) patients (Table-I).

		Frequency	Percent
Gender	Male	176	52.4
	Female	160	47.6
Residence	Rural	130	38.7
	Urban	206	61.3
SES	Low	127	37.8
	Middle	144	42.9
	High	65	19.3
UTI on dipstick method	Positive	189	56.3
	Negative	147	43.8
UTI on urine culture	Positive	188	56.0
	Negative	148	44.0
Age (months)		12.23±6.74 (2.0-24.0)	
Weight (kg)		9.59±3.08 (3.0-15.0)	
Duration of symptoms		5.04±1.38 (3.0-7.0)	

Table-I. Descriptive statistics of demographic and clinical variables of the patients

The sensitivity, specificity, PPV, NPV and diagnostic accuracy of dipstick method for detection of UTI was 95.21%, 93.24%, 94.71%, 93.88% & 94.35% respectively taking urine culture as gold standard (Table-II).

Urinary Tract Infection		Urine Culture		Total
		Positive	Negative	
Dipstick Method	Positive	179	10	189
	Negative	9	138	147
Total		188	148	336

Table-II. Validity of detection of UTI by dipstick method taking urine culture as gold standard

Sensitivity	:	95.21%
Specificity	:	93.24%
Positive Predictive Value	:	94.71%
Negative Predictive Value	:	93.88%
Diagnostic Accuracy	:	94.35%

In patients having age ≤12 months the diagnostic accuracy of dipstick method for detection of UTI was 94.8% and in patients having age >12 months the diagnostic accuracy of dipstick method for detection of UTI was 93.7% taking urine culture as gold standard. In male patients the diagnostic accuracy of dipstick method for detection of UTI was 94.3% and in female patients the diagnostic accuracy of dipstick method for detection of UTI was 94.4% taking urine culture as gold standard. In patients having weight ≤8 kg the diagnostic accuracy of dipstick method for detection of UTI was 96% and in patients having weight >8 kg the diagnostic accuracy of dipstick method for detection of UTI was 93.3% taking urine culture as gold standard. In patients having duration of symptoms ≤5 the diagnostic accuracy of dipstick method for detection of UTI was 93.9% and in patients having duration of symptoms >5 the diagnostic accuracy of dipstick method for detection of UTI was 97.1% taking urine culture as gold standard. In patients from rural area the diagnostic accuracy of dipstick method for detection of UTI was 92.3% and in patients from urban area the diagnostic accuracy of dipstick method for detection of UTI was 95.6% taking urine culture as gold standard. In patients low SES the diagnostic accuracy of dipstick method for detection of UTI was 98.4%, in patients from middle SES group it was 93.7%and in patients from high socio-economic group the diagnostic accuracy of dipstick method for detection of UTI was 87.7% taking urine culture as gold standard (Table-III).

Variables	Dipstick Method for UTI detection				
	Sensitivity	Specificity	PPV	NPV	Diagnostic Accuracy
Age (months)					
Up to 12	98%	81.3%	92.4%	97.6%	94.8%
>12	92.05%	97.5%	97.6%	88.5%	93.7%
Gender					
Male	92.9%	96.1%	96.8%	91.4%	94.3%
Female	97.7%	90.1%	92.5%	96.9%	94.4%
Weight (Kg)					
Up to 8	96.9%	95.1%	95.4%	96.7%	96.0%
>8	94.3%	91.9%	94.3%	91.9%	93.3%
Duration of symptoms					
Up to 5	96.3%	90.9%	92.8%	95.2%	93.9%
>5	97.4%	96.7%	97.4%	96.7%	97.1%
Residence					
Rural	93.4%	90.7%	93.4%	90.7%	92.3%
Urban	96.4%	94.7%	95.6%	95.7%	95.6%
Socio-economic Group					
Low	98.6%	98.2%	98.6%	98.2%	98.4%
Middle	91.4%	98.0%	98.8%	86.2%	93.7%
High	100.0%	80.9%	74.2%	100.0%	87.7%

Table-III. Validity of detection of UTI by dipstick method taking urine culture as gold standard stratified by age, gender, weight, duration of symptoms, residence and SES

DISCUSSION

The most common cause of infection in children under five is urinary tract infections (UTIs).[12] Reducing the risk of renal scarring requires prompt diagnosis and treatment. In place of culture, quick and economical techniques for UTI analysis are required.[13,14] Urine dipsticks are useful at the point of care, but urinalysis requires laboratory analysis.[15]

According to a study by Malik Abid Ali et al.[13], which used urine culture as the gold standard, the frequency of UTI in children was 20.69% (n=84). The diagnostic performance of dipstick in comparison to urine culture, showed a sensitivity of 80.95%, specificity of 62.42%, positive predictive value 35.98%, negative predictive value 92.63%, and overall diagnostic accuracy of 66.26%.

The author concluded that when urine culture is utilized as the gold standard, urine dipsticks had a higher diagnostic accuracy in diagnosing UTIs in children. This simple and affordable method may be utilized in our daily routine to anticipate UTIs in children.

Several studies have reported varying diagnostic accuracy of dipstick urinalysis for the detection of Urinary tract infections using urine culture as the gold standard. It has been reported that dipstick urinalysis had 42% sensitivity and 95% specificity for diagnosis of UTI taking urine culture as gold standard.[16] In contrast another study demonstrated a sensitivity of 93% and specificity of 91%.[11] Another study found that the sensitivity and specificity of dipsticks tests were 56% and 85%, respectively taking urine culture as gold standard.[17] A study conducted in Pakistan found that sensitivity and specificity of dipsticks tests were 75.74% and 68.90%, respectively, for diagnosis of UTI.[18]

A study by Whiting et al[19] which examined the diagnostic precision of microscopy and

dipstick analysis for pediatric UTIs provided a comprehensive evaluation, that UTI can be reliably excluded without performing culture when dipstick analysis is negative for leukocyte esterase and nitrite when microscopy does not reveal bacteriuria or pyuria. Additionally, microscopy and positive dipstick tests may warrant additional testing with a urine culture to confirm a UTI.[20]

A study by Thomas Waterfield et al showed that the presence of leukocytes was the most sensitive individual dipstick test for UTIs. A sensitivity of 0.87 (95% CI 0.69 to 0.94) and a specificity of 0.73 (95% CI 0.67 to 0.79) were obtained by classifying "trace" as positive. The presence of nitrites was the most reliable individual dipstick test for UTIs. With a specificity of 0.91 (95% CI 0.86 to 0.94) and a sensitivity of 0.42 (95% CI 0.26 to 0.59), the trace was deemed positive.[16]

Our study's findings support the use of urine dipsticks to identify UTIs early since they are a simple, affordable test that enables prompt diagnosis, early initiation of antibiotic therapy and minimizes complications associated with delayed diagnosis. Although this successful method is not commonly used in our hospital context, based on our research findings and those of other studies, its usage might help us reduce problems by promoting early treatment and minimize the need for further invasive investigations such as lumbar puncture.

CONCLUSION

On the basis of this study we may conclude that dipstick urinalysis is reliable and useful method with high diagnostic value for diagnosing urinary tract infection in febrile infants taking urine culture as gold standard

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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1	**Kiran Azhar:** Study concept, study design, data collection, methodology, data analysis, discussion.
2	**Rubina Zulfqar:** Study concept, study design, discussion, literature review, proof reading.
3	**Sohail Aslam:** Literature review, discussion, proof reading.
4	**Sadaf Khan:** Data collection, study design, drafting, introduction, methodology.
5	**Hira Hameed:** Data collection, data analysis, introduction, discussion, methodology.
6	**Kamran Ullah:** Data collection, data analysis, literature review.