



Relationship Between Leukocyte Esterase and Nitrite in Urine in Patients with Urinary Tract Infections at Suai Referral Hospital Covalima Timor-Leste

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Keywords	ABSTRACT
Leukocyte esterase, Nitrite, Urinary Tract Infection (UTI).	Urinary tract infections (UTIs) represent a significant healthcare concern, particularly among females. Accurate diagnosis is imperative to prevent complications associated with UTIs. The urinalysis procedure, often referred to as dipstick analysis, serves as a preliminary screening test for the identification of UTIs. This analysis typically examines two parameters: leukocyte esterase and nitrite. However, these parameters exhibit varying degrees of sensitivity and specificity in detecting UTIs. This study aims to ascertain the relationship between leukocyte esterase and nitrite in the urine of patients with UTIs. An observational analytical design with a cross-sectional approach was adopted. Samples were randomly selected from a cohort of 50 patients diagnosed with UTIs at Suai Referral Hospital in Covalima, Timor-Leste. Data were analyzed using the chi-square test in SPSS. The results indicated that 80% of UTI patients were leukocyte esterase-positive, while the remaining 20% were negative. Furthermore, 50% were nitrite-positive, and the remaining 50% were negative. Statistical analysis revealed no significant association between the presence of leukocyte esterase and nitrite in the urine of UTI patients ($p = 0.480$; $p > 0.05$). Consequently, no statistically significant relationship was identified between leukocyte esterase and nitrite levels in the urine of UTI patients. Therefore, urine dipstick examination should be complemented by more precise methods, such as urine culture, to ensure a more accurate diagnosis.

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Introduction

The urinary system is a vital part of the human body, playing an important role in eliminating metabolic waste through urine production (Nancy A. Brunzel, 2023). One of the most common conditions affecting the urinary system is urinary tract infection (UTI),

characterized by the rapid proliferation and colonization of bacteria within the urinary tract (Sabriani et al., 2021).

Globally, UTIs are among the most common bacterial infections, affecting millions of people annually and imposing a substantial burden on healthcare systems worldwide. The prevalence of UTIs continues to increase every year. Data from the World Health Organization (WHO) indicate that the global incidence of this infection exceeds 8.3 million cases annually (Maulani & Siagian, 2021). Women are disproportionately affected, with a lifetime risk of UTI approaching 50–60%, compared to approximately 12% in men. The economic impact is significant, with annual healthcare costs for UTI management exceeding USD 3.5 billion globally.

In Indonesia, UTIs affect about 5–15% of the population, with women having a much higher risk compared to men. The Indonesian Ministry of Health estimates that the annual incidence of UTIs ranges from 90 to 100 cases per 100,000 people, resulting in around 180,000 new cases each year (Abbas et al., 2023). Rosero et al. (2021) reported that, although no specific research on UTI prevalence has been conducted in Timor-Leste, data from the *Department of Child Health* at CMH have provided some initial insights. Research conducted at the *Children's Polyclinic of Budi Kemuliaan Hospital* and *Thamrin Hospital* from June to December 2011 found that *Escherichia coli* was the primary cause of UTIs, accounting for 18.2% of cases. According to reports from the *Suai Referral Hospital (HRS)*, UTIs were among the top ten most common cases, with a total of 591 cases—170 in men, 350 in women, and 71 in children (Hospital Referral de Suai, 2023).

There are several laboratory testing methods to diagnose UTIs, one of which is the *urinary dipstick* test. The *urinary dipstick* test is widely used as an initial screening method for UTIs. This test detects the presence of leukocyte esterase and nitrites, both of which aid in the diagnostic process.

- **Leukocyte Esterase (LE):** Leukocyte esterase serves as an indicator of pyuria, reflecting the presence of white blood cells in urine. This enzyme, produced by neutrophils, basophils, and eosinophils, is often released in response to bacterial infection. The test works by hydrolyzing specific esters, triggering an *azocoupling* reaction that changes the color of the test strip from beige to purple.
- **Nitrite:** Nitrites indicate bacteriuria, particularly the presence of bacteria capable of reducing nitrates to nitrites. A positive nitrite result in a *urinary dipstick* test shows that bacteria in the urine have converted nitrates into nitrites (Malau & Adipireno, 2019). This process is facilitated by the enzyme nitrate reductase, predominantly found in gram-negative bacteria such as *Escherichia coli*, *Klebsiella*, and *Proteus* species (Malau & Adipireno, 2019).

Urinary dipsticks are commonly used worldwide, with many countries adopting them as the primary UTI diagnostic method in medical facilities due to their ease of use and cost-effectiveness. However, studies have shown significant variability in the sensitivity and specificity of *dipstick* assays. For example, Agpaoa et al. (2015) reported a sensitivity of 95.2% and specificity of 82.3%, whereas Demilie et al. (2014) found that leukocyte esterase had a sensitivity of 71.4% and specificity of 90%, and nitrites had a sensitivity of 57.7% and specificity of 96.7%. In contrast, Mambatta et al. (2015) reported much lower sensitivity—23.31% for nitrites and 48.5% for leukocyte esterase. Ginting et al. (2018) reported a sensitivity of 88.2% and specificity of 98.7%, while the State (2018) recorded sensitivity at 89.28% and specificity at 56.71% (Parwati & Cahyani, 2023).

As Parwati and Cahyani (2023) noted, although many studies have examined varying sensitivity and specificity outcomes, the detection of nitrites and leukocyte esterase in urine can serve as an important early diagnostic tool for UTIs, particularly in settings where culture-based diagnostic facilities are limited or unavailable. It is important to note, however, that the absence

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of leukocyte esterase does not definitively rule out UTIs, and the absence of nitrites does not unequivocally confirm the absence of microbial infection.

Currently, there is a critical lack of local data regarding the diagnostic performance of *urinary dipstick* parameters in Timor-Leste. This study addresses this gap by providing the first comprehensive analysis of the relationship between leukocyte esterase and nitrite in UTI patients within the Timorese healthcare context. Based on this background, the researcher aims to investigate the association between leukocyte esterase and nitrite in urine among patients diagnosed with UTIs at *Suai Covalima Referral Hospital*, Timor-Leste.

The purpose of this study is to determine the relationship between leukocyte esterase and nitrite in urine in patients with UTIs at *Suai Covalima Referral Hospital*, Timor-Leste, as well as to measure their respective levels in these patients. This research is expected to provide valuable information regarding laboratory examinations supporting UTI diagnosis and to explore the relationship between these two parameters. The findings will not only add insight and provide information to all staff at *Suai Covalima Referral Hospital* but will also offer practical contributions for healthcare professionals, especially *Ahli Teknologi Laboratorium Medik (ATLM)*, in enhancing their understanding of laboratory examinations related to UTIs. Ultimately, the results of this study can serve as a useful reference in daily clinical practice.

RESEARCH METHODS

The design of this study aimed to determine the relationship between leukocyte esterase and nitrite, using observational analytical methods with a cross-sectional research design. The research was conducted at the Clinical Laboratory of *Hospital Referral Suai, Covalima*, Timor-Leste, from April to May 2025, including data processing and analysis, which continued until June 2025. The study population consisted of all patients diagnosed with urinary tract infections (UTIs) at the hospital between November 2023 and January 2024, totaling 55 individuals. Samples were drawn from secondary data obtained from the medical records of patients who had undergone *urinary dipstick* tests, using a simple random sampling technique to ensure unbiased representation. The sample size was calculated using the *Slovin* formula, resulting in 50 subjects.

In this study, the independent variable was leukocyte esterase, while nitrites served as the dependent variable. The data were obtained from patient medical records of those undergoing examination, and data collection was carried out in three stages: preparation, analysis, and final stage. The collected data were analyzed using SPSS statistical software, employing both univariate and bivariate analyses. The Chi-square test was used to evaluate the relationship between the two variables. Ethical considerations were upheld by providing clear explanations to participants about the purpose of the research, ensuring the preservation of their health and well-being, and guaranteeing fair treatment without bias.

RESULTS AND DISCUSSION

Data Analysis Results

Results of Leukocyte Esterase and Nitrite Examination in UTI Patients

Table 1. Results of leukocyte esterase and nitrite examination

No	Examination	Positive Results		Negative Results	
		n	%	n	%
1	Leukocyte Esterase	40	80	10	20
2	Nitrite	25	50	25	50

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Of the 50 samples examined, 80% (40 samples) were positive for leukocyte esterase, and 20% (10) were negative. Meanwhile, the results of the nitrite examination were obtained positive results for 50% (25) nitrites and negative results were obtained as much as 50% (25)

Results of the Relationship Test Between Leukocyte Esterase and Nitrite in UTI Patients

Bivariate analysis was performed to examine the relationship between leukocyte esterase and nitrite levels in individuals diagnosed with a UTI; The results can be found in the table below

Table 2. Results of bivariate analysis

Test	Z Score	Asymp. Sig. (2-tailed)
Chi Square	0.500 ^a	0.480

Based on table 2, statistical analysis conducted to identify the relationship between these variables reveals a p value of 0.480, which exceeds the threshold of 0.05. Therefore, the results of this study revealed that there was no significant relationship between the levels of leukocyte esterase and nitrite in the urine of patients suffering from UTIs.

Discussion

Examination of Leukocyte Esterase Levels in UTI Patients

Table 1 illustrates the results of the leukocyte esterase test which revealed that 80% (40) gave positive results, this indicates an immune response to inflammation. A positive leukocyte esterase test reveals the presence of neutrophil leukocytes in the urine, the detection of leukocytes in the urine is facilitated through the dipstick test, which relies on the enzymatic activity of leukocyte esterase, an enzyme produced by granular leukocytes including neutrophils, basophils, and eosinophils. Leukocyte esterase works by hydrolyzing specific esters, triggering an azocoupling reaction that changes the color of the test strip from beige to purple (Tuntun & Aminah, 2021).

This statement is in line with the research that has been conducted by Mambatta et al., (2015) from 635 samples, 72.28% of positive leukocyte esterase results were obtained in UTI patients. The result was 20% (10) negative for leukocyte esterase. Negative results do not always indicate the absence of UTIs as in the study of Mambatta et al., (2015) stating that several factors can cause negative results including infections caused by microorganisms that do not trigger a significant leukocyte response such as *Candida* sp. And enterococcus, the use of antibiotics before sampling, technical errors such as reading results that are too fast and there are interfering substances in the urine such as high levels of protein, vitamin c, formalin and other oxidizing substances that can interfere with chemical reactions in the urine strips.

Nitrite Level Examination in UTI Patients

The results of nitrite examination are also shown in table 4.2 with a positive nitrite result of 50% (25) this result indicates that there are bacteria that can reduce nitrate to nitrite with the help of enzyme nitrate reductase in the urine of UTI patients, this statement is in line with research that has been conducted by Tuntun & Aminah, (2021) where from 92 samples studied, positive results for nitrites were obtained as much as 29.35%. 50% (25) negative results were obtained for nitrites. A negative result on a nitrite test does not always indicate the absence of a UTI, this

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can happen because not all bacteria that cause UTIs are able to reduce nitrate to nitrites such as *Enterococcus*, *Streptococcus* and *Candida*. In addition, negative results can also be caused by urine retention time in the bladder that is too short < 4 hours, dilution of urine that is too diluted, other factors that also play a role are the use of antibiotics before sampling and technical errors in the examination procedure (Tuntun & Aminah, 2021).

The Relationship Between Leukocyte Esterase and Nitrite in UTI Patients

Findings from the bivariate analysis using the chi square test detailed in Table 4.3, reveal a p-value of 0.480, which exceeds the significance level of 0.05. Therefore, this study concluded that there was no relationship between leukocyte esterase and nitrite levels in UTI patients. This conclusion contradicts the research of Tuntun & Aminah (2021) which reported a significant relationship between leukocyte esterase and nitrite levels, which is supported by a p-value of 0.000 and this conclusion is also parallel to the research by Advani et al., (2024), in which it was stated that urinalysis parameters such as leukocyte esterase and nitrite have limitations in diagnosing UTIs. In the study of 3,392 patients, leukocyte sensitivity only reached 90% with a positive predictive value of 33%, while nitrites had a lower sensitivity of 48% even though the specificity was quite high at 83%, but these results showed that there was no strong relationship between positive leukocyte esterase and nitrite results with the occurrence of UTIs confirmed through urine culture. In patients with asymptomatic UTIs, the interpretation of urinalysis parameters such as leukocyte esterases and nitrites becomes more complex, where in the study Advani et al., (2024) found that the positive predictive values of both parameters were low, especially in asymptomatic patients.

Contextual Factors in Timor-Leste Influencing Results

Dominant Bacterial Strains: The bacterial profile in Timor-Leste may differ from other regions due to local environmental factors, antibiotic usage patterns, and population genetics. Based on available regional data, *Escherichia coli* remains the predominant pathogen (18.2% prevalence), but the presence of other gram-positive organisms that do not reduce nitrates could explain the high rate of nitrite-negative results (50%) observed in this study.

Patient Behavior Factors: Several behavioral factors specific to the Timorese population may influence dipstick results:

- **Hydration Patterns:** Cultural practices regarding fluid intake may result in diluted urine samples, potentially affecting nitrite concentration and detection
- **Healthcare Seeking Behavior:** Delayed presentation to healthcare facilities may alter the inflammatory response, affecting leukocyte esterase levels
- **Self-medication Practices:** Common use of traditional remedies or over-the-counter antibiotics before hospital presentation could influence both parameters

Sample Quality Considerations: In resource-limited settings like Timor-Leste, several factors may compromise sample quality:

- **Collection Timing:** Inadequate bladder incubation time (<4 hours) for nitrite formation due to frequent urination patterns
- **Storage Conditions:** Limited refrigeration facilities may affect sample integrity
- **Processing Delays:** Extended time between collection and analysis may impact results

- **Contamination Risk:** Limited access to proper collection materials may increase contamination rates

These contextual factors collectively contribute to the observed lack of correlation between leukocyte esterase and nitrite, highlighting the need for locally adapted diagnostic protocols in Timor-Leste.

Leukocyte Esterase and Nitrite are two parameters measured to detect UTIs but they both measure things differently. Leukocyte esterase functions as an indicator of the immune system's response to infection or inflammation, while the presence of nitrites reveals the presence of bacteria that are able to convert nitrates into nitrites, which are generally found in UTIs caused by gram-negative bacteria such as *Escherichia coli*, on the other hand, gram-positive bacteria are also one of the causes of UTIs where gram-positive bacteria that do not reduce nitrates to nitrites show negative nitrite results even though leukocytes esterase positive.

In the study Sabrina et al. (2021) stated that leukocyte esterase and nitrite are the two main factors in urine tests used to identify UTIs however, because each test has limitations, positive or negative results on one or both tests cannot always definitively establish the diagnosis of UTIs, as in the study Parwati & Cahyani (2023) stated that the level of sensitivity and specificity of the dipstick apparatus varies greatly so it is important to complement this test with a thorough clinical evaluation, including the patient's symptoms and, if necessary, additional laboratory tests such as urine cultures.

CONCLUSION

Based on a study conducted at the Laboratory of *Suai Referral Hospital* involving 50 samples from patients with urinary tract infections (UTIs), the following conclusions were drawn: Positive leukocyte esterase results were found in 40 samples (80%), while negative results were observed in 10 samples (20%). Nitrite results were positive in 25 samples (50%) and negative in 25 samples (50%). Statistical analysis revealed no significant correlation between leukocyte esterase levels and nitrite levels in the urine of UTI patients treated at *Suai Referral Hospital, Covalima, Timor-Leste*.

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