

Isolation and Identification of Bacteria Causing Urinary Tract Infections in Pregnant Women in Tarhuna city

Awatif Ahmed Mohammed Eshtiwey ^{1*}, Aedah Ahmed Mohamed Eshtiwey ², Tasneem salem Alzawwam ³, Asmhan Meftah Sultan ⁴, Sorour Khalil Omar ⁵

¹ Department of Medical Laboratory Technology, Higher Institute of Science and Technology-Bir Matouk, Tarhuna, Libya .

² Department of Life Sciences, Higher Institute of Science and Technology-Bir Matouk, Tarhuna, Libya .

^{3,4,5} Student, Higher Institute of Science and Technology – Bir Matouk, Tarhuna, Libya.

*Email (for reference researcher): naser.omar@uob.edu.ly

عزل والتعرف على البكتيريا المسببة لالتهابات المسالك البولية في لدى النساء الحوامل في مدينة ترهونة

عواطف احمد محمد اشتويوي ^{1*}، عائده احمد محمد اشتويوي ²، تسنيم سالم الزوام ³، اسمهان مفتاح سلطان ⁴، سرور خليل عمر ⁵

¹ قسم المختبرات الطبية، المعهد العالي للعلوم والتقنية - بئر معتوق، المدينة ترهونة، ليبيا

² قسم علوم الحياة، المعهد العالي للعلوم والتقنية - بئر معتوق، المدينة ترهونة، ليبيا

^{3,4,5} طالبة، المعهد العالي للعلوم والتقنية - بئر معتوق، ترهونة، ليبيا.

Received: 12-07-2025; Accepted: 13-09-2025; Published: 10-10-2025

الملخص

هدفت هذه الدراسة إلى عزل وتشخيص البكتيريا المسببة لالتهابات المسالك البولية لدى النساء الحوامل في مدينة ترهونة، ليبيا. جُمعت (72) عينة بول من الحوامل وتم تحليلها باستخدام طرق الزرع البكتيري، الاختبارات الكيميائية الحيوية، وتقنية MALDI-TOF عند توفرها. أظهرت النتائج أن المكورات العنقودية الذهبية (*Staphylococcus aureus*) كانت الأكثر شيوعاً بنسبة (45.5%)، تلتها الإشريكية القولونية (*E. coli*) بنسبة (20%)، ثم الكليسيلا بنسبة (14.5%)، بالإضافة إلى أنواع أخرى مثل المعويات، البروتيويس، والعقديات. كما بينت النتائج أن كلاً من النتروفورانتوين والسيروفلوكساسين أظهرتا أعلى فعالية ضد البكتيريا المعزولة، في حين سجلت معدلات مقاومة مرتفعة تجاه الأموكسيسيلين-كلافولانيك و الترايميثوبريم-سلفاميثوكسازول. وتؤكد هذه النتائج على أهمية الفحص الدوري لعينات البول، وترشيد استخدام المضادات الحيوية، واستمرار المراقبة لمعدلات المقاومة البكتيرية. خلصت الدراسة إلى أن التهابات المسالك البولية لا تزال تمثل مشكلة صحية شائعة أثناء الحمل، مما يتطلب تشخيصاً دقيقاً، علاجاً مناسباً، وتطبيق إجراءات وقائية لتقليل المضاعفات التي قد تؤثر على الأم والجنين.

الكلمات المفتاحية: التهابات المسالك البولية، النساء الحوامل، ترهونة، العزل البكتيري، مقاومة المضادات الحيوية.

Abstract:

This study investigated the bacterial pathogens responsible for urinary tract infections (UTIs) among pregnant women in Tarhuna, Libya. A total of 72 urine samples were collected and analyzed using culture methods, biochemical tests, and MALDI-TOF confirmation where available. The findings revealed that *Staphylococcus aureus* was the most frequently isolated bacterium (45.5%), followed by *Escherichia coli* (20%), *Klebsiella spp.* (14.5%), and other pathogens such as *Enterococcus spp.*, *Proteus spp.*, and *Streptococcus*. The results showed that Nitrofurantoin and

Ciprofloxacin were the most effective antibiotics, while high resistance rates were observed against Amoxicillin-Clavulanic acid and Trimethoprim-Sulfamethoxazole. These outcomes highlight the need for routine urine culture screening, targeted antibiotic stewardship, and continuous surveillance of antimicrobial resistance patterns. The study concludes that urinary tract infections remain a significant health problem during pregnancy, requiring proper diagnosis, treatment, and preventive strategies to minimize maternal and fetal complications.

Keywords: Urinary tract infections, Pregnant women, Tarhuna, Bacterial isolation, Antibiotic resistance, *Staphylococcus aureus*, *Escherichia coli*.

1. Introduction:

Urinary tract infections (UTIs) are among the most prevalent health concerns affecting pregnant women worldwide. Recent evidence suggests that the physiological and hormonal changes occurring during pregnancy significantly increase the susceptibility of the urinary tract to bacterial infections (UK Health Security Agency, 2023). The clinical importance of addressing these infections lies in their potential to cause serious maternal and fetal complications if left untreated, including preterm delivery and low birth weight (Ahmad et al., 2020).

In most cases, UTIs in pregnancy result from the translocation of bacteria from the gastrointestinal tract—particularly *Escherichia coli*—into the urinary system. Pregnancy provides favorable conditions for bacterial proliferation due to elevated levels of hormones, sugars, and proteins in urine, as well as the mechanical pressure of the uterus on the bladder and a reduction in immune response (Al-Nasser, Mohammed, & Al-Ibrahim, 2021). Several risk factors further predispose women to infection, including the naturally short female urethra, inadequate personal hygiene, multiparity, and the presence of chronic illnesses such as diabetes (Tebcan, 2023).

Effective prevention and management of UTIs in pregnancy require routine urine tests and culture-based identification of the causative bacteria, as accurate diagnosis enables timely treatment and reduces the likelihood of complications (Altibbi, 2017). Global and regional studies consistently report *E. coli* as the most frequently isolated pathogen, followed by other species (Shiblawi, 2022).

Given the rising rates of antimicrobial resistance, isolating and identifying the bacterial agents responsible for UTIs during pregnancy is a critical step in both clinical care and public health. Continuous surveillance and updated treatment protocols based on laboratory evidence are necessary to ensure therapeutic success (Al-Taima, 2024).

Accordingly, the present research seeks to isolate and identify bacterial pathogens associated with urinary tract infections among pregnant women in Tarhuna, Libya. The study aims to determine the most common bacterial species, assess their resistance profiles, and provide reliable data that may contribute to improving diagnostic accuracy, guiding treatment choices, and ultimately reducing infection-related complications for both mothers and their infants.

Research Problem

Urinary tract infections (UTIs) represent one of the most frequent health issues among pregnant women, posing a considerable risk to maternal and fetal health if not properly diagnosed and managed. Despite the availability of antibiotics, the increasing emergence of antimicrobial resistance has complicated treatment strategies, making it difficult to ensure effective therapy. In Libya, and specifically in Tarhuna city, there is a noticeable lack of updated, evidence-based data regarding the bacterial species responsible for UTIs in pregnant women and their resistance profiles.

This gap in knowledge creates uncertainty in clinical decision-making, as physicians may prescribe antibiotics empirically without adequate awareness of local resistance patterns. Such practices can lead to treatment failure, recurrence of infection, or serious complications such as preterm labor and low birth weight. Therefore, the research problem centers on the need to isolate and identify the bacterial pathogens causing UTIs in pregnant women in Tarhuna and to determine their antibiotic susceptibility patterns, in order to provide accurate and reliable data that supports effective diagnosis, treatment, and prevention.

Research Questions

This study seeks to answer the following research questions:

1. What are the demographic and clinical characteristics of pregnant women affected by urinary tract infections in Tarhuna city?
2. Which bacterial species are most commonly isolated from urine samples of pregnant women with UTIs?

3. What are the antibiotic susceptibility and resistance patterns of the isolated bacterial strains, particularly toward frequently prescribed antibiotics such as Nitrofurantoin, Ciprofloxacin, and Amoxicillin-Clavulanic Acid?
4. How can the findings of this study contribute to improving diagnosis, guiding treatment protocols, and reducing infection-related complications during pregnancy?

Objectives:

This study aims to:

1. Examine the demographic and clinical characteristics of pregnant women with urinary tract infections in Tarhuna city.
2. Isolate and identify the bacterial species responsible for UTIs using culture methods, biochemical tests, and advanced diagnostic techniques where available.
3. Evaluate the antimicrobial susceptibility and resistance patterns of the isolated bacteria, focusing on commonly used antibiotics such as Nitrofurantoin, Ciprofloxacin, and Amoxicillin-Clavulanic Acid.
4. Provide accurate scientific data that can improve diagnostic accuracy, guide appropriate treatment, and contribute to updated protocols for reducing maternal and fetal complications.

Research Significance

The significance of this study lies in addressing one of the most common and clinically important health problems among pregnant women—urinary tract infections (UTIs)—which, if left untreated, can result in severe complications such as preterm birth and low birth weight. In the local context of Tarhuna city, there is a lack of comprehensive research that identifies the bacterial pathogens responsible for UTIs and their antimicrobial resistance patterns, leaving a gap in clinical knowledge and practice. The outcomes of this research are expected to:

1. Provide updated and reliable data on the most prevalent bacterial species affecting pregnant women in the region.
2. Assist physicians in selecting more accurate and effective treatments based on local resistance trends.
3. Support preventive strategies through routine screening and early detection of infections.
4. Contribute to the development of tailored diagnostic and therapeutic protocols that reflect the Libyan healthcare setting, thereby reducing maternal and fetal complications.

Materials and Methods

This descriptive, cross-sectional laboratory-based study was conducted in Tarhuna, Libya, from March to June 2025. A total of 72 urine samples were collected from pregnant women attending the Tarhuna Combined Clinic and private laboratories. Midstream morning urine samples were obtained using sterile containers, and demographic/clinical data were collected through structured questionnaires.

Samples were cultured on Blood Agar, MacConkey Agar, and CLED Agar, then incubated at 37°C for 24–48 hours. Colonies were examined microscopically and identified using Gram staining, biochemical tests, and MALDI-TOF mass spectrometry where available. All laboratory procedures followed standard operating protocols and biosafety guidelines to ensure reliability and accuracy.

Previous Studies

1. El-Mahdi, A. (2019).

Isolation and antimicrobial susceptibility of uropathogens among pregnant women at Benghazi Medical Center, Libya. This cross-sectional study aimed to identify the bacterial species causing UTIs in pregnant women attending Benghazi Medical Center. Urine cultures revealed *Escherichia coli* as the predominant isolate, followed by *Klebsiella spp.* and *Staphylococcus aureus*. The study reported high resistance to ampicillin and amoxicillin, while nitrofurantoin showed high efficacy. The authors emphasized the importance of routine culture-based diagnosis rather than empirical prescriptions, highlighting the need for updated antimicrobial resistance data in Libyan hospitals.

2. Salem, F. (2021).

Prevalence and antimicrobial resistance of urinary tract infection pathogens among pregnant women in Eastern Libya. This field-based study investigated both symptomatic and asymptomatic pregnant women in Eastern Libya. The findings showed a significant burden of UTIs, with a growing incidence of multidrug-resistant bacteria. The study concluded that empirical treatment is often ineffective due to resistance trends, recommending regular urine culture

testing during pregnancy. This work is crucial in demonstrating the need for surveillance systems tailored to Libyan healthcare facilities.

3. Ali, M. A., et al. (2024).

Phenotypic and genotypic characterization of uropathogenic *Escherichia coli* isolated from pregnant women in Egypt. Conducted in Egypt, this study combined culture methods with molecular techniques to identify resistance genes in *E. coli*. The results confirmed that *E. coli* was the leading pathogen, and many isolates carried β -lactamase resistance genes. High resistance was recorded against amoxicillin-clavulanic acid, while nitrofurantoin and ciprofloxacin remained effective. The authors recommended integrating molecular diagnostics with conventional microbiology to better manage resistant infections during pregnancy.

4. Osman, H., et al. (2024).

Bacterial profile and antibiotic susceptibility patterns of urinary tract infections among pregnant women in Sudan. This Sudanese study highlighted the high prevalence of UTIs, particularly in the third trimester of pregnancy. *Escherichia coli* was the most frequent isolate, followed by *Klebsiella spp.* The resistance profile showed reduced effectiveness of amoxicillin-clavulanic acid, while nitrofurantoin demonstrated strong activity. The authors emphasized the importance of trimester-specific screening and the adjustment of empirical treatment guidelines.

5. Al-Khalidi, R. (2023).

A review of urinary tract infections among pregnant women in Iraq: prevalence, risk factors, and antimicrobial resistance (2000–2023). This comprehensive review summarized data from multiple Iraqi studies over two decades. It confirmed that *E. coli* remains the dominant cause of UTIs in pregnancy, with increasing resistance to first-line antibiotics such as ampicillin and trimethoprim-sulfamethoxazole. The review stressed the necessity of regional surveillance and highlighted similarities with resistance patterns observed in neighboring countries, including Libya.

6. Tadesse, B. T., et al. (2020).

Bacterial profile and drug susceptibility among urinary tract infection-suspected pregnant women in Ethiopia. Published in BMC Infectious Diseases, this cross-sectional study reported that 11% of pregnant women had asymptomatic bacteriuria. *E. coli* and *Staphylococcus aureus* were the most common isolates. The study revealed high resistance to ampicillin and trimethoprim-sulfamethoxazole, whereas nitrofurantoin and ciprofloxacin were effective. These results underline the importance of routine screening for asymptomatic bacteriuria in resource-limited settings.

7. Mwaka, A. D., et al. (2021).

Prevalence and antimicrobial susceptibility of bacterial uropathogens among pregnant women in Northern Uganda. This study collected urine samples from pregnant women with suspected UTIs and found *E. coli* and *S. aureus* to be the dominant pathogens. Nitrofurantoin and ciprofloxacin showed the highest sensitivity rates, while ampicillin and cotrimoxazole resistance was widespread. The authors emphasized the importance of continuous local surveillance to inform antibiotic stewardship.

8. Mensah, P., et al. (2025).

Risk factors and antimicrobial resistance of urinary tract infections in pregnant women in Ghana. This recent Ghanaian study investigated clinical risk factors alongside laboratory findings. It identified recurrent UTIs, gestational diabetes, and poor personal hygiene as significant contributors. The bacterial profile confirmed *E. coli* as the leading isolate. The study reported extensive resistance to first-line antibiotics, reinforcing the importance of region-specific treatment protocols and patient education.

9. Turay, A. A., & Emeka, M. (2022).

A systematic review of uropathogens and antimicrobial resistance patterns among pregnant women in East Africa. This review analyzed multiple studies from 2015–2022, confirming *E. coli* as the most prevalent pathogen across the region. The review also highlighted the global trend of rising antimicrobial resistance, with widespread resistance to ampicillin and trimethoprim-sulfamethoxazole. The authors recommended regional treatment guidelines and emphasized the value of continuous surveillance to reduce maternal and fetal complications.

Commentary

The reviewed studies consistently demonstrate that *Escherichia coli* is the leading causative agent of urinary tract infections in pregnant women across various regions, including Libya, Egypt, Sudan, Iraq, and East Africa. However, some local variations have been noted: while *E. coli* remains dominant in most studies, *Staphylococcus aureus* was also frequently isolated in several African and Libyan contexts, suggesting possible differences in hygiene practices, healthcare systems, or sample handling procedures.

A common theme across all studies is the alarming rise of antimicrobial resistance. High resistance rates to ampicillin, amoxicillin-clavulanic acid, and trimethoprim-sulfamethoxazole were reported in nearly every setting, whereas

nitrofurantoin and ciprofloxacin consistently showed good effectiveness. This pattern highlights the need for continuous antibiotic susceptibility testing to avoid treatment failure.

Despite these similarities, the reviewed literature also reveals gaps. Most available studies are either regional surveys or reviews, with limited data from specific Libyan cities such as Tarhuna. Furthermore, few studies combined both phenotypic and molecular methods in identifying pathogens, which could provide a more comprehensive understanding of resistance mechanisms.

Thus, the current study addresses these gaps by focusing specifically on pregnant women in Tarhuna city, combining traditional microbiological techniques with advanced tools like MALDI-TOF where available. By providing updated and localized data, this research aims to guide clinicians in choosing the most effective treatments and to contribute to developing protocols that reflect the microbial ecology of the Libyan healthcare context.

Section One: Epidemiological Characteristics and Bacterial Etiology of UTIs in Pregnancy

Urinary tract infections (UTIs) are among the most common medical conditions affecting pregnant women worldwide. The increased susceptibility during pregnancy is attributed to physiological and hormonal changes, such as elevated progesterone levels and the mechanical pressure exerted by the enlarging uterus on the bladder. These changes lead to urinary stasis, reduced bladder emptying, and a favorable environment for bacterial growth (UK Health Security Agency, 2023).

The majority of UTIs in pregnancy originate from the migration of bacteria from the gastrointestinal tract to the urinary tract, with *Escherichia coli* being the predominant pathogen. Studies across multiple regions confirm that *E. coli* is responsible for 50–80% of cases, followed by *Klebsiella spp.*, *Staphylococcus aureus*, *Proteus spp.*, and *Enterococcus spp.* This dominance of *E. coli* is largely due to its virulence factors, such as fimbriae that enhance adhesion to the uroepithelium (Shiblawi, 2022).

Predisposing factors further increase infection risk, including anatomical features like the short female urethra, inadequate personal hygiene, multiparity, and the presence of chronic illnesses such as diabetes mellitus. In addition, a weakened maternal immune response during pregnancy further facilitates bacterial colonization and infection (Al-Nasser, Mohammed & Al-Ibrahim, 2021).

Several studies from Africa and the Middle East emphasize the importance of identifying the local bacterial profile. For example, research in Libya and neighboring countries demonstrated that while *E. coli* remained the most frequent isolate, *Staphylococcus aureus* appeared with higher prevalence compared to global reports. This variation suggests that local hygiene practices, healthcare systems, and environmental conditions may influence bacterial distribution (Abubakar, 2021).

Section Two: Antimicrobial Resistance and Therapeutic Challenges in Managing UTIs during Pregnancy

One of the most pressing challenges in treating UTIs during pregnancy is the increasing rate of antimicrobial resistance (AMR). Studies from different regions show a consistent pattern of high resistance against commonly prescribed antibiotics, particularly ampicillin, amoxicillin-clavulanic acid, and trimethoprim-sulfamethoxazole. These antibiotics, once considered first-line therapies, have lost effectiveness due to decades of overuse and misuse (Ahmad et al., 2020).

In contrast, nitrofurantoin and ciprofloxacin remain highly effective in many studies. For instance, investigations in Uganda and Sudan demonstrated that more than 90% of isolates were sensitive to these drugs, making them valuable treatment options during pregnancy when appropriately prescribed. However, their use must be carefully considered due to safety profiles and gestational age (Mwaka et al., 2021).

The problem of antibiotic resistance is further complicated by recurrent UTIs, which are common among pregnant women. A Sudanese study showed that more than 70% of women with UTIs had experienced at least one previous infection during the same pregnancy, raising concerns about persistence, reinfection, and treatment failure. This highlights the importance of routine urine cultures and antibiotic susceptibility testing to guide therapy rather than relying on empirical treatment (Osman et al., 2024).

Globally, systematic reviews confirm that AMR trends in uropathogens are not confined to developing countries but represent a worldwide public health concern. Resistance to β -lactam antibiotics and cotrimoxazole has been widely reported, while alternative therapies are being explored. This calls for region-specific guidelines, antibiotic stewardship programs, and continuous surveillance to ensure effective management of UTIs in pregnancy (Turay & Emeka, 2022).

Results

1. Study Population

The study population consisted of pregnant women from the city of Tarhuna who presented with symptoms suggestive of urinary tract infections. A total of 72 urine samples were collected, and an equal number of questionnaires were distributed and successfully retrieved. This resulted in a 100% response rate, as shown in Table (1).

Table (1): Distribution of Questionnaires

Distribute Questionnaires	Received Questionnaires	Response Rate	Lost Questionnaires	Loss Rate
72	72	100%	0	0%

2. Health Status of the Participants

Out of the 72 pregnant women included in the study, 57 were diagnosed with urinary tract infections, representing 79.2% of the sample. The remaining 15 women (20.8%) were found to be free from infection. These results are summarized in Table (2).

Table (2): Distribution of Participants by Health Status

Status	Frequency	Percentage
Infected Cases	57	79.2%
Healthy Cases	15	20.8%
Total	72	100.0%

The results clearly demonstrate a high prevalence of urinary tract infections among the studied population, with nearly four out of five participants testing positive for infection.

.2. Age

Table (2) shows the distribution of the study sample according to age groups.

Age Group	Frequency	Percentage
18-24	19	26.4%
25-30	21	29.2%
31-37	19	26.4%
38-44	13	18.1%
Total	72	100.0%

The results indicate that the age group of 25 to 30 years has the largest number of participants, with 21 cases (29.2%). This is followed by the age groups 18-24 and 31-37, each with 19 cases (26.4%). The age group 38-44 was the least represented, with 13 cases (18.1%).

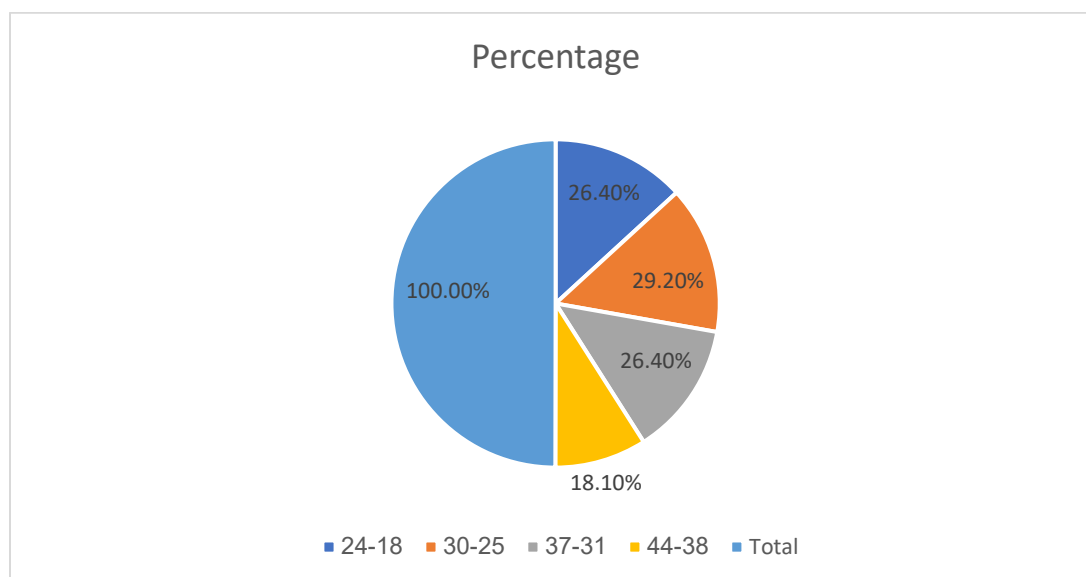


Figure (2) illustrates this distribution.

3.. Current Week of Pregnancy

Table (3) Distribution of Study Sample Based on Weeks of Pregnancy

<i>Current Week of Pregnancy</i>	<i>Frequency</i>	<i>Percentage</i>
1-15 Weeks	22	30.6%
16-26 Weeks	23	31.9%
27-37 Weeks	26	36.1%
Lost Cases	1	1.4%
Total	72	100.0%

The results indicate that the largest number of participants was in the 27-37 week category, with 26 cases (36.1%). This is followed by the 16-26 week category, with 23 cases (31.9%), and then the 1-15 week category, which includes 22 cases (30.6%). It is also noted that there is one lost case, representing 1.4% of the sample.

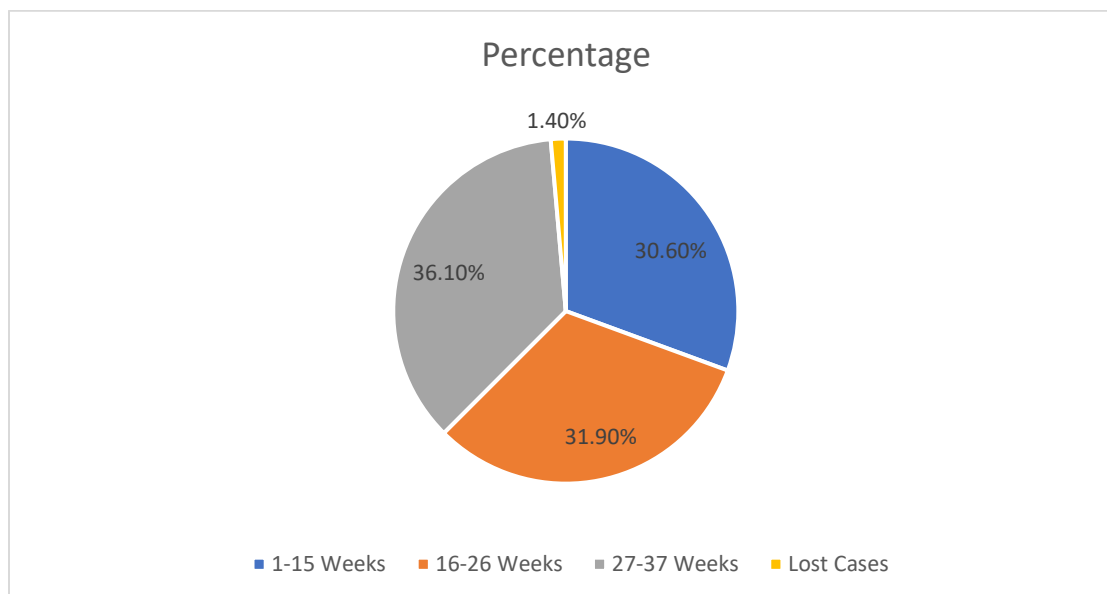


Figure 3: Distribution of Study Sample Based on Weeks of Pregnancy

5. Previous UTI Infection During Pregnancy?

Table (6) Distribution of Study Sample Based on Previous UTI Infection

<i>UTI During Pregnancy</i>	<i>Frequency</i>	<i>Percentage</i>
Yes	56	77.7%
No	16	22.3%
Total	72	100.0%

The results indicate that 56 cases (77.8%) of participants had previously experienced a UTI, while 12 cases (22.3%) had no prior infections.

6. Current Symptoms

Table (5) Distribution of Study Sample Based on Current Symptoms

<i>Current Symptoms</i>	<i>Frequency</i>	<i>Percentage</i>
Burning Urination	25	63.4%
Flank Pain	13	10.1%
Cloudy Urine	12	9.3%
Fever	22	17.1%
Total	72	100.0%

The results indicate that 66 cases (51.2%) do not experience any symptoms, suggesting that more than half of the participants in the study show no clinical signs.

In contrast, 16 cases (12.4%) report burning sensation during urination, 13 cases (10.1%) report flank pain, and 12 cases (9.3%) report cloudy urine. Additionally, there are 22 cases (17.1%) with fever.

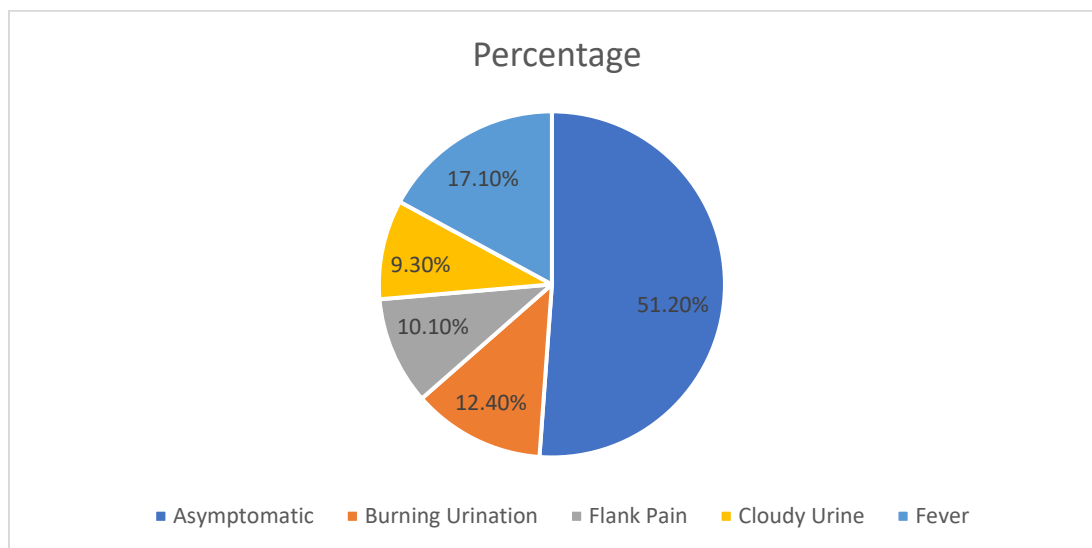


Figure:5 Distribution of Study Sample Based on Current Symptoms

7. Type of Sample

Table (6) Distribution of Sample Type

<i>Sample Type</i>	<i>Frequency</i>	<i>Percentage</i>
Midstream Urine	30	41.7%
Morning Urine	18	25.0%
Random	3	33.3%
Total	72	100.0%

The results indicate that the largest number of samples was from "midstream urine," with 30 cases (41.7%). This is followed by "random urine" with 23 cases (31.9%) and "morning urine" with 18 cases (25.0%). Additionally, there is one lost case, representing 1.4% of the sample.

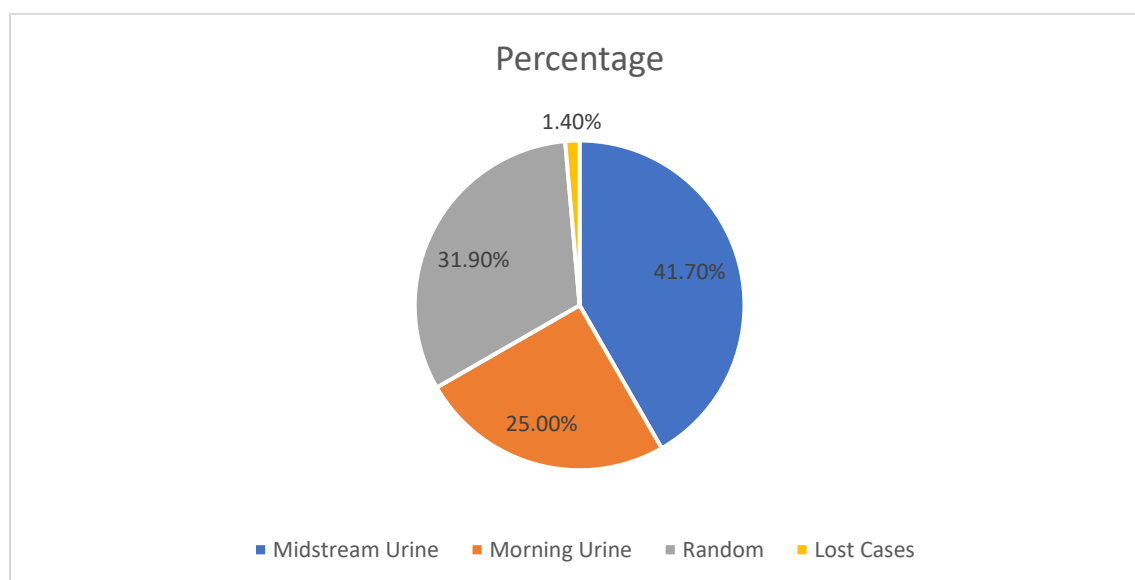


Figure: Distribution of Sample Types

7 . Type of Culture Medium Used:

Table (7) shows the numbers and percentages of the sample

<i>Type of Culture Medium Used</i>	<i>Frequency</i>	<i>Percentage</i>
Blood Agar	22	30.6%
MacConkey	33	45.8%
CLED	13	18.1%
No Response	4	5.6%
Total	72	100.0%

The results indicate that the largest number of samples were cultured in MacConkey medium, with 33 cases (45.8%). This is followed by Blood Agar with 22 cases (30.6%), and CLED with 13 cases (18.1%). There are 4 cases (5.6%) that did not provide an answer.

The following figure illustrates this:

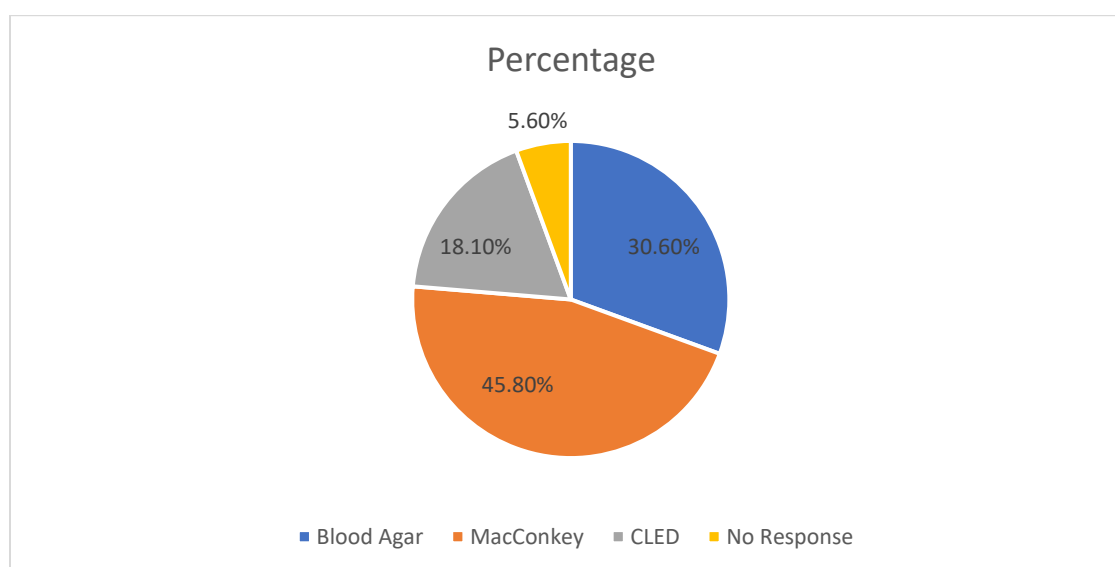


Figure (7) illustrates the distribution of types of culture media used in the study sample.

8 . Type of Isolated Bacteria:

Table (8) illustrates the distribution of types of bacteria isolated from the samples

<i>Type of Isolated Bacteria</i>		<i>Frequency</i>	<i>Percentage</i>		
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Klebsiella spp.	8	11.1	14.5	14.5
	E. coli	11	15.3	20.0	34.5
	Enterococcus spp.	5	6.9	9.1	43.6
	Proteus spp.	4	5.6	7.3	50.9
	Streptococcus	2	2.8	3.6	54.5

	Staphylococcus spp.	25	34.7	45.5	100.0
	Total	55	76.4	100.0	
Missing	System	17	23.6		
	Total	72	100.0		

The results indicate that Staphylococcus was the most common (34.7%), with E. coli 11 cases (15.3%). This was followed by Klebsiella spp. with 8 cases (11.1%), Enterococcus spp. with 5 cases (6.9%), Proteus spp. with 4 cases (5.6%), and finally Streptococcus with 2 cases (2.8%). There are 17 cases (23.6%) that were not infected.

8. Confirmation Method

Table (9) shows the numbers and percentages of the sample

<i>Confirmation Method</i>	<i>Frequency</i>	<i>Percentage</i>
MALDI-TOF	7	9.7%
Biochemical	46	63.9%
Other	4	5.6%
No Response	15	20.8%
Total	72	100.0%

The results indicate that the most common method was Biochemical, used in 46 cases (63.9%). The MALDI-TOF method was used in 7 cases (9.7%), and other methods in 4 cases (5.6%). Additionally, there are 15 cases (20.8%) that were not infected.

The following figure illustrates this:

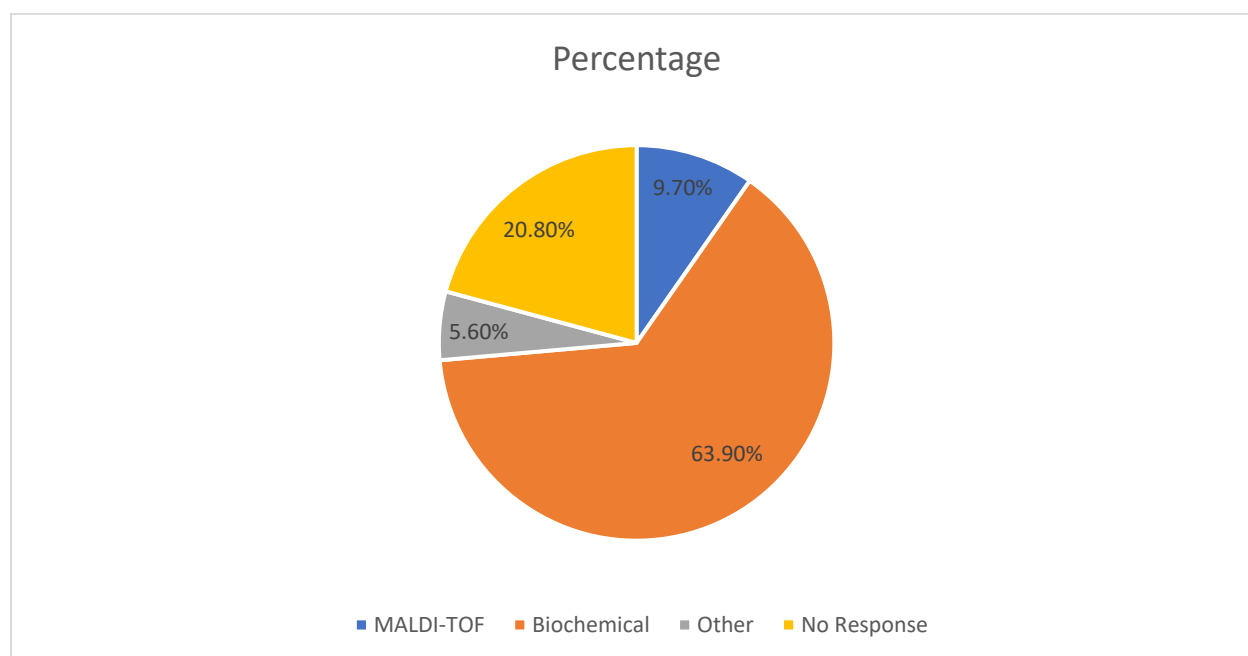


Figure (8) illustrates the distribution of confirmation methods used in the study sample

9-Antibiotics and Type of Isolated Bacteria

Table (17) illustrates the antibiotics and the type of isolated bacteria.

Isolated Bacteria Type * Antibiotics									
			Isolated Bacteria Type						Total
			Klebsiella spp.	E. coli	Enterococcus spp.	Proteus spp.	Streptococcus	Staphylococcus spp.	
Nitrofurantoin	Resistant	Cases	1	0	0	0	0	3	4
		%							
		Percent age	2.00%	0.00 %	0.00%	0.00 %	0.00%	5.90%	7.80 %
	Sensitive	Cases	7	11	5	4	2	18	47
		%							
		Percent age	13.70%	21.60 %	9.80%	7.80 %	3.90%	35.30%	92.20 %
Ciprofloxacin	Resistant	Cases	0	0	0	0	0	4	4
		%							
		Percent age	0.00%	0.00 %	0.00%	0.00 %	0.00%	7.40%	7.40 %
	Sensitive	Cases	8	11	5	4	2	20	50
		%							
		Percent age	14.80%	20.40 %	9.30%	7.40 %	3.70%	37.00%	92.60 %
Amoxicillin-	Resistant	Cases	4	7	2	1	1	8	23
Clavulanic		%							
		Percent age	7.30%	12.70 %	3.60%	1.80 %	1.80%	14.50%	41.80 %
	Sensitive	Cases	4	4	3	3	1	17	32
		%							
		Percent age	7.30%	7.30 %	5.50%	5.50 %	1.80%	30.90%	58.20 %
Ceftriaxone	Resistant	Cases	1	2	1	3	2	8	17
		%							
		Percent age	2.00%	4.00 %	2.00%	6.00 %	4.00%	16.00%	34.00 %
	Sensitive	Cases	7	9	4	1	0	12	33
		%							
		Percent age	14.00%	18.00 %	8.00%	2.00 %	0.00%	24.00%	66.00 %
Trimethoprim-Sulfamethoxazole	Resistant	Cases	5	4	2	4	1	12	28
		%							
		Percent age	9.60%	7.70 %	3.80%	7.70 %	1.90%	23.10%	53.80 %
	Sensitive	Cases	3	7	3	0	1	10	24
		%							
		Percent age	5.80%	13.50 %	5.80%	0.00 %	1.90%	19.20%	46.20 %
Cefixime	Resistant	Cases	3	1	1	1	1	2	9
		%							
		Percent age	10.00%	3.30 %	3.30%	3.30 %	3.30%	6.70%	30.00 %
	Sensitive	Cases	3	4	0	3	0	11	21
		%							
		Percent age	10.00%	13.30 %	0.00%	10.00 %	0.00%	36.70%	70.00 %
Cephalexin		Cases	0	3	0	1	0	2	6

	Resistant	% Percentage	0.00%	12.00%	0.00%	4.00%	0.00%	8.00%	24.00%
	Sensitive	Cases	6	2	0	3	1	7	19
Amoxicillivi	Resistant	% Percentage	24.00%	8.00%	0.00%	12.00%	4.00%	28.00%	76.00%
		Cases	5	3	0	1	1	2	12
	Sensitive	% Percentage	26.30%	15.80%	0.00%	5.30%	5.30%	10.50%	63.20%
		Cases	0	2	1	1	0	3	7
		% Percentage	0.00%	10.50%	5.30%	5.30%	0.00%	15.80%	36.80%

Discussion

This study investigated the bacterial pathogens responsible for urinary tract infections (UTIs) among pregnant women in Tarhuna, Libya, with particular attention to their prevalence and antimicrobial susceptibility profiles. The findings demonstrated that *Staphylococcus aureus* was the most frequently isolated organism (45.5%), followed by *Escherichia coli* (20%), *Klebsiella spp.* (14.5%), and other pathogens including *Enterococcus spp.*, *Proteus spp.*, and *Streptococcus*.

These results present a partial divergence from the global literature, where *E. coli* is consistently reported as the predominant uropathogen among pregnant women, accounting for 37%–55% of cases (Turay & Emeka, 2022; Abubakar, 2021; Tadesse et al., 2020). For instance, studies from Egypt (Ali et al., 2024) and Sudan (Osman et al., 2024) also identified *E. coli* as the leading isolate, followed by *Klebsiella spp.*. However, in the current study, *S. aureus* surpassed *E. coli*, suggesting possible regional differences in microbial ecology or reflecting hygiene and healthcare practices specific to Tarhuna. Similar observations have been noted in Ethiopia and Uganda, where *S. aureus* was reported in higher proportions than in Western studies (Mwaka et al., 2021; Ghahfarokhi et al., 2023).

With regard to antibiotic susceptibility, Nitrofurantoin (92.2%) and Ciprofloxacin (92.6%) were found to be the most effective drugs against the isolated uropathogens. This finding is consistent with several African and Middle Eastern studies, including those from Uganda and Sudan, which also demonstrated high sensitivity rates to these antibiotics (Mwaka et al., 2021; Osman et al., 2024). Similarly, Ghahfarokhi et al. (2023) confirmed the effectiveness of Nitrofurantoin in treating multidrug-resistant isolates. In contrast, high resistance levels were detected against Amoxicillin-Clavulanic acid (41.8%) and Trimethoprim-Sulfamethoxazole (53.8%), which mirrors global resistance trends reported in Egypt, Iraq, and East Africa (Ahmad et al., 2020; Ali et al., 2024; Turay & Emeka, 2022).

Additional indicators, such as the presence of white blood cells in 84.7% of urine samples and nitrites in 63.9%, further confirmed active infection and strengthened the reliability of the microbiological results. Moreover, the predominance of UTIs in the third trimester (36.1%) aligns with McCormick et al. (2008), who associated late-pregnancy physiological changes with heightened susceptibility to infection. Likewise, regional studies from Sudan and Ghana documented higher UTI rates in late gestation, suggesting that pregnancy stage is a consistent risk factor across populations (Osman et al., 2024; Mensah et al., 2025).

The current findings also revealed that 77.8% of participants had a history of recurrent UTIs during the same pregnancy. This observation is in agreement with studies from Sudan and Ethiopia, which reported high recurrence rates and emphasized the need for regular screening (Tadesse et al., 2020; Osman et al., 2024). The recurrence highlights the risks of untreated or inadequately treated infections, which may lead to complications such as preterm delivery and low birth weight, as previously noted by Flores-Mireles et al. (2015) and Unlu et al. (2014). In summary, the comparison with previous studies underscores two main points: first, while *E. coli* remains the global leader in pregnancy-related UTIs, *S. aureus* demonstrated unusually high prevalence in Tarhuna, warranting further local investigations into community hygiene and clinical practices; second, resistance patterns in Tarhuna closely mirror regional and global trends, reinforcing the urgent need for antibiotic stewardship. These findings call for updated treatment guidelines tailored to the Libyan microbial landscape, continuous surveillance, and enhanced preventive strategies, including routine urine cultures even in asymptomatic women.

Conclusion:

This study demonstrated that urinary tract infections (UTIs) are a prevalent health problem among pregnant women in Tarhuna, Libya, with a significant proportion of cases caused by *Staphylococcus aureus* and *Escherichia coli*. The unexpectedly high prevalence of *S. aureus* suggests regional variations in microbial ecology and emphasizes the importance of conducting local surveillance. Antibiotic susceptibility testing revealed that Nitrofurantoin and Ciprofloxacin remain highly effective, while resistance to Amoxicillin-Clavulanic acid and Trimethoprim-Sulfamethoxazole was alarmingly high.

The findings also confirmed that the majority of infections occurred during the third trimester and that recurrent UTIs were common, underlining the need for routine urine culture screening even in asymptomatic women. By comparing these results with previous regional and global studies, the research highlights both common trends and unique local differences. Overall, the study concludes that updated treatment protocols, targeted antibiotic stewardship, and improved preventive strategies are urgently needed to reduce the risks of maternal and fetal complications associated with UTIs in pregnancy.

Recommendations:

1. Regular susceptibility testing of bacteria to antibiotics should be conducted to ensure treatment efficacy in UTI cases.
2. The use of antibiotics that showed high resistance rates, such as Amoxicillin and Trimethoprim-Sulfamethoxazole, should be re-evaluated for effective usage.
3. It is important to educate physicians about common bacterial patterns and antibiotic responses to better guide treatment choices.
4. Additional studies are recommended to understand the evolution of bacterial resistance and identify new strategies for combating infections.
5. Preventive measures in healthcare should be enhanced, such as improving hygiene and care practices, to reduce the incidence of bacterial infections.
6. Consideration should be given to using alternative therapies or combining antibiotics to enhance treatment efficacy and reduce resistance.

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