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Prevalence, bacterial etiologies, and antimicrobial resistance profiles of urinary tract infections (UTIs) among pregnant women in Benghazi

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معدل الانتشار، والمسببات البكتيرية، وملفات مقاومة مضادات الميكروبات لعدوى المسالك البولية (*UTIs*) بين النساء الحوامل في بنغازي

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Abstract:
Background: Urinary tract infections (UTIs) represent serious health problems during pregnancy, potentially causing significant complications for both mothers and fetuses. Determining antibiotic sensitivity is of paramount importance for healthcare providers. The aim of this study is to highlight the prevalence, bacterial etiologies, and antimicrobial resistance profiles of UTIs among pregnant women in Benghazi, Libya. Methods: A total of 170 urine samples were collected from pregnant women from October 2025 to May 2026. Samples were cultured, and isolates were identified using morphological and biochemical tests. Results: Out of 170 samples, 123 (72.35%) were confirmed to have UTIs. The most common pathogen was *Escherichia coli*, followed by *Staphylococcus aureus* and *Klebsiella pneumoniae*. UTIs were most prevalent in the 18–22 age group (39.8%) and the third trimester of pregnancy (56.9%). High susceptibility was observed for Imipenem and Gentamicin. Conclusion: Routine screening for bacteriuria during pregnancy is essential to prevent adverse maternal and fetal outcomes.

Keywords: Urinary tract infection; Pregnancy; Bacteriuria; Antimicrobial resistance.

الملخص
الخلفية: تمثل عدوى المسالك البولية (UTIs) مشكلة صحية خطيرة أثناء الحمل، حيث قد تؤدي إلى مضاعفات كبيرة لكل من الأم والجنين. وتعتبر معرفة حساسية المضادات الحيوية أمراً بالغ الأهمية لمقدمي الرعاية الصحية. تهدف هذه الدراسة إلى تسليط الضوء على معدل انتشار عدوى المسالك البولية، ومسبباتها البكتيرية، وأنماط مقاومة المضادات الحيوية لدى النساء الحوامل في مدينة بنغازي، ليبيا. الطريقة: تم جمع 170 عينة بول من نساء حوامل في الفترة من أكتوبر 2025 إلى مايو 2026، حيث تمت زراعة العينات

وتحديد العزلات باستخدام الاختبارات المورفولوجية والكيميائية الحيوية. النتائج: من أصل 170 عينة، تأكدت إصابة 123 (72.35%) بعدوى المسالك البولية. وكان الممرض الأكثر شيوعاً هو الإشريكية القولونية(*Escherichia coli*) ، تليها المكورات العنقودية الذهبية (*Staphylococcus aureus*) والكلبسيلا الرئوية .(*Klebsiella pneumoniae*) كانت العدوى أكثر انتشاراً في الفئة العمرية 18-22 سنة (39.8%) وفي الثلث الثالث من الحمل (56.9%). أظهرت النتائج حساسية عالية للمضادات الحيوية إيميبينيم وجنتاميسين. الخاتمة: يعد الفحص الدوري لبكتيريا البول أثناء الحمل ضرورياً للوقاية من النتائج السلبية على الأم والجنين.

الكلمات المفتاحية: عدوى المسالك البولية؛ الحمل؛ بكتيريا البول؛ مقاومة مضادات الميكروبات.

1-INTRODUCTION

Urinary tract infections (UTIs) are the most frequent bacterial infections encountered during pregnancy (Schnarr & Smaill, 2008). These infections typically manifest as symptomatic bladder infections, known as cystitis, or kidney infections, referred to as pyelonephritis. Additionally, they may present as asymptomatic bacteriuria, which is characterized by the presence of bacteria in the urine in the absence of clinical symptoms (Le et al., 2004). Previous research indicates that during pregnancy, the prevalence rates for asymptomatic bacteriuria, cystitis, and pyelonephritis reach up to 10%, 4%, and 2%, respectively (Schnarr & Smaill, 2008). UTIs occur primarily through the ascending migration of bacteria from the lower digestive and genital tracts, with *Escherichia coli* and other gram-negative bacteria being the most common causative agents (Sheffield & Cunningham, 2005).

Physiological and anatomical changes during pregnancy, including urethral dilation, increased bladder volume, and decreased bladder tone, contribute to urinary stasis, thereby increasing susceptibility to infection (Angelescu et al., 2016). UTIs are categorized based on their clinical presentation (Gunes et al., 2005). Asymptomatic bacteriuria is defined as significant bacteriuria without symptoms of acute infection, while symptomatic UTIs are classified as either lower tract (acute cystitis) or upper tract (acute pyelonephritis) infections (Schnarr & Smaill, 2008). UTIs are significantly associated with adverse obstetric outcomes, specifically preterm birth; recent studies have demonstrated a direct correlation between untreated UTIs during pregnancy and delivery prior to 37 weeks of gestation (Agger et al., 2014).

In recent years, this clinical challenge has intensified due to the rapid development of bacterial drug resistance (Nath et al., 1996). The frequent, often indiscriminate, use of broad-spectrum antibiotics without prior susceptibility testing has led to the emergence of multidrug-resistant bacterial strains (Chandel et al., 2012). A significant challenge remains in selecting appropriate treatments, as therapeutic options during pregnancy are strictly regulated to ensure both maternal and fetal safety (Nath et al., 1996; Chandel et al., 2012). Research regarding the prevalence of UTIs and their associated antibiotic sensitivity profiles among pregnant women is essential for healthcare providers and health planners. In modern medical practice, obstetric care centers on antenatal surveillance, which is vital for ensuring satisfactory perinatal outcomes.

2. Materials and Methods

2.1 Aim of the Study

The primary objective of this study is to evaluate the prevalence, bacterial etiologies, and antimicrobial resistance profiles of urinary tract infections (UTIs) among pregnant women in Benghazi. This research seeks to establish a localized database to optimize routine antenatal care and follow-up protocols. Furthermore, the study aims to mitigate maternal and fetal complications arising from delayed diagnoses or ineffective clinical treatments.

2.2 Sample Collection

This cross-sectional study was conducted in Benghazi, Libya, between October 2025 and May 2026. The target population consisted of pregnant women attending various polyclinics across the city for routine antenatal care and periodic follow-ups. A total of 170 pregnant women, aged between 18 and 38 years, were enrolled in the study. Patients currently receiving antibiotic therapy were excluded to prevent skewed results. Participants were provided with detailed instructions on the proper technique for collecting midstream urine samples, which involved thorough cleansing of the perineal area without the use of antiseptics to avoid the potential inhibition of bacterial growth.

2.3 Laboratory Analysis

Urine samples were inoculated onto Blood Agar and CLED Agar and incubated at 37°C for 24–48 hours. Following incubation, isolates were identified based on morphological characteristics and a series of biochemical tests, including Coagulase and Catalase tests. For definitive species identification, Analytical Profile Index (API) test kits were utilized.

3. Results

A total of 170 urine samples were collected from pregnant women attending various polyclinics in Benghazi, Libya. Of these, 123 (72.35%) were diagnosed with a urinary tract infection (UTI) based on positive bacterial cultures (Table 1). The study population encompassed an age range of 18–38 years across all trimesters of pregnancy. Statistical analysis of the age variable yielded a p-value of 0.421 ($p > 0.05$), indicating no statistically significant correlation between age and UTI prevalence. UTIs were most prevalent in the 18–22 age group, accounting for 49 cases (39.8%), followed by the 22–26 age group with 37 cases (30.1%), while the 34–38 age group recorded the lowest prevalence with 7 cases (7.5%). Regarding gestational age, the p-value for pregnancy trimesters was 0.001 ($p < 0.05$), demonstrating high statistical significance; the findings indicate that the highest infection rate occurred during the third trimester of pregnancy, with 70 cases (56.9%).

Table (1) collected samples according to bacterial growth

Material growth	Frequency (n)	Percentage%
Growth	123	72.35%
No –growth	47	27.65%
Total	170	%100

Table (2) Percentage of isolated bacteria

Bacterial growth	Frequency (n)	Percentage%
Gram positive bacteria	52	42.28%
Gram negative bacteria	71	57.72%
Total	123	%100

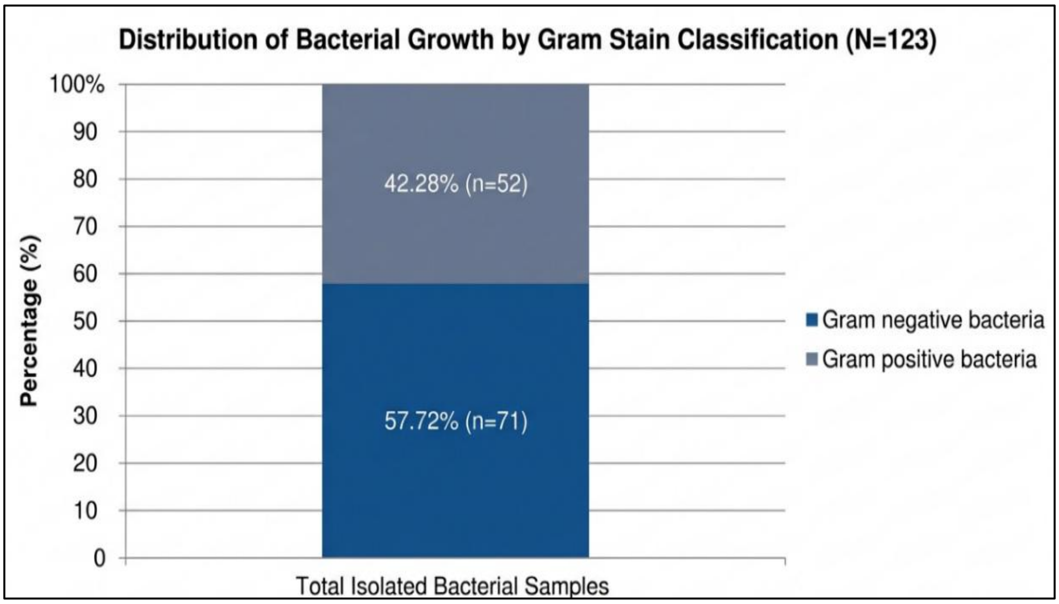


Table (3) Frequency and Percentages of isolated uropathogens

causative organism	Frequency (n)	Percentages%
E.coli	**43**	**34.9%**
Staph. Aureus	**31**	**25.2%**
Klebsiella pneumonia	**24**	**19.5%**
Staph.saprophyticus	**11**	**9%**
Proteus mirabilis	**5**	**4.1%**
Neisseria gonorrhea	**5**	**4.1%**
Strepto.agalactea	**3**	**2.4%**
Pseudomonas aeruginosa	**1**	**0.8 %**
Total	**123**	**100%**

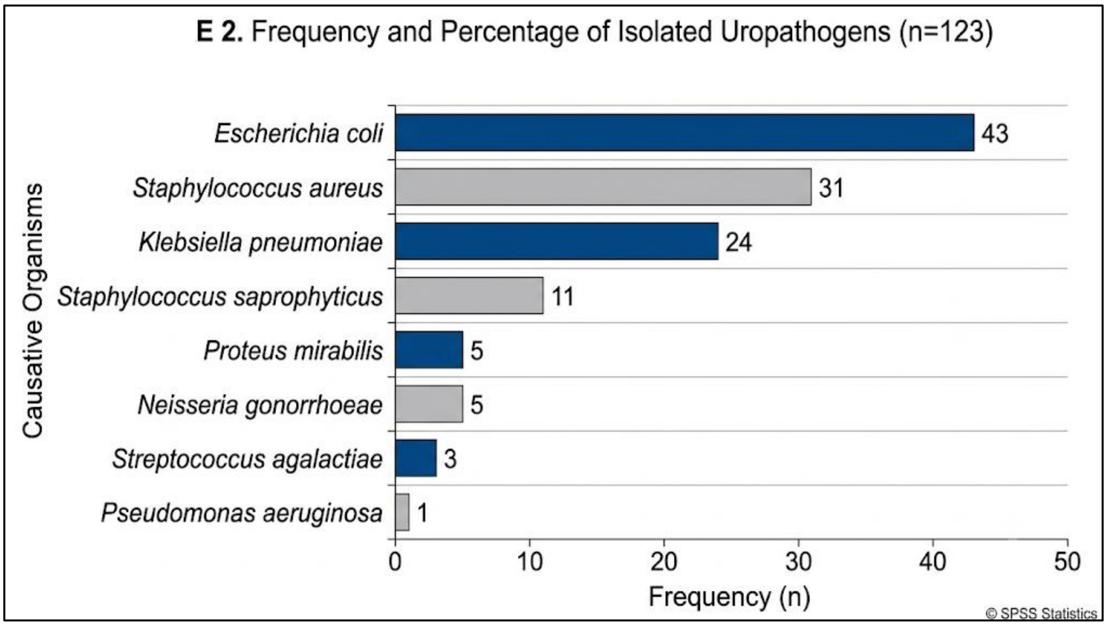


Table (4) Frequency and Percentages according to age group

Age group	No.patient %	No.positive%	No.negative%
18-22	49(39.8%)	21(40.4%)	28(39.43%)
22-26	37(30.1%)	14(27%)	23 (32.40%)
26-30	18(14.6%)	5(9.62%)	13(18.31%)
30-34	12(9.8%)	10(19.2%)	2(2.82%)
34-38	7(5.7%)	2(3.8%)	5(7.04%)
Total	123(100%)	52 (%100)	71(100%)

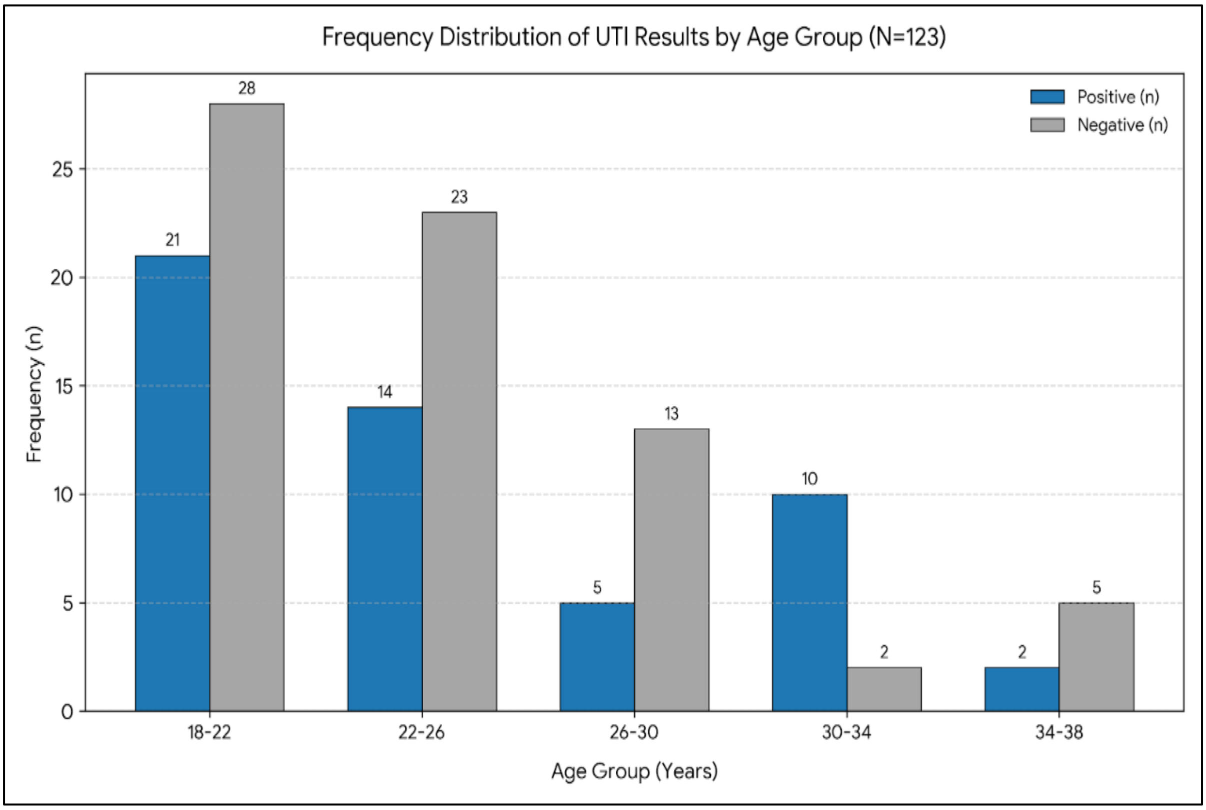
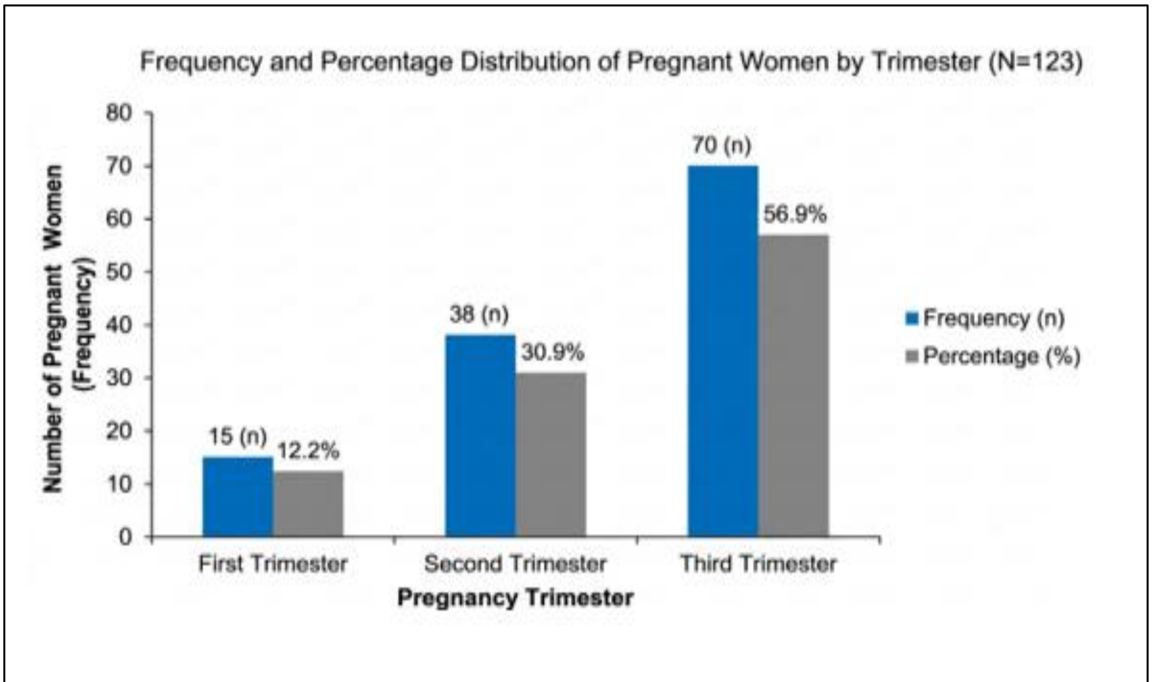


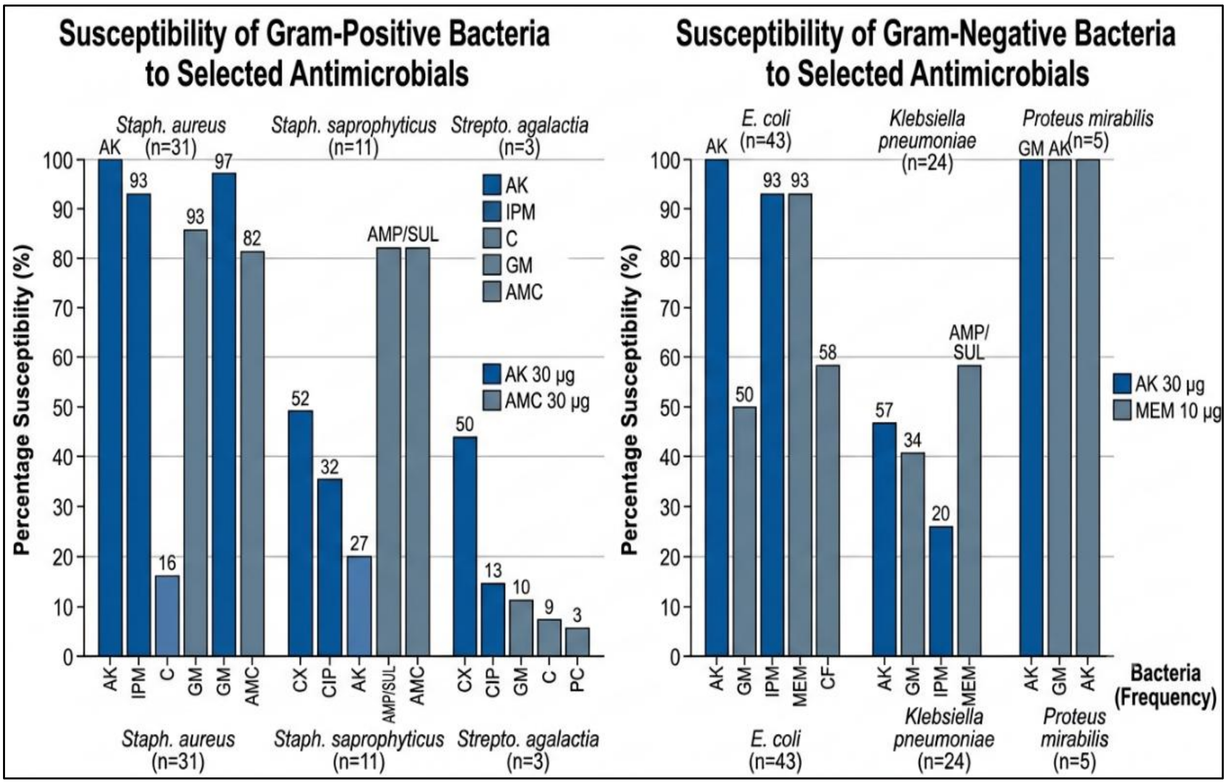
Table (5) Frequency and Percentages according to Trimester

Trimester	Frequency (n)	Percentages %
First trimester	15	12.2%
Second trimester	38	30.9%
Third trimester	70	56.9%
Total	123	100%

Table (6) Frequency and Percentages according to susceptibility of antimicrobial

Bacteria	Frequency (n)	Susceptibility of antimicrobial %										
		AMC 30 µg	AMP/SUL 20 µg	MEM 10 µg	IPM 10 µg	CF 30 µg	PC 100 µg	C 30 µg	GM 10 µg	AK 30 µg	CIP 5 µg	CX 1 µg
Gram positive												
Staph. Aureus	31	28s	25s	23s	31s	24s	28s	28s	30s	27s	21s	25s
Staph.saprophyticus	11	9s	9s	11s	11s	11s	2S	9s	11s	10s	9s	10s
Strepto.agalactea	3	3s	3s	3s	3s	3s	1s	1s	0s	0s	2s	3s
Gram negative												
E.coli	43	30S	26S	40S	40S	28S	29S	37S	37S	43S	29S	35S
Klebsiella pneumonia	24	17S	14S	23S	23S	19S	15S	20S	17S	24S	15S	13S
Proteus mirabilis	5	5S	5S	5S	5S	3S	3S	4S	5S	R	3S	5S
Neisseria gonorrhea	5	5S	4S	5S	5S	3S	R	4S	R	R	4S	5S
Pseudomonas aeruginosa	1	R	R	S	S	R	S	R	S	S	S	R
Total	123											





4. Discussion

4. Discussion

The early detection and prompt clinical management of asymptomatic bacteriuria and symptomatic urinary tract infections (UTIs) are of paramount importance in obstetric care. Left untreated, these infections significantly increase the risk of progression to acute pyelonephritis, a condition that poses severe physiological threats to both maternal and fetal well-being, including an established correlation with preterm delivery and low birth weight (Smaill & Vazquez, 2007; Romero et al., 1989). The findings of this study underscore the local epidemiological landscape in Benghazi, emphasizing the necessity for standardized, accurate isolation and identification of uropathogens to guide evidence-based therapeutic interventions in Libyan clinical settings (Ben Hsin et al., 2025).

The current study reported a high prevalence of UTIs (72.35%) among the cohort, with *Escherichia coli* identified as the most frequent isolate (34.9%), followed by *Staphylococcus* species (25.2%). This distribution aligns with established regional and local data, which consistently identify Gram-negative enteric bacteria as the primary etiology for pregnancy-associated UTIs (Ben Hsin et al., 2025; Mohamed et al., 2017; Hamdan et al., 2011). Demographic analysis revealed that women in the 18–22 age group were particularly susceptible, representing 39.8% of positive cases. This vulnerability may be linked to various socio-biological factors or early-stage antenatal behavioral patterns, mirroring trends observed in other developing clinical contexts (Kerure et al., 2024).

The global emergence of multidrug-resistant (MDR) bacterial strains has severely limited the efficacy of conventional pharmacological treatments, necessitating the exploration of innovative and alternative therapeutic modalities. Recent investigations into natural products have highlighted the potent antimicrobial activity of diverse botanical extracts. Specifically, *Plantago ovata*, *Taraxacum officinale*, *Usnea barbata*, and *Hypericum decaisneanum* have shown significant potential in inhibiting the growth of clinically relevant strains, including *E. coli* and *S. aureus* (Khalil et al., 2025; Salem et al., 2025; Salem, 2024; Salem & Alhadad, 2026; Kadak & Salem, 2020). Beyond crude extracts, detailed phytochemical profiling has

facilitated the identification of specific bioactive molecules, such as isothiocyanates from *Sinapis alba* or essential oils derived from flaxseed, which exhibit rapid bactericidal kinetics against resilient uropathogens (Soof et al., 2025; Salem & Lakwani, 2024).
Furthermore, the integration of advanced material science—such as the development of antimicrobial polymers—offers a sophisticated technological strategy to combat bacterial resistance mechanisms (Salem & Salem, 2025; Alshawish et al., 2025). Collectively, these findings suggest that a multi-faceted approach, incorporating both traditional screening protocols and the integration of bioactive-based therapies, is essential to mitigate the growing challenges posed by antibiotic resistance in pregnancy-related UTIs. Future research should prioritize clinical validation and the standardization of these non-conventional therapies to ensure their safety and efficacy for maternal and perinatal health.

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