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ANTIMICROBIAL SENSITIVITY PATTERN OF BACTERIAL SPECIES ISOLATED FROM PREGNANT WOMEN WITH URINARY TRACT INFECTION

Original Research

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Acknowledgement: The authors express gratitude to the microbiology laboratory staff for their technical support in sample processing and analysis.

Conflict of Interest: None

Grant Support & Financial Support: None

ABSTRACT

Background: Urinary tract infections (UTIs) are among the most common bacterial infections in pregnant women and can lead to adverse maternal and fetal outcomes if untreated. Physiological changes in pregnancy increase susceptibility, and the emergence of antimicrobial resistance complicates management. Continuous monitoring of causative agents and their susceptibility profiles is critical for guiding effective therapy and preventing resistance escalation.

Objective: To identify bacterial species causing UTIs in pregnant women and evaluate their antimicrobial sensitivity patterns to guide targeted therapeutic strategies.

Methods: A cross-sectional study was conducted on 150 midstream urine samples collected from pregnant women attending Allied Hospital, Faisalabad. Samples were transported to the Microbiology Laboratory, Riphah International University, Faisalabad, and cultured on cysteine-lactose-electrolyte deficient agar (CLED). Bacterial identification was performed using standard biochemical tests. Antimicrobial susceptibility testing was carried out using the modified Kirby-Bauer disc diffusion method, following Clinical and Laboratory Standards Institute (CLSI) guidelines.

Results: Out of 150 urine samples, 38.7% showed bacterial growth, while 61.3% yielded no growth. *Escherichia coli* was the most prevalent pathogen (39.7%), followed by *Staphylococcus saprophyticus* (20.7%), *Enterococcus faecalis* (13.8%), *Klebsiella pneumoniae* (10.3%), *Proteus mirabilis* (8.6%), and *Pseudomonas aeruginosa* (6.9%). Nitrofurantoin and fosfomycin demonstrated 100% susceptibility against *E. coli* but no activity against *P. aeruginosa* (0%). Piperacillin-tazobactam showed high effectiveness against *K. pneumoniae* (84%), *P. mirabilis* (80%), and *P. aeruginosa* (100%). For Gram-positive isolates, nitrofurantoin was effective against *S. saprophyticus* (92%) and *E. faecalis* (75%), while fosfomycin showed similar high activity. *E. faecalis* exhibited complete resistance to ampicillin and amoxicillin (0%).

Conclusion: The study highlights *E. coli* as the predominant uropathogen in pregnancy-associated UTIs and emphasizes nitrofurantoin, fosfomycin, and piperacillin-tazobactam as the most effective treatment options. Routine susceptibility testing is essential to optimize maternal care and curb antimicrobial resistance.

Keywords: Antimicrobial sensitivity, Enterococcus faecalis, Escherichia coli, Klebsiella pneumoniae, Pregnancy, Urinary tract infections, Urine culture.

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INTRODUCTION

Urinary tract infection (UTI) is one of the most common bacterial infections affecting women globally, with a particularly high incidence during pregnancy due to physiological, anatomical, and hormonal changes that predispose to urinary stasis and pathogen ascension (1,2). The condition arises when bacteria—most frequently Escherichia coli—colonize and proliferate within the urinary tract, often originating from the gastrointestinal tract and ascending via the urethra (3). Pregnancy-specific changes, such as increased progesterone levels, ureteral dilation, reduced bladder tone, and vesicoureteral reflux, enhance the risk of both lower UTIs (cystitis) and upper UTIs (pyelonephritis), which, if untreated, can cause significant maternal and fetal complications including preterm birth, low birth weight, anemia, and preeclampsia (4,5). Other pathogens, such as Klebsiella pneumoniae, Proteus mirabilis, Pseudomonas aeruginosa, Staphylococcus saprophyticus, and Group B Streptococcus, though less prevalent, are clinically significant due to their virulence and resistance potential (6). The pathophysiology of UTIs in pregnancy is strongly influenced by altered urinary tract dynamics, reduced immune response, and pregnancy-associated glycosuria, which provides a favorable growth medium for bacteria (7). Clinically, pregnancy-related UTIs may present as asymptomatic bacteriuria, acute cystitis, or acute pyelonephritis. While asymptomatic bacteriuria often goes unnoticed in non-pregnant women, it is routinely screened and treated in pregnancy because of its strong association with pyelonephritis and adverse obstetric outcomes (8). Acute cystitis is characterized by dysuria, frequency, urgency, and suprapubic discomfort, while acute pyelonephritis presents with systemic symptoms such as fever, flank pain, nausea, and vomiting, and carries a high risk of sepsis and obstetric complications (9). Bacterial virulence factors—including adhesins, fimbriae, siderophores, and toxins—enhance colonization and immune evasion, while host susceptibility factors such as prior UTIs, structural urinary abnormalities, diabetes mellitus, and increased sexual activity contribute to infection risk (10). The clinical management of UTIs during pregnancy requires careful antibiotic selection to ensure maternal cure while safeguarding fetal safety. Commonly prescribed agents include nitrofurantoin, cephalexin, and amoxicillin-clavulanate, with avoidance of fluoroquinolones and tetracyclines due to teratogenic potential (11,12).

However, the rising prevalence of multidrug-resistant (MDR) uropathogens, particularly extended-spectrum β-lactamase (ESBL)-producing Enterobacteriaceae, has complicated empirical treatment choices (13). Mechanisms of antimicrobial resistance—ranging from β-lactamase production and efflux pump activity to biofilm formation and horizontal gene transfer—are increasingly reported among pregnancy-related UTI isolates (14). Globally, prevalence estimates for UTIs in pregnancy vary between 2% and 10% depending on geography, diagnostic criteria, and screening practices (1,15). Studies from both developed and resource-limited settings consistently report E. coli as the dominant pathogen, followed by Klebsiella spp. and Gram-positive cocci, with resistance patterns showing high variability and often correlating with local antibiotic use trends (13-15). In many low- and middle-income countries, empirical therapy is frequently initiated without culture confirmation, increasing the risk of treatment failure and promoting resistance (16). Current evidence underscores the importance of regular surveillance of local antimicrobial susceptibility profiles to guide empirical therapy, early detection of asymptomatic bacteriuria, and stewardship strategies to prevent further escalation of resistance (17). Given these epidemiological trends, pathogenic mechanisms, and growing antimicrobial resistance, there is a pressing need for region-specific data on bacterial species distribution and antibiotic sensitivity among pregnant women with UTIs. Such data are crucial to refine empirical treatment guidelines, optimize patient outcomes, and reduce the burden of complications for both mother and fetus. Therefore, the objective of this study is to isolate and identify bacterial species from pregnant women with UTIs and to determine their antimicrobial sensitivity patterns, thereby providing evidence-based recommendations for effective clinical management in this vulnerable population.

METHODS

The study was conducted as an analytical cross-sectional investigation (1) over a six-month period from 1 June 2024 to 30 November 2024 at the Microbiology Laboratory of Riphah International University, Faisalabad, with partial work undertaken at Allied Hospital, Faisalabad. Ethical clearance was obtained prior to commencement from the Institutional Biosafety and Bioethics Committee (IBBC) of Riphah International University, Faisalabad, and Allied Hospital, Faisalabad, with informed consent secured from all participants before enrolment. A total of 150 pregnant women aged between 18 and 45 years, presenting with symptoms suggestive of urinary tract infection and confirmed by a positive urine culture indicating significant bacteriuria, were included in the study (2,3). Random sampling was employed to recruit participants. Women with known immunodeficiency disorders or undergoing immunosuppressive therapy, as

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well as those who had received antibiotic treatment for UTI within the preceding two weeks, were excluded to avoid confounding results (4). Demographic and clinical information, including age, gestational age, ethnicity, socioeconomic status, geographical location, prior UTI history, previous antibiotic use, and underlying medical conditions, was collected to assess potential factors influencing infection risk and antimicrobial sensitivity patterns (5).

Clean-catch midstream urine specimens (10–20 mL) were collected from each participant into sterile, screw-capped, wide-mouth containers. Each sample was appropriately labeled with a unique identification number, date, and time of collection, and promptly transported to the microbiology laboratory under recommended conditions (6). Urine cultures were performed using a calibrated wire loop (0.001 mL) to inoculate well-mixed, uncentrifuged specimens onto Cystine-Lactose-Electrolyte-Deficient (CLED) agar, following the streak plate method (5,6). Plates were incubated aerobically at 37°C for 24 hours, and bacterial growth was quantified; counts $\geq 10^5$ colony-forming units (CFU)/mL were considered significant bacteriuria. Colony morphology, hemolysis patterns, swarming ability, and odor were recorded. Gram staining was performed, and isolates were further identified using conventional biochemical tests including triple sugar iron (TSI) agar, indole, Simmons citrate, oxidase, urease, motility, catalase, and coagulase tests, following standard diagnostic algorithms (7-10). Identification protocols adhered strictly to quality-controlled microbiological procedures, with biochemical results interpreted according to established taxonomic criteria.

Antimicrobial susceptibility testing was conducted using the Kirby-Bauer disk diffusion method on Mueller-Hinton agar in accordance with Clinical and Laboratory Standards Institute (CLSI) guidelines (11,12). Standardized inocula equivalent to a 0.5 McFarland turbidity standard (10^5–10^6 CFU/mL) were prepared from pure bacterial cultures and swabbed evenly across agar surfaces to ensure confluent growth (13). Antibiotic disks tested included ampicillin, ceftriaxone, amoxicillin, gentamicin, nitrofurantoin, trimethoprim-sulfamethoxazole, colistin, piperacillin-tazobactam, and ciprofloxacin. Disks were placed at recommended distances to prevent overlapping inhibition zones, and plates were incubated at 37°C for 24 hours. Zone diameters were measured in millimeters and interpreted as sensitive, intermediate, or resistant based on CLSI performance standards (14). Reference control strains—Escherichia coli ATCC 25922 and Pseudomonas aeruginosa ATCC 27853—were used to validate culture and sensitivity procedures (17). Data entry and statistical analysis were performed using IBM SPSS Statistics version 26 and Microsoft Excel. Descriptive statistics were used to summarize demographic variables, bacterial isolate distribution, and antimicrobial resistance patterns. Comparative analyses were planned to explore associations between demographic or clinical variables and resistance profiles, with statistical significance set at $p < 0.05$.

RESULTS

The study included 150 pregnant women diagnosed with urinary tract infection (UTI) based on clinical symptoms and urine culture results. Of these, 68 women (45.3%) resided in urban areas and 82 women (54.7%) were from rural areas, indicating a slightly higher representation from rural settings. The age distribution revealed that 66 women (44.0%) were in the 18–24 years group, 60 women (40.0%) in the 31–37 years group, 13 women (8.7%) in the 25–30 years group, and 11 women (7.3%) in the 38–45 years group. Analysis of gestational age showed that 30 women (20.0%) were in the first trimester (0–13 weeks), 53 women (35.3%) in the second trimester (14–26 weeks), and 67 women (44.7%) in the third trimester (27–40 weeks). Across all age groups, the third trimester accounted for the largest proportion of cases. Evaluation of risk factors demonstrated that hormonal changes during pregnancy were the most prevalent, reported in 90 women (60.0%, $p = 0.008$). Other significant risk factors included a history of UTI in 70 women (46.7%, $p = 0.03$), poor hygiene in 25 women (16.7%, $p = 0.02$), diabetes in 20 women (13.3%, $p = 0.01$), urinary tract abnormalities in 10 women (6.7%, $p = 0.04$), frequent urinary retention in 28 women (18.7%, $p = 0.03$), and immune suppression in 12 women (8.0%, $p = 0.03$). Non-significant factors included sexual activity (33.3%, $p = 0.07$), recent antibiotic use (12.0%, $p = 0.06$), increased fluid intake (20.0%, $p = 0.09$), low socioeconomic status (23.3%, $p = 0.21$), use of spermicides (10.0%, $p = 0.11$), anemia (14.7%, $p = 0.05$), kidney stones (5.3%, $p = 0.10$), and catheter use (3.3%, $p = 0.27$). Urine culture analysis revealed that 58 samples (38.7%) were culture-positive, while 92 samples (61.3%) showed no bacterial growth. Among the positive cultures, 38 isolates (65.6%) were Gram-negative rods and 20 isolates (34.4%) were Gram-positive cocci. The most frequently isolated organism was *Escherichia coli* (23 isolates, 39.7%), followed by *Staphylococcus saprophyticus* (12 isolates, 20.7%), *Enterococcus faecalis* (8 isolates, 13.8%), *Klebsiella pneumoniae* (6 isolates, 10.3%), *Proteus mirabilis* (5 isolates, 8.6%), and *Pseudomonas aeruginosa* (4 isolates, 6.9%).

Antimicrobial sensitivity testing of Gram-negative bacteria showed that *E. coli* had the highest susceptibility to fosfomycin and nitrofurantoin (100%), followed by colistin (91%) and piperacillin-tazobactam (87%). Moderate susceptibility was observed with

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gentamicin (74%) and ceftriaxone (57%), while lower susceptibility was seen with ciprofloxacin (53%), ampicillin (34%), amoxicillin (17%), and trimethoprim-sulphamethoxazole (48%). *K. pneumoniae* was fully sensitive to fosfomycin (100%), with high sensitivity to gentamicin and piperacillin-tazobactam (84% each), moderate sensitivity to colistin (34%), and poor sensitivity to ciprofloxacin (17%). Ampicillin and amoxicillin demonstrated complete resistance. *P. mirabilis* showed full sensitivity to gentamicin (100%) and high sensitivity to piperacillin-tazobactam (80%), with moderate sensitivity to fosfomycin (60%) and low sensitivity to ciprofloxacin and ceftriaxone (40% each). *P. aeruginosa* demonstrated 100% sensitivity to piperacillin-tazobactam, moderate sensitivity to colistin (50%), and low sensitivity to gentamicin (25%). Among Gram-positive isolates, *S. saprophyticus* demonstrated the highest sensitivity to nitrofurantoin and fosfomycin (92% each), followed by gentamicin (75%), vancomycin (67%), and ciprofloxacin (50%). Resistance was observed to ampicillin, amoxicillin, ceftriaxone, and trimethoprim-sulphamethoxazole. *E. faecalis* exhibited highest sensitivity to fosfomycin (87%), nitrofurantoin (75%), and vancomycin (75%), moderate sensitivity to gentamicin (63%) and ciprofloxacin (50%), low sensitivity to amoxicillin (25%), and complete resistance to ampicillin and trimethoprim-sulphamethoxazole.

These results confirmed that Gram-negative organisms, particularly *E. coli*, were the predominant pathogens in pregnancy-related UTIs, with fosfomycin, nitrofurantoin, and piperacillin-tazobactam showing the highest sensitivity rates across most isolates. Analysis of antimicrobial sensitivity patterns in relation to demographic characteristics revealed notable trends. E. coli emerged as the predominant isolate across all age groups, with particularly high resistance to ampicillin and amoxicillin among women aged 18–24 years ($p = 0.04$) and to both ampicillin and trimethoprim–sulfamethoxazole in the 31–37 years group ($p = 0.03$). Rural residents showed a higher prevalence of *S. saprophyticus*, with moderate resistance to gentamicin ($p = 0.05$), whereas urban residents predominantly yielded *E. coli* isolates exhibiting elevated ciprofloxacin resistance ($p = 0.05$). Gestational age also influenced bacterial distribution, with *E. coli* being most frequent in the first and third trimesters, the latter showing moderate ceftriaxone resistance ($p = 0.01$), while *S. saprophyticus* predominated in the second trimester, demonstrating high ampicillin resistance ($p = 0.04$). Significant associations were observed between certain risk factors, including history of UTI, diabetes, poor hygiene, urinary tract abnormalities, immune suppression, and hormonal changes in pregnancy, with both the type of isolate and its resistance profile. These findings highlight the interplay between demographic variables and antimicrobial resistance, underlining the need for tailored empiric therapy based on local epidemiological data.

Table 1: Correlation of Demographic Factors with Bacterial Isolates and Resistance Patterns

Demographic Factors	Most Common Isolate	Resistance Trend	p-value
Age Group			
18–24	*E. coli*	High resistance to Ampicillin, Amoxicillin	0.04
25–30	*E. coli*	High resistance to Ampicillin	0.06
31–37	*E. coli*	High resistance to Ampicillin, Trimethoprim–SMX	0.03
38–45	*E. coli*	Moderate resistance to multiple drugs	0.07
Residence			
Urban	*E. coli*	High resistance to Ciprofloxacin	0.05
Rural	*S. saprophyticus*	Moderate resistance to Gentamicin	0.05
Trimester			
First	*E. coli*	Low resistance overall	0.02
Second	*S. saprophyticus*	High resistance to Ampicillin	0.04
Third	*E. coli*	Moderate resistance to Ceftriaxone	0.01

Table 2: Age and Gestational Age-Wise Distribution of Pregnant Women

Age Groups (Years)	No. of Pregnant Women (N)	Percentage (%)	First Trimester (0–13 weeks)	Second Trimester (14–26 weeks)	Third Trimester (27–40 weeks)	Total
18–24	66	44.0%	15 (22.7%)	25 (37.9%)	26 (39.4%)	66
25–30	13	8.7%	3 (23.1%)	4 (30.8%)	6 (46.1%)	13
31–37	60	40.0%	10 (16.7%)	20 (33.3%)	30 (50.0%)	60
38–45	11	7.3%	2 (18.2%)	4 (36.4%)	5 (45.4%)	11
Total	150	100%	30 (20.0%)	53 (35.3%)	67 (44.7%)	150

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Table 3: Analysis of the Other Risk Factors of UTI in Pregnant Women by using T-test

Risk Factors	Frequency	Percent	Valid Percent	Cumulative Percent	p- value
History of UTI	70	46.7	46.7	46.7	0.03
Sexual activity	50	33.3	33.3	80.0	0.07
Diabetes	20	13.3	13.3	93.3	0.01
Poor hygiene	25	16.7	16.7	30.0	0.02
Use of spermicides	15	10.0	10.0	40.0	0.11
Urinary tract abnormalities	10	6.7	6.7	53.3	0.04
Recent antibiotic use	18	12.0	12.0	60.0	0.06
Catheter use	5	3.3	3.3	63.3	0.27
Increased fluid intake	30	20.0	20.0	83.3	0.09
Frequent urinary retention	28	18.7	18.7	92.0	0.03
Immune suppression	12	8.0	8.0	68.0	0.03
Hormonal changes in Pregnancy	90	60.0	60.0	100.0	0.008
Anemia	22	14.7	14.7	85.3	0.05
Low socioeconomic status	35	23.3	23.3	71.3	0.21
Kidney stones	8	5.3	5.3	95.3	0.10
Total	**150**	**100**	**100**		

Table 4: Culture results of urine samples collected from pregnant women

Culture results	No of urine samples (N)	Percentage (%)
Growth	58	38.7%
No Growth	92	61.3%
Total	**150**	**100%**

Table 5: Prevalence of Gram-positive and Gram-negative bacteria in positive urine culture

Bacteria	No. of Isolates	% of Isolates
Gram-negative Rods	38	65.6%
Gram-positive Cocci	20	34.4%
Total	**58**	**100%**

Table 6: Prevalence of different bacteria in positive urine culture

Bacterial Species	Number of Isolates (N)	Percentage (%)
E. coli	23	39.7%
S. saprophyticus	12	20.7%
E. faecalis	8	13.8%
K. pneumoniae	6	10.3%
P. mirablis	5	8.6%
P. aeruginosa	4	6.9%
Total	**58**	**100.0%**

Table 7: Antimicrobial Sensitivity Pattern of Bacterial Isolates from Pregnant Women with UTI

Antibiotics	E. coli	K. pneumoniae	P. mirabilis	P. aeruginosa	S. saprophyticus	E. faecalis
	Gram negative bacteria				Gram positive bacteria	
Ampicillin	34%	0%	40%	-	-	0%
Amoxicillin	17%	0%	0%	-	-	25%
Ceftriaxone	57%	0%	40%	0%	-	-

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Antibiotics	E. coli	K. pneumoniae	P. mirabilis	P. aeruginosa	S. saprophyticus	E. faecalis
Nitrofurantoin	100%	-	-	0%	92%	75%
Gentamicin	74%	84%	100%	25%	75%	63%
Trimethoprim-Sulphamethoxazole	48%	0%	0%	-	-	0%
Ciprofloxacin	53%	17%	40%	0%	50%	50%
Fosfomycin	100%	100%	60%	25%	92%	87%
Colistin	91%	34%	-	50%	-	-
Piperacillin-Tazobactam	87%	84%	80%	100%	-	-

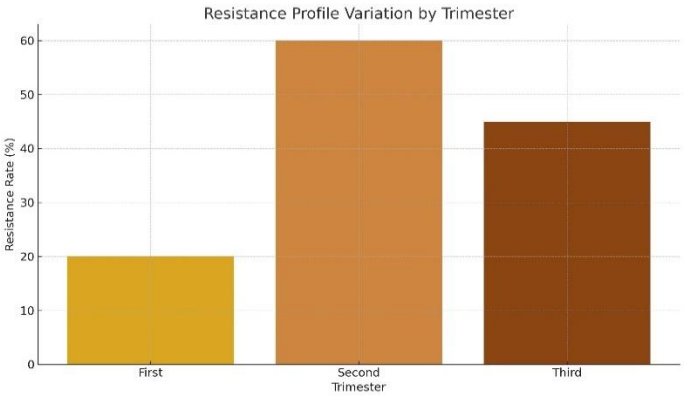


Figure 1 Resistance Profile Variation by Trimester

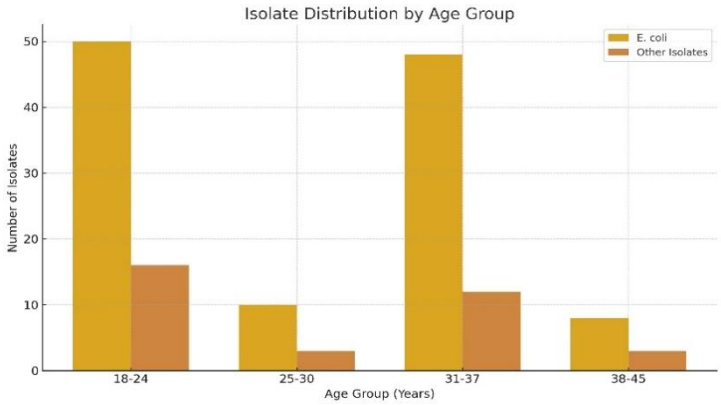


Figure 2 Isolate Distribution by Age Group

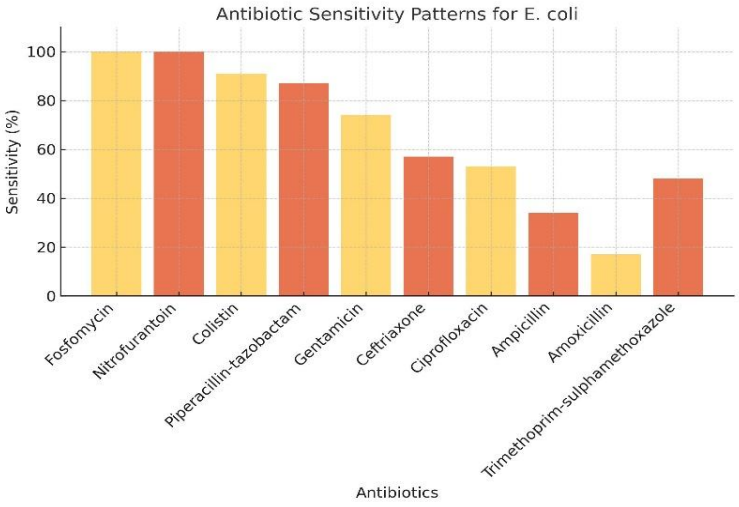


Figure 3 Antibiotic Sensitivity Patterns for E. Coli

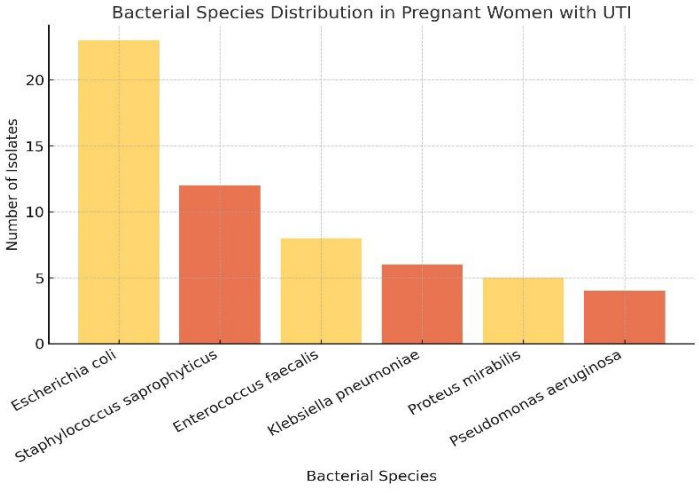


Figure 4 Bacterial Species Distribution in Pregnant Women with UTI

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DISCUSSION

The present study provided an in-depth evaluation of the bacterial profile and antimicrobial sensitivity patterns among pregnant women diagnosed with urinary tract infections (UTIs) in a tertiary care setting. The findings demonstrated that *Escherichia coli* remained the predominant uropathogen, consistent with previous literature that identifies it as the leading causative agent of UTIs in pregnancy due to its virulence factors and ability to colonize the urinary tract. The high prevalence of *E. coli* aligns with reports from other regional and international studies, further confirming its clinical significance in this population. Gram-positive species such as *Staphylococcus saprophyticus* and *Enterococcus faecalis* were also isolated at considerable rates, underscoring the need for broad-spectrum diagnostic vigilance. The antimicrobial susceptibility patterns revealed that nitrofurantoin, fosfomycin, and piperacillin-tazobactam exhibited the highest efficacy against the majority of isolates, particularly *E. coli* and *Klebsiella pneumoniae*. These results corroborate earlier findings that nitrofurantoin remains an effective and safe first-line agent for the treatment of uncomplicated UTIs in pregnancy (17,18). The observed complete resistance of *K. pneumoniae* to ceftriaxone and the markedly low sensitivity of *E. coli* and *Proteus mirabilis* to ampicillin, amoxicillin, and trimethoprim-sulfamethoxazole indicate a concerning trend of resistance towards commonly prescribed antibiotics, which has been similarly reported in several developing countries (19-21). This resistance pattern likely reflects the cumulative effect of empirical prescribing practices, limited antimicrobial stewardship, and the widespread availability of antibiotics without prescription in resource-limited settings.

The detection of multidrug resistance in *Pseudomonas aeruginosa*, particularly its high resistance to fluoroquinolones and cephalosporins, aligns with global trends in which *P. aeruginosa* demonstrates intrinsic and acquired resistance mechanisms. This poses a therapeutic challenge in pregnancy, where treatment options are already constrained by safety considerations for the fetus. The sensitivity of *S. saprophyticus* and *E. faecalis* to nitrofurantoin and vancomycin supports their continued use in treating Gram-positive uropathogens, though resistance to ampicillin and trimethoprim-sulfamethoxazole in these species warrants cautious selection of therapy (22,23). Demographic correlations revealed that the highest number of isolates were recovered from women in the 18–24 and 31–37-year age groups, with the third trimester showing the greatest proportion of culture-positive cases. These patterns are consistent with physiological and hormonal changes in pregnancy, such as urinary stasis and immune modulation, which are accentuated in late gestation. Risk factor analysis indicated statistically significant associations between UTI occurrence and a history of UTIs, diabetes, poor hygiene, urinary tract abnormalities, frequent urinary retention, immune suppression, and hormonal changes of pregnancy (24). These findings emphasize the multifactorial nature of UTI susceptibility and reinforce the importance of targeted preventive strategies.

The strengths of this study include its use of culture-based bacterial identification combined with antimicrobial susceptibility testing, which allowed for accurate profiling of resistance patterns. The inclusion of demographic and risk factor analyses further enriched the interpretation of microbiological data. However, limitations must be acknowledged. The study's sample size and single-center design restrict generalizability, and the absence of molecular characterization of resistance mechanisms precludes deeper insight into genetic determinants of antimicrobial resistance. Additionally, potential seasonal variations in UTI incidence were not assessed, which could influence pathogen prevalence and resistance patterns. From a public health and clinical perspective, the findings highlight the urgent need to update empirical treatment guidelines for UTIs in pregnancy based on local susceptibility profiles. The documented resistance trends support the implementation of antimicrobial stewardship programs, regular surveillance, and the development of rapid diagnostic tools to facilitate targeted therapy. Expanding future research to include multicenter studies with larger populations and molecular epidemiology would enhance the understanding of resistance evolution and guide more effective interventions. Furthermore, exploring alternative therapeutic options, such as bacteriophage therapy, probiotics, or immunomodulatory approaches, may offer viable solutions to combat multidrug-resistant uropathogens in vulnerable populations like pregnant women. Overall, this study reinforces the critical role of ongoing microbiological monitoring, rational antibiotic use, and patient education in mitigating antimicrobial resistance while ensuring safe and effective management of UTIs in pregnancy.

CONCLUSION

This study concluded that urinary tract infections in pregnant women are predominantly caused by *Escherichia coli*, with other Gram-positive and Gram-negative pathogens also contributing significantly to disease burden. The findings underscore the critical importance of tailoring antibiotic therapy to local antimicrobial sensitivity patterns, as substantial resistance was observed to several routinely prescribed agents. Effective treatment options such as nitrofurantoin, fosfomycin, and piperacillin-tazobactam remain valuable choices, reinforcing the need for targeted prescribing based on culture and susceptibility testing. By highlighting the influence of demographic

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and risk factors alongside resistance trends, this research provides an evidence-based foundation for optimizing maternal care, strengthening antimicrobial stewardship, and improving outcomes in both mothers and infants, particularly in resource-limited settings where empirical prescribing is common.

AUTHOR CONTRIBUTION

Author	Contribution
Rimsha Kiran	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Samra Asghar	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Hasan Ijaz	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Saman	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Ayesha Asif	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Muhammad Owais	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Sania Sajid	Contributed to study concept and Data collection Has given Final Approval of the version to be published
Areej Naveed	Writing - Review & Editing, Assistance with Data Curation
Hassnain Ijaz*	Writing - Review & Editing, Assistance with Data Curation

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