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ORIGINAL ARTICLE

Prevalence, etiological microorganisms and treatment susceptibility in urinary tract infections in pregnant women of Kohat Khyber Pakhtunkhwa

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ABSTRACT

Background: This study aimed to determine the frequency of urinary tract infection (UTI), identify the causative organisms, and assess the antibiotic sensitivity patterns among pregnant women in Kohat.

Methods: This cross sectional observational study enrolled 350 pregnant women attending Health Ways Hospital Kohat during December 2024 to April 2025. Midstream clean-catch urine samples were collected and cultured. Positive cultures were further analysed for antimicrobial susceptibility. Socio-demographic characteristics, hemoglobin levels, parity status, trimester of pregnancy, and education levels were also recorded. Data was analysed using SPSS version 22.0.

Results: Out of 350 pregnant women aged 18–42 years (mean age 29.84 ± 4.93), 48 (13.7%) were diagnosed with UTI based on positive urine culture. Most cases occurred in the 25–30 age groups. Multiparous women showed a higher prevalence of UTI. A greater proportion of UTI-positive women belonged to low socioeconomic backgrounds and had only primary or secondary education. UTI was more frequent in the third trimester. *Escherichia coli* (E. coli) were the most common isolated pathogen (45.8%), followed by *Klebsiella pneumoniae* (18.7%), *Pseudomonas* (12.5%), *Staphylococcus aureus* (10.4%), and *Enterococcus* (10.4%). Highest antibiotic sensitivity was observed for piperacillin-tazobactam (91.7%), meropenem (85.4%), nitrofurantoin (81.2%), and fosfomycin (79.1%). Moderate sensitivity was noted with cefixime, cefotaxime and amoxicillin/clavulanic acid, while high resistance was observed with ampicillin and ciprofloxacin.

Conclusion: A notable proportion of pregnant women in Kohat suffered from UTI, with E. coli being the predominant uropathogen. Piperacillin-tazobactum, meropenem, nitrofurantoin, and fosfomycin were the most effective antibiotics. Continuous screening, culture-based diagnosis, and local antibiotic guidelines are necessary to manage UTIs in pregnancy and prevent maternal-fetal complications.

Keywords: Antimicrobial Resistance, Escherichia coli, Pregnancy, Risk Factors, Urinary tract infection.

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Introduction

Urinary tract infections (UTIs) are among the most prevalent bacterial infections encountered during pregnancy and are linked to adverse maternal and perinatal outcomes when left untreated (1). A UTI is characterized by the presence and multiplication of pathogenic microorganisms anywhere along the urinary tract, from the renal cortex to the urethral meatus (1, 2). These infections may involve the upper tract (pyelonephritis) or lower tract (cystitis or urethritis), and can be symptomatic or asymptomatic (3).

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Pregnancy increases the susceptibility to UTIs due to anatomical and physiological changes, including urethral shortening, proximity to the anus and vagina, and urinary stasis from progesterone-induced smooth muscle relaxation and mechanical pressure from the enlarging uterus (4). Decreased bladder tone, ureteral dilatation, and vesico-ureteral reflux further promote bacterial colonization (5).

The prevalence and microbial patterns of UTIs vary globally, influenced by geographic, socioeconomic, and ethnic factors. In Pakistan, UTIs in pregnancy are a common but often underdiagnosed concern, especially in rural and underdeveloped areas. Limited awareness, delayed screening, and empirical use of antibiotics without sensitivity testing compound the risks. In regions like Kohat, Khyber Pakhtunkhwa, where healthcare resources are constrained and public health surveillance is limited, the burden of UTI may be even more pronounced—but data remain scarce.

Symptomatic UTIs occur in 1–2% of pregnancies, while asymptomatic bacteriuria is reported in 2–13% of cases (5, 6). Risk factors include advanced maternal age, diabetes, high parity, poor hygiene, low socioeconomic status, sickle cell disease, structural urinary anomalies, increased sexual activity, and prior UTI history (7, 8)

Significant bacteriuria is defined as a colony count of $\geq 10^5$ CFU/mL in a clean-catch midstream urine sample (9). Lower counts or polymicrobial growth typically indicate contamination. Symptoms may include dysuria, urgency, frequency, suprapubic pain, flank pain, and systemic signs like fever or nausea (10). The primary mode of infection is ascending, originating from enteric organisms colonizing the perineum and progressing to the kidneys. Escherichia coli is the leading pathogen in up to 80% of cases, followed by Klebsiella spp., Staphylococcus aureus, Proteus spp., and Pseudomonas spp. (11)

In Pakistan, empirical antibiotic treatment is often chosen without culture-based sensitivity is common due to limitations in diagnostic infrastructure. Beta-lactam antibiotics are widely used; however, fluoroquinolones are generally avoided in pregnancy due to potential teratogenicity. Early screening for asymptomatic bacteriuria, ideally between 12–16 weeks of gestation, remains the gold standard for UTI detection. Untreated UTIs may lead to complications such as preterm labour, low birth weight, and pyelonephritis, which occurs in up to 40% of untreated asymptomatic cases. Given these challenges, this study seeks to address a crucial gap by determining the prevalence, microbial etiology, and antibiotic sensitivity profiles of UTIs among pregnant women

attending antenatal clinics in Kohat. By generating local epidemiological data, we aim to support region-specific guidelines and strengthen clinical strategies for the prevention and treatment of UTIs during pregnancy.

Methods

This descriptive cross-sectional study was conducted between December 2024 and April 2025 across multiple gynecological and diagnostic clinics in Kohat, Khyber Pakhtunkhwa, Pakistan. Ethical approval was obtained from the Institutional Review Health Ways Hospital via letter no. HWH/311, adhering to the principles outlined in the Declaration of Helsinki (12).

A total of 350 pregnant women aged 25–35 years were recruited using convenient sampling. Participants either presented with symptoms suggestive of urinary tract infection (UTI) or were undergoing routine antenatal screening and willing to participate in the study were enrolled with no other complications. Non-pregnant individuals and those unwilling to participate were excluded.

After recording of demographic data, midstream urine samples were collected using sterile, labelled containers and were promptly transported to the microbiology laboratory, Health Ways Hospital. All the urine samples were inoculated onto Blood agar, MacConkey agar, and Cysteine Lactose Electrolyte Deficient (CLED) agar (Oxoid, UK) using a calibrated loop. Plates were incubated aerobically at 37°C for 24 hours; if no growth was observed, incubation was extended for another 24 hours. A colony count of $\geq 10^5$ colony-forming units (CFU)/mL was considered indicative of significant bacteriuria (13).

Isolates were identified based on Gram staining, colony morphology, and conventional biochemical assays including oxidase, catalase, indole, citrate utilization, urease, and triple sugar iron (TSI) tests. Identification was performed to the species level where possible, encompassing both Gram-negative and Gram-positive organisms. Antibiotic susceptibility was evaluated using the Kirby-Bauer disk diffusion method, following Clinical and Laboratory Standards Institute (CLSI) guidelines (13, 14). The following antibiotic discs for both gram negative and gram positive were used including ceftriaxone (CRO$^{30\mu g}$), ceftazidime (CAZ$^{30\mu g}$), cefepime (FEP$^{30\mu g}$), meropenem (MRP$^{10\mu g}$), ciprofloxacin (CIP$^{5\mu g}$), levofloxacin (LEV$^{15\mu g}$), amoxicillin-clavulanic acid (AUG$^{30\mu g}$), piperacillin-tazobactam (TZP$^{\mathbf{110\mu g}}$), nitrofurantoin (N$^{\mathbf{300\mu g}}$), cefixime (CFM$^{5\mu g}$), ofloxacin (OFX$^{\mathbf{5\mu g}}$), ampicillin (AMP$^{10\mu g}$), cefotaxmine (CTX$^{30\mu g}$) and fosfomycin (FOX$^{200\mu g}$). Zones of inhibition were measured in millimetres and interpreted as sensitive, intermediate, or resistant. *Escherichia coli* ATCC 25922 served as the quality control strain.

Data were entered into SPSS version 22.0 for analysis. Numerical data were presented as mean and standard deviation while categorical data were summarized as frequencies and percentages.

Results

The mean age of pregnant women with UTI was 29.84 ± 4.93 years. In total 350 urine cultures 48 (13.71%) were positive for uropathogenic microorganisms in which 52.1% were in age between 25-30 years while 47.9% were in 31-35 years

In terms of socioeconomic status, 45.8% of the UTI-positive women belonged to the lower class, 41.7% to the middle class, and 12.5% to the upper class. Regarding educational

background, 27.1% had primary education, 35.4% had secondary education, 18.7% had tertiary education, and 18.8% were illiterate.

UTI cases were distributed across trimesters as follows: 20.8% in the first trimester, 37.5% in the second trimester, and 41.7% in the third trimester as in Table I.

Figure 1 summarises the isolated uropathogenic microorganisms. **E. coli** remained the most common bacterial isolate, accounting for **22 (45.8%)** of the total isolates. This was followed by **Klebsiella pneumoniae**, which accounted for **10 (20.8%)**. Other isolates included *Pseudomonas spp.* **6 (12.5%)**, *Enterococcus spp.* **5 (10.4%)**, and *Staphylococcus aureus* **5 (10.4%)**.

The **overall antibiotic sensitivity pattern** of bacterial isolates is shown in **Table 2**. **Piperacillin-tazobactam** had the highest overall sensitivity at **91.7%**, followed closely by **Meropenem (87.5%)**. **Nitrofurantoin** and **Fosfomycin** showed sensitivity rates of **85.4%** and **79.2%**, respectively. **Cefixime**, **Cefotaxime**, and **Amoxicillin/clavulanic acid** had moderate sensitivities above 50%.

Table-I: Socio-demographic Characteristics of Pregnant Women

Variables	Pregnant Women with Positive Culture n = 48 (13.71%)	Pregnant Women with Negative Culture n = 302 (86.29%)
Age (25–35 years)		
25–30 years	25 (52.1%)	171 (56.6%)
31–35 years	23 (47.9%)	131 (43.4%)
Parity		
Primigravida	15 (31.3%)	86 (28.5%)
Primipara	6 (12.5%)	76 (25.2%)
Multipara	19 (39.6%)	110 (36.4%)
Grand multipara	8 (16.6%)	30 (9.9%)
Socioeconomic Status		
Low	22 (45.8%)	102 (33.8%)
Middle	20 (41.7%)	146 (48.3%)
High	6 (12.5%)	54 (17.9%)
Education Level		
No formal education	9 (18.8%)	31 (10.3%)
Primary	13 (27.1%)	77 (25.5%)
Secondary	17 (35.4%)	119 (39.4%)
Higher	9 (18.7%)	75 (24.8%)
Trimester		
First trimester	10 (20.8%)	86 (28.5%)
Second trimester	18 (37.5%)	119 (39.4%)
Third trimester	20 (41.7%)	97 (32.1%)ma

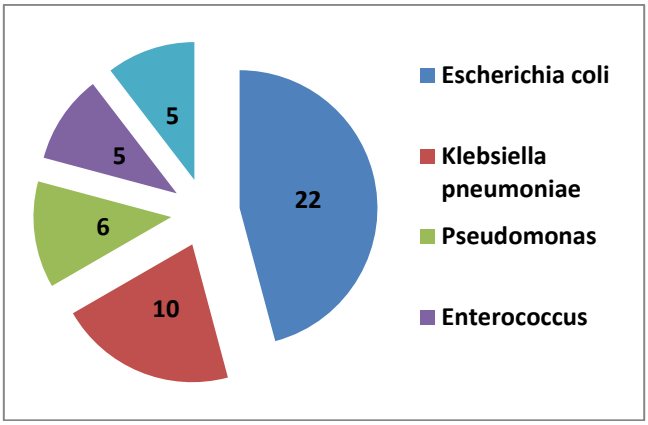

Figure 1: Prevalence of isolated organisms causing UTI

Table 2: Overall Antibiotics Sensitivity Pattern irrespective of bacterial isolates (n = 48)

Antibiotics	Sensitive (%)
Piperacillin-tazobactam	91.7%
Meropenem	87.5%
Nitrofurantoin	85.4%
Fosfomycin	79.2%
Cefixime	64.6%
Cefotaxime	60.4%
Amoxicillin/clavulanic acid	54.2%
Ciprofloxacin	41.7%
Ampicillin	27.1%
Ofloxacin	8.3%

Discussion

Urinary tract infections (UTIs) during pregnancy remain a significant clinical concern due to their association with adverse maternal and perinatal outcomes.

Physiological and anatomical adaptations in pregnancy—such as ureteral dilation, urinary stasis, and elevated progesterone levels—create a conducive environment for bacterial proliferation. If left untreated, even asymptomatic bacteriuria can escalate to acute pyelonephritis, posing risks such as preterm labor, intrauterine growth restriction, low birth weight, and increased perinatal morbidity, as highlighted in recent clinical guidelines (15, 16).

In the present study conducted in Kohat, the prevalence of UTI among pregnant women was found to be 13.7%. This is lower than the 32% prevalence reported in general patients in shaheen et. al (17). Similarly a much higher prevalence (81%) was reported by Umema et.al representing pregnant women from Lahore (18). A study conducted by Iram et.al. reported 28% prevalence of UTI among pregnant women in Faisalabad (19). These disparities likely stem from multiple factors, including geographical variation, demographic and socioeconomic characteristics, population density, diagnostic criteria, and access to preventive healthcare. The methodology used in this study, which included both symptomatic and asymptomatic bacteriuria, likely produced a more inclusive estimate (20, 21).

In this study, the majority of UTI-positive women were aged 25–30 years (52.1%), followed by those aged 31–35 years (47.9%). Similar age-related susceptibility has been observed in other regions, with Das et.al. reporting 49% of cases among women aged 21–30 years in North India (22), and Al-Gasha'a et.al. documenting 44% in the 20–30 year age group in Baghdad (23). These findings suggest that reproductive age remains the most vulnerable period for UTI acquisition.

Socioeconomic distribution in this study revealed that 45.8% of culture-positive cases belonged to the low-income group, 41.7% to the middle class, and only 12.5% to the high-income group. This pattern aligns with findings from Al-Gasha'a et.al., who reported a higher prevalence of UTI (52%) among women of lower socioeconomic backgrounds (23). Similarly, Abejew et.al observed that 58% of cases occurred among women of low income in Ethiopia (24), confirming the association between socioeconomic deprivation and increased UTI risk.

Regarding education, in this study, 18.8% of UTI-positive women had no formal education, 27.1% had primary-level education, 35.4% secondary, and 18.7% higher education. Illiterate individuals lacks hygienic understandings and that is one of the reasons of higher UTI rates as reported by articles published in the past (22, 24).

Trimester-wise distribution in this study showed that UTI prevalence was highest in the third trimester (41.7%), followed by the second trimester (37.5%), and first trimester (20.8%). Similar trimester-related trends were observed by Sajed and Batool (2014), who reported 43% in the third trimester and 36% in the second trimester, while Abejew and Denboba (2014) noted 45% in the third trimester. These findings highlight physiological changes such as urinary stasis and smooth muscle relaxation that increase susceptibility in later pregnancy (15).

From a microbiological perspective, this study identified *Escherichia coli* as the predominant organism (45.8%), followed by *Klebsiella pneumoniae* (20.8%), Pseudomonas spp. (12.5%), *Enterococcus spp*. (10.4%), and *Staphylococcus aureus* (10.4%). This distribution aligns with global reports where E. coli predominates as reported by many researchers in the past (22, 24, 25).

Antibiotic susceptibility in this study showed the highest sensitivity to Piperacillin-tazobactam (91.7%), Meropenem (87.5%), Nitrofurantoin (85.4%), and Fosfomycin (79.2%), while moderate responses were seen with Cefixime (64.6%) and Cefotaxime (60.4%). Low sensitivity was noted with Ciprofloxacin (41.7%), Ampicillin (27.1%), and Ofloxacin (8.3%). Comparable resistance patterns have been reported in Pakistan (25) and neighbouring countries like Bangladesh and Saudi Arabia (26, 27). These trends highlight the on-going challenge of antimicrobial resistance and the importance of using local anti-biograms for empirical therapy (21).

Conclusions

This study reports a UTI prevalence of 13.7% among pregnant women in Kohat, showing lesser prevalence among other cities of Pakistan. A notable proportion of pregnant women in Kohat suffered from UTI, with E. coli being the predominant uropathogen. Piperacillin-tazobactam, meropenem, nitrofurantoin, and fosfomycin were the most effective antibiotics.

Future recommendation: Continuous screening, culture-based diagnosis, and local antibiotic guidelines are necessary to manage UTIs in pregnancy and prevent maternal-fetal complications.

Conflict of Interest: The authors affirm that there are no conflicts of interest.

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Data acquisition, analysis and interpretation	SHAS,TMK, NU,KR,SUK
Manuscript writing and approval	KR, SUK

All the authors agree to take responsibility for every facet of the work, making sure that any concerns about its integrity or veracity are thoroughly examined and addressed.