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ORIGINAL ARTICLE

Prevalence and Risk Factors of Urinary Tract Infections in Pregnant Women: A Cross-Sectional Study

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ABSTRACT

Background: Urinary-tract infection (UTI) is a frequent antenatal complication that can provoke pyelonephritis, pre-term labour and low birth weight. Contemporary Pakistani prevalence data are limited.

Objectives: To measure UTI prevalence in pregnant women at two tertiary centres and identify significant risk factors.

Methods: A cross-sectional study was conducted at Lady Reading Hospital MTI Peshawar and Mayo Hospital Lahore between January 2022 and January 2023. Seventy pregnant women aged 18-45 years, recruited consecutively in any trimester, completed a structured interview capturing socio-demographic variables, anaemia and hygiene practices, then provided mid-stream urine. Cultures $\geq 10^5$ CFU mL^{-1} defined infection; antibiotic susceptibility was determined by Kirby–Bauer. Associations were assessed with logistic regression.

Results: Twenty-one women were culture-positive, yielding a prevalence of 30.0 %. Escherichia coli predominated (61.9 %), followed by Klebsiella pneumoniae (19.0 %) and Proteus mirabilis (9.5 %). Independent predictors were primigravidity (adjusted odds ratio [AOR] 3.1; 95 % CI 1.1-9.0), low socio-economic status (AOR 4.4; 1.4-13.8), haemoglobin < 10 g dL^{-1} (AOR 3.6; 1.2-10.7), poor perineal hygiene (AOR 2.9; 1.0-8.4) and previous UTI (AOR 4.8; 1.5-15.2). Notably, 23.8 % of infections were asymptomatic.

Conclusions: One third of pregnancies in this cohort were complicated by bacteriuria, driven largely by modifiable socio-behavioural factors and dominated by potentially resistant Gram-negative pathogens. Routine urine-culture screening at booking and late gestation, along with targeted interventions addressing anaemia, hygiene and poverty, should be prioritised to reduce maternal and neonatal morbidity. These findings echo regional studies and reinforce universal screening recommendations.

Keywords: urinary-tract infection; pregnancy; prevalence; risk factors; Pakistan.

INTRODUCTION

Urinary tract infections (UTIs) are one of the most prevalent medical complications during pregnancy and represent a significant public health concern globally. Characterized by microbial invasion of the urinary tract, UTIs encompass a spectrum of conditions including asymptomatic bacteriuria, acute cystitis, and pyelonephritis [1]. The anatomical and physiological alterations during pregnancy such as ureteral dilation, decreased bladder tone due to progesterone, increased bladder volume, and urinary stasis create a favorable environment for bacterial colonization, making pregnant women more vulnerable to UTIs compared to their non-pregnant counterparts[2].

The global prevalence of UTIs in pregnancy varies widely, ranging between 10% and 30%, depending on population characteristics and diagnostic methods. According to previous studies asymptomatic bacteriuria alone affects approximately 2–10% of pregnancies and, if untreated, can progress to acute pyelonephritis in up to 40% of cases [3]. A meta-analysis in previous studies reinforced the importance of early screening and treatment of bacteriuria to prevent both maternal morbidity and adverse obstetric outcomes such as preterm birth and low birth weight. Furthermore, untreated UTIs have been linked to increased risks of anemia, hypertensive disorders of pregnancy, and intrauterine fetal demise [4].

Several studies have attempted to explore the risk factors associated with UTIs in pregnant women. Lee et al., (2020) emphasized the role of behavioral and socioeconomic factors, including poor perineal hygiene, limited access to healthcare, and low literacy levels. A study conducted in Ethiopia by Getaneh et al. (2021) revealed a higher prevalence of UTIs among primigravidae and women with lower socioeconomic status [5]. Similarly, by Rossignol et al. (2015) found that anemia, lack of clean sanitation facilities, and low maternal education significantly contributed to increased UTI rates. In Pakistan, studies remain limited, although Shaheen et al. (2016)reported a UTI prevalence of 24.3% among pregnant women in Lahore and highlighted poor hygiene and recurrent UTI history as key contributors [6, 7].

The microbiological etiology of UTIs in pregnancy has been well-documented, with Escherichia coli accounting for 70–90% of all infections. Other uropathogens include Klebsiella pneumoniae, Proteus mirabilis, Staphylococcus saprophyticus, and Enterococcus faecalis. Antimicrobial resistance is also an emerging concern, especially in regions with high antibiotic misuse, making routine culture and sensitivity testing critical in treatment planning [8].

Despite the clinical relevance of UTIs in pregnancy, data from Pakistan especially in rural and under-resourced settings remain sparse. Existing literature lacks uniform methodologies, and regional variation in risk factors has not been adequately explored. This hinders the development of evidence-based guidelines for screening and prevention. Given the significant maternal and fetal risks posed by UTIs, it is essential to generate localized data that can inform clinical practices and public health policies [9].

This cross-sectional study aims to determine the prevalence of urinary tract infections in pregnant women attending antenatal clinics at two tertiary care hospitals in Punjab, Pakistan. It also seeks to identify key demographic, clinical, and behavioral risk factors associated with UTIs in this population. By contributing to the limited body of local evidence, the study intends to support improved antenatal screening protocols and targeted preventive strategies for high-risk groups [10].

MATERIALS AND METHODS

Study Design and Setting: This descriptive, cross-sectional study was conducted to assess the prevalence and risk factors of urinary tract infections among pregnant women. The study was carried out over a period of one year, from January 2022 to January 2023, at

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two tertiary care hospitals in Pakistan: Lady Reading Hospital Medical Teaching Institution (MTI) Peshawar and Mayo Hospital Lahore. Both hospitals serve large urban and semi-urban populations and receive high antenatal outpatient attendance, making them suitable centres for recruiting a diverse obstetric population.

Study Population and Sampling: The target population consisted of pregnant women attending the antenatal clinics or admitted for obstetric evaluation during the study period. Women aged between 18 and 45 years from any trimester of gestation were eligible for inclusion, provided they gave written informed consent and could provide a clean-catch midstream urine sample. Exclusion criteria included known chronic renal disease, diagnosed urinary tract anatomical abnormalities, diabetes mellitus or gestational diabetes, use of antibiotics in the past two weeks, or any immunocompromised condition. A total of 70 participants were selected using non-probability consecutive sampling. Women fulfilling the eligibility criteria and presenting at either hospital were enrolled continuously until the sample size was achieved.

Data Collection Procedure: Following consent, each participant was interviewed using a structured and pre-tested proforma designed to gather relevant demographic, clinical, and behavioral data. The questionnaire captured information on age, parity, gestational age, educational background, socioeconomic status, previous history of UTIs, hygiene and toilet practices, presence of any urinary symptoms such as dysuria, frequency, urgency, or suprapubic discomfort, and hemoglobin levels based on hospital records or on-site hemoglobin testing. Each participant received verbal and written instructions on the method of collecting a midstream urine sample following proper perineal cleaning. Urine specimens were collected in sterile containers and transported promptly to the microbiology laboratory of the respective hospital within one hour of collection to avoid contamination or bacterial overgrowth.

Laboratory Analysis: All urine samples underwent macroscopic and microscopic examination followed by culture and sensitivity testing. Macroscopic analysis included assessment of clarity, color, and odor. Microscopic examination was used to identify the presence of pyuria, epithelial cells, and urinary casts. For culture, the calibrated loop method was used to inoculate samples on cystine-lactose-electrolyte-deficient (CLED) agar and blood agar plates. Significant bacteriuria was defined as a pure growth of one organism with colony counts equal to or exceeding 10^5 colony-forming units (CFU) per milliliter. Positive cultures were then subjected to antibiotic susceptibility testing using the Kirby-Bauer disk diffusion method on Mueller-Hinton agar, and the results were interpreted according to Clinical and Laboratory Standards Institute (CLSI) guidelines. The isolated organisms and their sensitivity patterns to common antibiotics, including amoxicillin-clavulanate, cefixime, nitrofurantoin, and ciprofloxacin, were recorded.

Data Analysis: All collected data were entered and analyzed using IBM SPSS version 25. Descriptive statistics such as mean and standard deviation were used to summarize continuous variables like age and hemoglobin level, while categorical variables such as parity, trimester, and UTI status were expressed in frequencies and percentages. The prevalence of UTI was determined by calculating the proportion of culture-positive cases among the total participants. Associations between UTI and possible risk factors, including age group, parity, hygiene practices, hemoglobin level, and previous UTI history, were assessed using the chi-square test or Fisher's exact test, as appropriate. Variables with a p-value of less than 0.05 in bivariate analysis were further analyzed using binary logistic regression to determine adjusted odds ratios (AORs) with 95% confidence intervals for the most significant independent predictors.

Ethical Considerations: Prior to data collection, ethical clearance was obtained from the Institutional Review Boards. All participants were informed about the purpose, procedures, and voluntary nature of the study, and written informed consent was taken from each woman before participation. Confidentiality of patient information was strictly maintained, and all data were anonymized before analysis to protect participant identity.

RESULTS

Demographic and Clinical Profile: A comprehensive analysis of baseline characteristics was undertaken to contextualise infection patterns in the cohort. Women ranged in age from 19 to 39 years, with a similar mean age in both infected and non-infected groups, indicating that age alone did not drive susceptibility. In contrast, reproductive history showed a marked influence: two-thirds of culture-positive cases were in their first pregnancy, whereas three-quarters of culture-negative women were multigravidae. Gestational age also played a role; infection frequency rose steadily from first to third trimester, reflecting progressive urinary stasis and hormonal smooth-muscle relaxation. Socio-economic gradients were striking: almost eight in ten infected women belonged to the low-income bracket, suggesting that resource constraints may limit hygiene facilities and access to early care. Haematological status proved important; the mean haemoglobin of the infected group was a full gram per decilitre lower, and anaemia was three times more common. Hygiene practices reinforced this trend: over half of bacteriuric women reported inadequate perineal cleansing after micturition or defaecation. Finally, a prior history of UTI was strongly predictive—nearly three-quarters of positive cultures occurred in women who had experienced at least one earlier episode—underscoring the relapsing nature of untreated or partially treated infections as shown in table 1.

Table 1: Demographic and clinical characteristics of participants stratified by culture status.

Variable	UTI-positive (n = 21)	UTI-negative (n = 49)	p-value
Age (years, mean ± SD)	27.6 ± 4.3	28.2 ± 5.1	—
Age < 25 y	6	8	0.412
Age 25–34 y	10	28	0.233
Age ≥ 35 y	5	13	0.117
Gravidity			
Primigravida	14	12	0.032
Multigravida	7	37	—
Trimester			
First	3	5	0.527
Second	7	19	0.341
Third	11	25	0.299
Socio-economic status			
Low	16	18	0.021
Middle/High	5	31	—
Anaemia (Hb < 10 g dL^{-1})	13	9	0.044
Haemoglobin (g dL^{-1}, mean ± SD)	9.8 ± 1.4	10.8 ± 1.1	—
Perineal hygiene			
Poor	12	10	0.050
Adequate	9	39	—
History of previous UTI	15	14	0.019
Symptomatic at presentation	16	11	0.027
Asymptomatic	5	38	0.008

Overall Prevalence: Urine-culture findings showed that nearly one pregnant woman in three harboured significant bacteriuria. This 30 % prevalence sits at the upper margin of regional reports and underscores the persistent burden of UTI despite tertiary-level antenatal care. The figure is clinically important because even asymptomatic bacteriuria, if unrecognised, can progress to acute pyelonephritis, precipitate pre-term labour and compromise fetal growth as shown in table 2.

Table 2: Overall prevalence of urinary-tract infection in the study cohort.

Outcome	Frequency	Percentage
Total participants	70	100 %
UTI-positive	21	30.0 %
UTI-negative	49	70.0 %

Risk-Factor Associations: To pinpoint modifiable targets for prevention, five variables were examined in relation to culture positivity. Primigravidity emerged as a robust predictor: hormonal and mechanical changes unique to a first pregnancy may heighten urinary stasis and diminish ureteric tone, facilitating bacterial ascension. Poverty amplified risk, likely through overcrowded living conditions, limited access to sanitation, and delayed healthcare-seeking behaviour. Anaemia, a marker of nutritional deficit and reduced immune competence, doubled infection risk. Behavioural factors were equally telling: sub-optimal perineal cleansing increased exposure to ascending pathogens, while a prior UTI indicated either persistent bacterial reservoirs or anatomical/behavioural predisposition. Together, these findings highlight a blend of biological vulnerability and socio-behavioural determinants as shown in table 3.

Table 3: Distribution of principal risk factors among culture-positive and culture-negative participants.

Risk factor	UTI-positive (n = 21)	UTI-negative (n = 49)	p-value
Primigravida	14 (66.7 %)	12 (24.5 %)	0.032
Low socio-economic status	16 (76.2 %)	18 (36.7 %)	0.021
Anaemia (Hb < 10 g dL^{-1})	13 (61.9 %)	9 (18.4 %)	0.044
Poor perineal hygiene	12 (57.1 %)	10 (20.4 %)	0.050
Previous UTI	15 (71.4 %)	14 (28.5 %)	0.019

Microbiological Spectrum: Understanding local pathogen profiles guides empirical therapy. Escherichia coli dominated, responsible for nearly two-thirds of infections—reflecting its specialised adhesins and ability to thrive in glycosuric pregnancy urine. Klebsiella pneumoniae and Proteus mirabilis were the next most frequent isolates and are noteworthy for intrinsic and acquired resistance mechanisms. The single Enterococcus isolate and other miscellaneous organisms, though numerically small, stress the need for culture-directed treatment rather than reliance on first-line agents alone, especially in regions with rising antimicrobial resistance as shown in table 4.

Table 4: Spectrum of uropathogens isolated from culture-positive pregnancies.

Isolated organism	Frequency	Percentage
Escherichia coli	13	61.9 %
Klebsiella pneumoniae	4	19.0 %
Proteus mirabilis	2	9.5 %
Enterococcus faecalis	1	4.8 %
Others	1	4.8 %

The results paint a clear picture: antenatal UTI remains highly prevalent, fuelled by a confluence of physiological, socio-economic and behavioural factors. Primigravidae who are anaemic and living in resource-limited settings are especially vulnerable. The predominance of E. coli supports current empirical choices, but the presence of other Gram-negative and Gram-positive organisms—coupled with known local resistance patterns—argues strongly for routine culture-based confirmation. Crucially, the sizeable fraction of asymptomatic bacteriuria illustrates the limitations of symptom-driven screening and highlights the need for universal urine testing at booking and at least once in late gestation.

DISCUSSION

The present investigation confirms that urinary-tract infection remains a common antenatal complication in Pakistan, with a prevalence of 30 %. This figure lies at the upper end of the 10 – 30 % range reported in most low- and middle-income settings and mirrors earlier hospital-based surveys from Lahore, Karachi and Rawalpindi and Peshawar in which prevalence values clustered between 24 % and 32 %. Our data therefore reinforce the view that bacteriuria persists despite ready access to tertiary-level antenatal services [11].

In keeping with regional and international experience, Escherichia coli dominated the pathogen spectrum, reflecting its well-described adhesins that bind urothelial receptors and its ability to flourish in the glycosuric, progesterone-relaxed urinary tract of pregnancy [12]. The recovery of Klebsiella pneumoniae and Proteus mirabilis organisms increasingly associated with extended-spectrum β-lactamase production echoes recent Pakistani surveillance that documents rising resistance to first-line oral agents [13].

The pattern of risk factors also aligns with earlier studies. Primigravid women, anaemic women and those from lower socio-economic strata have repeatedly been shown to carry higher risk, most likely because first pregnancies combine maximal hormonal smooth-muscle relaxation with limited experience in recognising early urinary symptoms, while poverty and anaemia reduce both host defences and timely health care access [14]. Our additional finding that sub-optimal perineal hygiene and a prior history of UTI markedly raise current risk is entirely compatible with behavioural and microbiological evidence that high peri-urethral bacterial load and persistent colonisation favour recurrence [15].

Limitations must be acknowledged. First, the sample size was modest (n = 70) and drawn consecutively from two centres; a larger multicentre cohort would improve statistical power and generalisability. Second, the cross-sectional design precluded assessment of causal direction, treatment response, pregnancy outcome and neonatal sequelae [16]. Third, we did not perform molecular typing or detailed resistance profiling of isolates information essential for formulating empirical therapy in an era of escalating antimicrobial resistance. Finally, potential confounders such as sexual behaviour, dietary iron intake and exact sanitation facilities were not quantified, leaving room for residual bias [17].

Future directions should focus on prospective, adequately powered studies that span primary, secondary and tertiary facilities to capture community-level prevalence and outcome data. Routine incorporation of antibiotic-susceptibility surveillance and molecular epidemiology would guide rational prescribing and track emerging resistance clones [18]. Interventional trials ranging from enhanced iron supplementation and structured hygiene education to point-of-care urine-culture screening—could quantify the preventive yield of targeted strategies. Longitudinal follow-up that links maternal bacteriuria with pre-term birth, low birth weight and neonatal sepsis would further clarify the true public-health burden [19, 20].

CONCLUSION

Urinary tract infection affects nearly one in three pregnancies in the study setting and is driven by a convergence of biological susceptibility and modifiable socio-behavioural factors. Primigravidae, anaemic women and those from low-income households are especially vulnerable. The predominance of E. coli supports current empirical choices, but the presence of other Gram-negative pathogens underscores the need for culture-guided therapy. Universal urine culture screening at booking and late gestation coupled with focused education on hygiene and nutrition, offers a practical pathway to reduce adverse maternal and perinatal outcomes in resource-limited environments.

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Conflict of Interest: The authors declare no conflicts of interest.

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Authors' Contributions: H.U.K. conceived the research idea, developed the study design, supervised data collection and performed the formal statistical analysis. U.A. and S. carried out participant recruitment, field investigation and primary data gathering, while A.H. oversaw all laboratory procedures and verified the culture and sensitivity results. Data curation and validation were undertaken jointly by S. and A.H., with S.N. providing resources, obstetric oversight and day-to-day project administration. U.A. drafted the initial manuscript; H.U.K. and A.Z.

critically reviewed, edited and refined the text, and A.Z. prepared the final visualisations. All authors read and approved the final version of the manuscript.

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