Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/5nz96k12

ASSOCIATION OF URINARY TRACT INFECTION WITH PRETERM LABOUR: PREVALENCE AND BACTERIOLOGICAL PROFILE

Dr Prof Godawari Joshi[1*], Dr. Indu Bartwal[2], Dr.Mahima Rani[3], Dr H.S Pandey[4], Dr.Shambhavi[5]

[1*]Professor & Head of Department, Department of Obstetrics & Gynaecology, Government Medical College, Haldwani, Uttarakhand
[2]JR-3 Obstetrics & Gynaecology Department, Government Medical College, Haldwani, Uttarakhand
[3]Associate professor, Department of obstetrics and gynaecology, Government Medical College, Haldwani , Uttarakhand
[4]Professor and Head of department, Department of Pathology, Government Medical College, Haldwani,Uttarakhand
[5]Assitant professor, Department of Microbiology, Government Medical College, Haldwani,Uttarakhand

***Corresponding Author:** Dr Prof Godawari Joshi
*Professor & Head of Department, Department of Obstetrics & Gynaecology, Government Medical College, Haldwani, Uttarakhand

Abstract

Background: Preterm labour is a leading cause of neonatal morbidity and mortality worldwide. Among preventable factors, urinary tract infection (UTI) plays a major role by triggering inflammatory pathways that induce uterine contractions and preterm birth. This study aimed to determine the prevalence of UTI among women with preterm labour and to evaluate the bacteriological spectrum and antibiotic susceptibility pattern of isolated organisms.

Methods: A prospective observational study was conducted at the Departments of Obstetrics and Gynaecology,Pathology & Microbiology, Government Medical College, Haldwani over 18 months. 167 pregnant women with preterm labour (28–36+6 weeks gestation) were included after informed consent. Midstream urine samples were sent for routine microscopy and cultured on CLED and MacConkey agar, and isolates were identified by standard microbiological methods. Antibiotic susceptibility testing was performed using the Kirby–Bauer disk diffusion method as per CLSI 2024 guidelines.

Results: UTI was detected in 28.74% of participants, with asymptomatic bacteriuria (23.35%) more frequent than cystitis (5.39%). *Escherichia coli* was the most common pathogen (75%), followed by *Klebsiella* spp. (14.58%), *Proteus mirabilis* (6.25%), and *Staphylococcus aureus* (4.17%). The highest sensitivity was observed to amikacin (70.83%), nitrofurantoin (66.67%), and amoxicillin–clavulanate (62.5%), while marked resistance occurred to ciprofloxacin (60.42%) and ampicillin (39.58%).

Conclusion: UTI is a frequent and preventable cause of preterm labour. Routine urine culture and microscopy screening and culture-guided antibiotic therapy are essential to reduce infection-related preterm births and improve perinatal outcomes.

Keywords: Preterm labour, Urinary tract infection, Asymptomatic bacteriuria, *Escherichia coli*, Antibiotic resistance.

Introduction:

Preterm labor, characterized by the initiation of regular uterine contractions accompanied by increasing cervical alterations prior to 37 weeks of gestation, remains a significant contributor to perinatal morbidity and mortality globally.[1–3] Notwithstanding considerable progress in antenatal care and neonatal intensive support, preterm birth continues to represent a substantial fraction of neonatal fatalities and enduring problems, including respiratory distress syndrome, neurological damage, and developmental delay.[4] Annually, almost 15 million infants are born preterm worldwide, with nearly one-fifth originating from India.[5] This significant burden indicates not only biological vulnerability but also the impact of socioeconomic disparities, inadequate maternal education, and constrained access to prompt obstetric and infection-control interventions.[6]

Among the several risk factors associated with preterm labor, urinary tract infection (UTI) is one of the most prevalent and preventable causes.[7–8] It is believed that up to 10% of pregnant women may develop bacteriuria throughout pregnancy, whether symptomatic or asymptomatic, significantly increasing the risk of premature delivery and low-birth-weight infants if ignored.[9] Physiological and structural adaptations during pregnancy, including ureteral dilation, smooth muscle relaxation from increased progesterone, and urine stasis, establish conducive conditions for bacterial colonization.[10]

In the majority of instances, infection initiates as asymptomatic bacteriuria (ASB), which may subsequently advance to symptomatic cystitis or pyelonephritis.[11] Despite the lack of clinical symptoms, ASB elicits an inflammatory response that can provoke uterine contractions via cytokine release and prostaglandin synthesis.[12] Bacterial endotoxins, namely lipopolysaccharides from Gram-negative bacilli such as *Escherichia coli*, activate toll-like receptors (TLRs) and stimulate the release of tumor necrosis factor-α (TNF-α) and interleukins (IL-6, IL-8). These inflammatory mediators provoke uterine smooth muscle activation and cervical softening, resulting in preterm labor.[13]

In underdeveloped regions, infections are frequently underdiagnosed owing to insufficient screening facilities and dependence on symptom-based therapy.[14] In these contexts, early urine culture testing is the most efficacious method for preventing infection-related preterm deliveries. Prior Indian research has indicated a varying prevalence of urinary tract infections (UTIs) among women in preterm labor, ranging from 17% to 30%, with *Escherichia coli* identified as the most commonly isolated pathogen.[15–16] The rising concern of antimicrobial resistance (AMR) complicates management, as numerous common medicines are contraindicated during pregnancy.[17]

This study aimed to ascertain the incidence of urinary tract infections in individuals experiencing premature labor and to delineate the bacteriological spectrum and antibiotic susceptibility profiles of the isolated pathogens. Comprehending the local microbial ecology and resistance patterns is crucial for formulating evidence-based guidelines that can improve maternal and newborn outcomes while mitigating inappropriate antibiotic usage.

Methodology

An observational study was undertaken over 18 months in the Department of Obstetrics and Gynaecology in conjunction with the Department of Microbiology and pathology at Government Medical College, Haldwani. A total of 167 pregnant women experiencing preterm labor between 28 and 36+6 weeks of gestation were enrolled following the acquisition of informed permission. Women between the ages of 18 and 40 with intact membranes were included, whereas those with renal illness, diabetes, hypertension, recent antibiotic usage, or ruptured membranes were omitted. Aseptically obtained clean-catch midstream urine samples (10–20 mL) was collected and subjected to routine microscopic examination and culture and sensitivity.Microscopic examination of the uncentrifuged urine of all the samples was done to detect the presence of pus cells, epithelial cells, cast, crystal and presence of bacteria. Urine samples were inoculated in Cysteine Lactose Electrolyte Deficient (CLED) agar with 0.01 ml calibrated nichrome wire loop by standard loop method. CLED plates were incubated at 37°C for 24 hours, with bacterial growth of $\geq 10^5$ CFU/mL deemed significant. Isolates

were identified using Gram staining and conventional biochemical assays, while antibiotic susceptibility was assessed using the Kirby–Bauer disk diffusion method on Mueller–Hinton agar in accordance with CLSI 2024 recommendations. Identification of the uropathogens- The isolates were identified as per standard laboratory protocol- colony morphology, Gram's staining, hanging drop preparation and biochemical tests.The antibiotics evaluated comprised amikacin, nitrofurantoin, amoxicillin–clavulanate, cefuroxime, ampicillin, and ciprofloxacin, with E. coli ATCC 25922 and S. aureus ATCC 25923 as control strains. Patient demographics, clinical data, and laboratory results were evaluated utilizing SPSS version 25.0, employing the Chi-square test for relationships; a p-value of < 0.05 was deemed signThe research acquired ethical approval from the Institutional Ethics Committee, and written informed permission was secured from all participants.

Results

Table 1. Distribution of subjects based on presence of UTI

Category	Frequency (n)	Percentage (%)
UTI Present	48	**28.74%**
Asymptomatic bacteriuria	39	23.35%
Cystitis	9	5.39%
No UTI	119	71.26%
Total n = 167		

In the current study of 167 women undergoing preterm labor, urinary tract infection (UTI) was identified in 28.74% (n = 48) of instances, whereas 71.26% (n = 119) of participants exhibited no signs of infection (Table 1 & Fig 1). In the cohort with urinary tract infections, the predominant condition was asymptomatic bacteriuria, comprising 23.35% (n = 39) of the overall study group, while 5.39% (n = 9) exhibited symptomatic cystitis. Consequently, over one-third of women in preterm labor had microbiological evidence of urinary tract infection, underscoring its therapeutic relevance in this population.

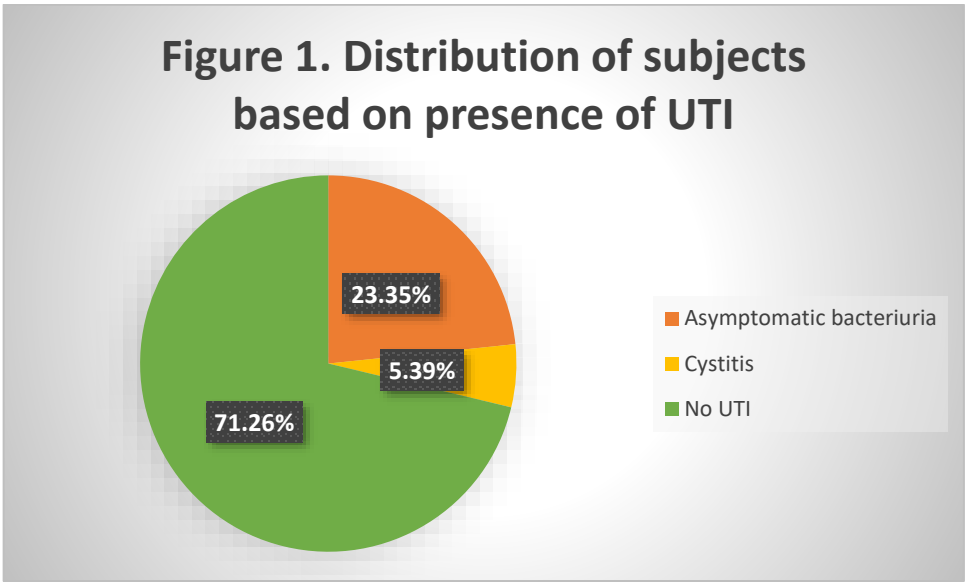

Table 2. Urine culture: Organism isolated

Organism	Frequency (n)	Percentage (%)
Escherichia coli	36	75
Klebsiella spp.	7	14.58
Proteus mirabilis	3	6.25
Staphylococcus aureus	2	4.17
Total n = 48		

Urine culture and sensitivity tests demonstrated substantial bacterial proliferation in 28.74% (n = 48) of specimens. Escherichia coli was the most often isolated organism, representing 75.0% (n = 36) of culture-positive cases, followed by Klebsiella species (14.58%, n = 7), Proteus mirabilis (6.25%, n = 3), and Staphylococcus aureus (4.17%, n = 2) (Table 2 & fig 2). This distribution indicates that Gram-negative enteric bacilli were the primary uropathogens linked to preterm labor in the current investigation.

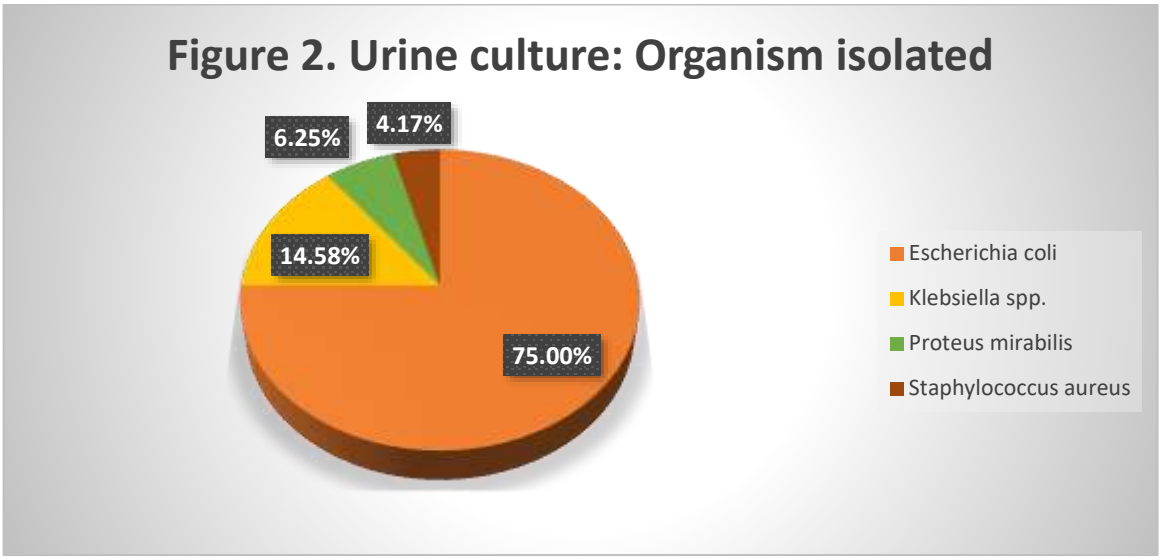

Table 3. Antibiotic sensitivity pattern of isolated organisms

Antibiotic	Sensitive n (%)	Intermediate n (%)	Resistant n (%)
Nitrofurantoin	32 (66.67)	8 (16.67)	8 (16.67)
Amoxycillin-clavulanate	30 (62.5)	4 (8.33)	14 (29.17)
Amikacin	34 (70.83)	6 (12.5)	8 (16.67)
Cefuroxime	20 (41.67)	6 (12.5)	22 (45.83)
Ciprofloxacin	19 (39.58)	0 (0.0)	29 (60.42)
Ampicillin	29 (60.42)	0 (0.0)	19 (39.58)

The antibiotic susceptibility testing of the isolates demonstrated diverse sensitivity patterns (Table 3). The greatest sensitivity was recorded for amikacin (70.83%) and nitrofurantoin (66.67%), succeeded by amoxycillin–clavulanate (62.5%). Moderate susceptibility was seen for cefuroxime (41.67%) and ampicillin (35.42%), while the lowest sensitivity was documented for ciprofloxacin (33.33%) and norfloxacin (45.83%). A significantly elevated resistance level was seen with ciprofloxacin (60.42%). The data suggest that although aminoglycosides and nitrofurantoin are still viable treatments for UTIs during pregnancy, the rising resistance to fluoroquinolones and beta-lactams necessitates careful and prudent antibiotic utilization.

Discussion

The current study indicated that 28.74% of women experiencing preterm labor were afflicted by urinary tract infections, while 71.26% exhibited sterile cultures. Infected patients had a significantly higher prevalence of asymptomatic bacteriuria (ASB) (23.35%) compared to cystitis (5.39%), underscoring that infections may go unnoticed during pregnancy. These findings underscore the significance of regular urine culture screening in pregnant women, especially during the second trimester, when physiological alterations in the urinary tract are most evident.

The prevalence identified in this study aligns with findings from multiple Indian investigations, which reported infection rates between 18% and 30% among women in premature labor.[15] The elevated percentage may be attributed to geographical disparities in hygiene habits, climatic conditions, and changes in health-seeking behaviors. The prevalence of asymptomatic bacteriuria highlights the

necessity for universal screening instead of a symptom-based methodology, since prompt identification and intervention can significantly decrease preterm birth rates and infant problems.[16]
Bacteriological examination revealed that *Escherichia coli* was the predominant organism, representing 75% of culture-positive cases, followed by *Klebsiella* spp. (14.58%), *Proteus mirabilis* (6.25%), and *Staphylococcus aureus* (4.17%). This pattern reflects earlier findings that Gram-negative bacilli, especially *E. coli*, predominate in pregnancy-related UTIs due to their superior adherence to uroepithelial cells through P-fimbriae and the synthesis of hemolysins.[17] Gram-positive isolates were rather rare, aligning with global data indicating that the primary cause of infection is the ascending route from the gastrointestinal tract.[18]
The antibiotic sensitivity profile indicated that amikacin (70.83%), nitrofurantoin (66.67%), and amoxicillin–clavulanate (62.5%) were the most efficacious agents against the isolated pathogens, while ciprofloxacin (60.42%) and ampicillin (39.58%) exhibited significant resistance rates. The findings align with several research studies indicating the sustained effectiveness of aminoglycosides and nitrofurantoin, coupled with increasing resistance to fluoroquinolones and β-lactam antibiotics.[19] Nitrofurantoin is an optimal option for lower urinary tract infections during pregnancy because of its high concentration in the urinary system and fewer systemic adverse effects; however, vigilance is warranted in cases of glucose-6-phosphate dehydrogenase (G6PD) impairment, particularly close to term.
The increasing resistance observed in this and other studies highlights the imperative for culture-guided antibiotic selection instead of empirical therapy. Empirical or improper antibiotic usage may lead to multidrug-resistant (MDR) bacteria, affecting the care of both mothers and neonates. Consequently, frequent updates of hospital antibiograms and compliance with antimicrobial stewardship standards are essential.[20] In addition to antibiotic selection, enhancing maternal knowledge of personal hygiene, hydration, and the prompt reporting of urinary symptoms can have a preventative function.
From a public health perspective, the current data confirm that urinary tract infection is a preventable and alterable factor in preterm labor. Incorporating urine culture testing into conventional antenatal practices, especially for women in their second trimester, can facilitate the detection of asymptomatic infections before the onset of obstetric problems. Early intervention diminishes the likelihood of preterm delivery while concurrently decreasing neonatal critical care admissions and healthcare costs.
In summary, the significant prevalence of bacteriuria, the dominance of *E. coli*, and indications of rising antimicrobial resistance underscore the critical necessity for enhanced surveillance, judicious antibiotic utilization, and uniform infection-control measures in antenatal programs. Strengthening these strategies can significantly decrease infection-associated preterm births and elevate perinatal outcomes.

Conclusion

This study demonstrates a high prevalence of urinary tract infection among women with preterm labor, with *Escherichia coli* as the predominant isolate. Asymptomatic bacteriuria was more common than symptomatic infection, highlighting the need for routine urine screening during pregnancy. Effective sensitivity to amikacin, nitrofurantoin, and amoxicillin–clavulanate, alongside notable resistance to ciprofloxacin and ampicillin, emphasizes the importance of culture-guided therapy and rational antibiotic use.
Routine urine culture testing, coupled with hygiene education and infection-control practices, can substantially reduce infection-associated preterm births and improve maternal and neonatal outcomes.

References:

1. Goldenberg RL, Culhane JF, Iams JD, Romero R. Epidemiology and causes of preterm birth. *Lancet.* 2008;371(9606):75–84.
2. Blencowe H, Cousens S, Oestergaard MZ, Chou D, Moller AB, Narwal R, et al. National, regional, and worldwide estimates of preterm birth rates in 2010 with time trends since 1990. *Lancet.* 2012;379(9832):2162–72.

3. Liu L, Oza S, Hogan D, Perin J, Rudan I, Lawn JE, et al. Global, regional, and national causes of child mortality in 2000–13. *Lancet.* 2015;385(9966):430–40.
4. Saigal S, Doyle LW. An overview of mortality and sequelae of preterm birth from infancy to adulthood. *Lancet.* 2008;371(9608):261–9.
5. March of Dimes, PMNCH, Save the Children, WHO. *Born Too Soon: The Global Action Report on Preterm Birth.* Geneva: World Health Organization; 2012.
6. Chawanpaiboon S, Vogel JP, Moller AB, Lumbiganon P, Petzold M, Hogan D, et al. Global, regional, and national estimates of levels and trends in preterm birth between 1990 and 2014. *Lancet Glob Health.* 2019;7(1):e37–75.
7. Smaill F, Vazquez JC. Antibiotics for asymptomatic bacteriuria in pregnancy. *Cochrane Database Syst Rev.* 2019;(11):CD000490.
8. Gilstrap LC, Ramin SM. Urinary tract infections during pregnancy. *Obstet Gynecol Clin North Am.* 2001;28(3):581–91.
9. Matuszkiewicz-Rowińska J, Małyszko J, Wieliczko M. Urinary tract infections in pregnancy: old and new unresolved diagnostic and therapeutic problems. *Arch Med Sci.* 2015;11(1):67–77.
10. Patterson TF, Andriole VT. Bacteriuria in pregnancy. *N Engl J Med.* 1997;336(18):1185–92.
11. Delzell JE Jr, Lefevre ML. Urinary tract infections during pregnancy. *Am Fam Physician.* 2000;61(3):713–21.
12. Romero R, Espinoza J, Chaiworapongsa T, Kalache K. Infection and prematurity and the role of preventive strategies. *Semin Neonatol.* 2002;7(4):259–74.
13. Kim YM, Romero R, Chaiworapongsa T, Espinoza J, Mor G, Kim CJ. Toll-like receptor-4: a molecular link between ‘danger signals,’ the innate immune system, and preterm labour. *BJOG.* 2004;111(6):524–9.
14. Hooton TM. Urinary tract infection in adults. *N Engl J Med.* 2012;366(11):1028–37.
15. Dheepthambiga V, Jeyakumari D, Bhat V, Senthamarai S, Kumar D. Prevalence of urinary tract infection among pregnant women and its correlation with preterm labour. *Int J Reprod Contracept Obstet Gynecol.* 2016;5(6):1808–12.
16. Dube S, Sharma A, Dutta S. Urinary tract infection as a risk factor for preterm labour: a hospital-based study. *Int J Contemp Med Res.* 2018;5(8):H6–H9.
17. Gupta K, Hooton TM, Naber KG, Wullt B, Colgan R, Miller LG, et al. International clinical practice guidelines for the treatment of acute uncomplicated cystitis and pyelonephritis in women: 2010 update. *Clin Infect Dis.* 2011;52(5):e103–20.
18. Warren JW, Abrutyn E, Hebel JR, Johnson JR, Schaeffer AJ, Stamm WE. Guidelines for antimicrobial treatment of uncomplicated acute bacterial cystitis and acute pyelonephritis in women. *Clin Infect Dis.* 1999;29(4):745–58.
19. Sharma M, Agarwal S, Bhatnagar S, Mishra A. Antibiotic resistance pattern of uropathogens isolated from antenatal women in North India. *J Family Med Prim Care.* 2019;8(2):599–604.
20. World Health Organization (WHO). *Global Antimicrobial Resistance and Use Surveillance System (GLASS) Report 2023.* Geneva: WHO; 2023.