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Original Research Article

BACTERIOLOGICAL PROFILE OF ASYMPTOMATIC BACTERIURIA IN PREGNANCY: A RETROSPECTIVE OBSERVATIONAL STUDY FROM A TERTIARY CARE HOSPITAL

Madhulatha Harish[1], Rashmi K.S[2], Harshitha Nagaraju[3], Faiza Samreen[4], Madala Honeyshree[5]

[1]Associate Professor, Department of Microbiology, Kempegowda Institute of Medical Sciences, Bangalore, Karnataka, India
[2]Professor, Department of Microbiology, Kempegowda Institute of Medical Sciences, Bangalore, Karnataka, India
[3]Assistant Professor, Department of Microbiology, Kempegowda Institute of Medical Sciences, Bangalore, Karnataka, India
[4]Assistant Professor, Department of Microbiology, Kempegowda Institute of Medical Sciences, Bangalore, Karnataka, India
[5]Tutor, Department of Microbiology, Kempegowda Institute of Medical Sciences, Bangalore, Karnataka, India

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Corresponding Author:
Dr. Faiza Samreen
Email: faizasamreen6@gmail.com

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ABSTRACT

Background: Asymptomatic bacteriuria (ASB) is one of the most common infections encountered during pregnancy. If left untreated, it frequently predisposes patients to severe complications, including pyelonephritis, preterm birth, and low birth weight. Early detection and appropriate management are therefore essential to safeguard maternal and fetal outcomes. **Materials and Methods:** This retrospective cross-sectional study aimed to determine the prevalence of ASB among pregnant women, identify the specific bacterial isolates, and characterize their antimicrobial susceptibility patterns. Clean-catch midstream urine samples from 100 asymptomatic pregnant women attending an antenatal clinic over six months (June–December 2022) were included in the study. Significant bacteriuria was defined as a colony count 10^5 CFU/ml using the Kass concept, and antibiotic susceptibility testing was conducted using the automated Vitek-2 Compact system. Data was analysed in the year 2025 using Microsoft excel and SPSS software. **Result:** Out of 100 samples, 17 (17%) demonstrated significant bacteriuria. The majority of positive cases occurred in the 21–30-year age group (71%) and during the second trimester (57%). Escherichia coli was the predominant organism isolated (76%), followed by Klebsiella pneumoniae (12%). E. coli isolates showed the highest sensitivity (92.3%) to nitrofurantoin, cotrimoxazole, amikacin, gentamicin, and piperacillin-tazobactam. **Conclusion:** Routine urine culture screening during early pregnancy is highly recommended to enable early diagnosis and targeted treatment, significantly reducing perinatal risks. Nitrofurantoin and cotrimoxazole remain effective empirical treatment options against common uropathogens.

INTRODUCTION

Urinary tract infection (UTI) is the most common infection across all age groups and stands as the most frequent infection reported during pregnancy.[1,2] The anatomical, physiological, and hormonal alterations that occur during pregnancy facilitate bacterial colonization and the subsequent ascent of infection, predisposing women to UTIs.[3] While these infections typically onset during early pregnancy—with only a quarter of cases presenting in the second and third trimesters—they can manifest as either symptomatic or asymptomatic conditions.

Asymptomatic bacteriuria (ASB) is explicitly defined as the presence of bacteria in significant counts (>10^5 bacteria/ml) within the urinary tract in the complete absence of typical UTI symptoms, such as fever with chills, dysuria, urgency, or burning micturition.[4] Globally, ASB occurs in 2–15% of pregnant women.[5-7] Untreated ASB during pregnancy can lead to highly undesirable adverse outcomes, including pyelonephritis, preterm birth, low birth weight, and neonatal sepsis.[8,9] Pregnant women with untreated bacteriuria experience a 20–

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50-fold increased risk of developing acute pyelonephritis compared to those without bacteriuria. The majority of bacteriuria cases in pregnancy are caused by Escherichia coli (63–85%) and Klebsiella pneumoniae (8%).[10] Rarer organisms include Staphylococcus aureus, Group B Streptococcus, and Pseudomonas spp. Although Group B Streptococcus accounts for only 2–10% of ASB-positive cultures, it is a definitive cause of severe neonatal and maternal infection if membrane rupture occurs, warranting strict prophylactic treatment. In cases of acute pyelonephritis, the primary causative organisms are E. coli (82%), Group B Streptococcus (21.4%), and K. pneumoniae (7%), with Proteus mirabilis, Enterococcus spp., and Pseudomonas aeruginosa also frequently identified.[11] Urine culture at the booking visit or between 12 and 16 weeks of gestation remains the gold-standard screening test of choice. Universal screening for ASB in pregnant women has been proven highly cost-effective compared to treating developed UTIs and acute pyelonephritis without prior screening.

Because antibiotic options are severely restricted during pregnancy due to fetal safety concerns, clinicians face immense difficulties in selecting appropriate empirical and targeted therapies. There is a clear deficiency in updated, localized data evaluating automated, highly accurate susceptibility profiles (such as the Vitek-2 Compact system) within tertiary care public health settings in Bangalore.[12]

Therefore, this study was undertaken to determine the precise localized prevalence of ASB among pregnant women in a tertiary care setting, identify the specific distribution of bacterial isolates, and establish their contemporary antimicrobial susceptibility profiles to optimize regional empirical stewardship programs.

MATERIALS AND METHODS

Study Design and Setting: This study was designed as a retrospective, cross-sectional, observational analysis. It evaluated clean-catch midstream urine samples collected from pregnant women attending the antenatal clinic over a six-month duration (June–December 2022) at a tertiary care hospital located in Bangalore. The study was formally reviewed and granted approval by the Institutional Ethics Committee.

Sample Size Calculation: The required sample size was calculated based on an expected 10% culture positivity rate for asymptomatic bacteriuria, utilizing a 95% confidence interval and a 5% margin of error. Based on these criteria, a total of 100 midstream urine samples were selected and analyzed.

Selection Criteria

Inclusion Criteria

Asymptomatic pregnant women attending routine antenatal visits during the designated six-month study window.

Exclusion Criteria

Patients presenting with overt symptoms of a UTI (e.g., fever, burning micturition, urgency, dysuria) were excluded. Additionally, women with known congenital anomalies of the urinary tract, active diabetes, chronic hypertension, or a history of antibiotic use within the preceding two weeks were excluded from the analysis.

Specimen Processing and Culturing

Urine samples were processed using standard microbiological protocols:

- **Inoculation:** Clean-catch midstream urine samples were cultured onto 5% sheep blood agar and MacConkey agar plates using the standard loop method (semiquantitative streaking technique).
- **Incubation:** Inoculated media plates were incubated aerobically at 37°C, and bacterial growth was formally interpreted after an incubation window of 16–24 hours.
- **Quantification:** Applying the principles of the Kass concept, significant bacteriuria was defined as a colony count $>10^5$ colony-forming units per millilitre (CFU/ml).
- **Contamination Controls:** Mixed growths presenting with >2 distinct organisms were categorized as contaminated samples and discarded from subsequent analysis.

Bacterial Identification and Antibiotic Susceptibility Testing (AST): Significant monomicrobial bacterial isolates were successfully identified using automated methods. Antimicrobial susceptibility testing (AST) was fully performed using the automated Vitek-2 Compact system (Biomerieux). The resulting minimum inhibitory concentrations (MICs) were interpreted strictly according to the Clinical and Laboratory Standards Institute (CLSI) guidelines.

Statistical Analysis: The collected data was compiled and analyzed in the year 2025 using Microsoft Excel and SPSS software. Continuous and categorical demographic variables were summarized descriptively. The specific correlation between the pregnancy trimester and culture positivity for asymptomatic bacteriuria was statistically evaluated using the Chi-square test. A p-value of <0.05 was established as the threshold for statistical significance. Strength of association was further qualified using Cramér's V analysis.

RESULTS

Out of the 100 clean-catch midstream urine samples screened from asymptomatic pregnant individuals, 17 samples yielded significant bacteriuria, establishing an overall ASB prevalence of 17% within this study cohort.

The distribution of the total screened population across age categories and gestational trimesters is presented in [Table 1].

When evaluating the 17 positive culture cases, the rates of significant bacteriuria varied across

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gestational stages [Table 2]. The second trimester exhibited the highest culture positivity rate, accounting for 12 out of 17 positive cases (21% of the trimester cohort). The third trimester accounted for 4 out of the 17 positive cases (11.4% of the trimester cohort).

To determine if a true relationship existed between gestational stage and infection rates, a Chi-square test of independence was performed. The analysis revealed no statistically significant association between the pregnancy trimester and culture positivity ($\chi^2 = 1.33$, df = 2, p = 0.514). Cramér's V was calculated at 0.115, indicating a very weak, non-significant association between these variables within the study population.

Table 1: Demographic and Gestational age Profile of Pregnant Women (n=100)

Demographics	Number (%)
Age 21–30 years	71 (71%)
Age 31–40 years	17 (17%)
Second Trimester	57 (57%)
Third Trimester	35 (35%)

Table 2: Trimester Association with Culture Positivity in Asymptomatic Bacteriuria (n=17 positive cases)

Trimester	Positive Cases (n)	Positivity Rate (%)
Second	12/17	21.0
Third	4/17	11.4

All 17 positive cultures exhibited purely monomicrobial growth. Escherichia coli was confirmed as the predominant uropathogenic organism isolated, identified in 13 cases (76%), followed by Klebsiella pneumoniae in 2 cases (12%), as detailed in [Table 3].

Table 3: Microbiological Isolates from Asymptomatic Bacteriuria (n=17)

Organism	Number (%)
Escherichia coli	13 (76%)
Klebsiella pneumoniae	2 (12%)

Antimicrobial susceptibility testing performed on the primary isolate (E. coli, n=13) revealed highly distinct sensitivity trends [Table 4]. The E. coli isolates showed the highest sensitivity (92.3%) to nitrofurantoin, cotrimoxazole, amikacin, gentamicin, and piperacillin-tazobactam.

Table 4: Antibiotic Susceptibility Patterns of Escherichia coli Isolates (n=13)

Antibiotic	Sensitivity (%)
Nitrofurantoin	92.3 (12/13)
Cotrimoxazole	92.3 (12/13)
Amikacin	92.3 (12/13)
Gentamicin	92.3 (12/13)
Piperacillin-tazobactam	92.3 (12/13)

DISCUSSION

The 17% prevalence of asymptomatic bacteriuria (ASB) observed in this study aligns closely with previous regional data published by Agarwal et al,[13] Prasanna et al., [9] and Senapati et al.[14] This substantial prevalence rate underscores the fact that ASB remains an important, covert clinical challenge during antenatal care, significantly driving risks for premature birth, low birth weight, postpartum UTIs, and elevated fetal mortality if ignored.[15]

The highest concentration of positive cases occurred among young women aged 21–30 years, matching observations documented by Agarwal et al. and Senapati et al. The heightened vulnerability seen in this specific age bracket may be physiologically explained by early or frequent exposure to sexual intercourse. This activity can induce localized urethral trauma, mechanical friction, and the subsequent upward transfer of normal perineal and bowel flora directly into the urinary bladder.[16]

In terms of gestational timeline, culture positivity peaked during the second trimester (21%). This elevated mid-pregnancy prevalence is driven by the progressive anatomical expansion of the gravid uterus. The physical weight and size of the uterus cause mechanical compression of the ureters, leading to pronounced urinary stasis and bladder distension. Concurrently, the physical changes of advanced pregnancy can make maintaining thorough perineal hygiene after urination or defecation challenging for the mother, creating an ideal, stagnant environmental niche for rapid bacterial replication and colonization.[17,18]

Escherichia coli was confirmed as the primary causative pathogen, responsible for 76% of all positive cultures. The definitive dominance of E. coli within the urinary tract is directly tied to peri-urethral contamination. Anatomical proximity, coupled with difficulties in maintaining proper personal hygiene during pregnancy, facilitates fecal contamination from the rectum. Because E. coli is a highly motile organism present in large numbers within the human

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gut, it easily ascends from the perineal region into the sterile environment of the urinary tract.[19-21]

Choosing an appropriate antibiotic during pregnancy represents a difficult clinical balance, as options are severely limited by maternal-fetal safety concerns and teratogenic risks. In this study, E. coli isolates demonstrated excellent, matching sensitivity rates of 92.3% to both nitrofurantoin and cotrimoxazole.[22,23] These findings strongly support historical evidence indicating that nitrofurantoin remains one of the safest, most reliable, and highly effective first-line therapeutic agents for eradicating uropathogens in asymptomatic pregnant individuals.[24]

Data from multiple randomized clinical trials and comprehensive meta-analyses conclusively demonstrate that targeted antibiotic eradication of ASB during pregnancy significantly reduces the incidence of acute pyelonephritis (Relative Risk [RR] ~ 0.23-0.24) while simultaneously lowering the risks of low birth weight and preterm delivery. Consequently, implementing universal, early screening alongside an objective, culture-guided antimicrobial stewardship program is absolutely vital for all antenatal patients to prevent empirical therapy failures and stop rising resistance.

Study Limitations

- The study utilized a relatively small, single-center representative sample size (n=100).
- The retrospective nature of the observational data limits the ability to track long-term maternal-neonatal clinical outcomes post-treatment.

CONCLUSION

This study demonstrates that asymptomatic bacteriuria remains a significant, highly prevalent clinical concern among pregnant women, with a detected prevalence rate of 17%. The condition occurs with greater frequency in younger women between the ages of 21 and 30 years and during the second trimester of gestation. Escherichia coli continues to be the dominant uropathogens responsible for ASB in this population. Crucially, the high sensitivity of these E. coli isolates to nitrofurantoin and cotrimoxazole (92.3%) proves that these oral medications remain highly suitable, effective first-line empirical agents.

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