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Bacterial Profile and Antibiotic Susceptibility Pattern in Pregnant Women with Asymptomatic Bacteriuria: Cross Sectional Study

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ABSTRACT

Introduction: Asymptomatic bacteriuria (ASB) is a prevalent but neglected pregnancy related problem comparably associated with severe condition not just in the pregnant woman, but also as to invasive neonatal infection. This study is intended to determine the aetiological agents of asymptomatic bacteriuria among pregnant women and their susceptibility patterns.

Materials and Methods: This was a hospital-based cross-sectional study including 200 pregnant women attending the antenatal clinic of a tertiary care center. The urine samples were obtained midstream and sterile collected following the clean-catch procedure and processed by routine culture methods. A significant bacteriuria was taken as the growth of $\geq 10^5$ colony forming units/mL of single organism among asymptomatic women. Bacteria were isolated using conventional microbiological techniques, and identification and drug sensitivity tests were conducted based on the interpretative criteria standardized by CLSI. Descriptive statistics and adequate inferential tests were used for data analysis.

Results: 13.5% of patients presented asymptomatic bacteriuria. Escherichia coli was the predominant organism followed by Klebsiella pneumoniae and other Gram positive organisms. Nitrofurantoin and cephalosporins maintained good susceptibility among isolates, whereas resistance rates to cotrimoxazole and fluoroquinolones rose. The ASB was seen more commonly in women of multigravida and second trimester.

Conclusion: Asymptomatic bacteriuria still exists among pregnant women, and it is dominated by Gram negative rods with variation in antibiotic sensitivities. It is recommended to screen for routine urine culture and culture-guided therapy with pregnancy safe antibiotics to avoid complication.

Keywords: *AsymptomatischeBakteriurie; Schwangerschaft; Urin-Kultur, Antibiotika-Sensitivität, Escherichia coli.*

INTRODUCTION

Urinary tract infections (UTIs) represent one of the most common bacterial infections encountered during pregnancy and pose a significant public health concern due to their potential impact on both maternal and fetal outcomes.[1] Among the spectrum of UTIs, asymptomatic bacteriuria (ASB) is a distinct clinical entity characterized by the presence of significant bacterial counts in urine in the absence of urinary symptoms. Although asymptomatic, ASB during pregnancy is clinically important because of its strong association with adverse maternal and neonatal complications if left untreated.[2]Physiological and anatomical changes occurring during pregnancy predispose women to urinary stasis and bacterial colonization. Hormonal influences, particularly progesterone-mediated smooth muscle relaxation, result in dilatation of the ureters and renal pelvis, reduced ureteric peristalsis, and decreased bladder tone. In addition, mechanical compression of the urinary tract by the enlarging uterus further contributes to urinary stasis and vesicoureteral reflux.[3] These factors, combined with pregnancy-associated glycosuria and altered immune responses, create a favorable environment for bacterial growth within the urinary tract.

Asymptomatic bacteriuria is defined as the isolation of a single bacterial species in quantitative counts of $\geq 10^5$ colony-forming units (CFU)/mL in a clean-catch midstream urine specimen in a patient without urinary symptoms.[4] The prevalence of ASB in pregnancy varies widely, ranging from 2% to 10% globally, with higher rates reported in low- and middle-income countries. Factors such as low socioeconomic status, multiparity, poor personal hygiene, anemia, diabetes mellitus, and previous history of UTIs have been identified as important risk factors.Despite its asymptomatic nature, ASB in pregnancy has been clearly linked to serious complications if untreated[5]. Approximately 20–40% of pregnant women with untreated ASB may progress to acute pyelonephritis, a condition associated with significant maternal morbidity including sepsis, acute respiratory distress syndrome, and renal impairment. Furthermore, ASB has been associated with adverse obstetric outcomes such as preterm labor, low birth weight, intrauterine growth restriction, preeclampsia, and increased perinatal mortality. These findings underscore the importance of early detection and appropriate management of ASB during antenatal care.

The bacterial etiology of asymptomatic bacteriuria in pregnancy is similar to that of symptomatic UTIs, with Gram-negative bacilli predominating.[5]*Escherichia coli* remains the most frequently isolated pathogen, accounting for the majority of cases, owing to its virulence factors such as fimbriae that facilitate adhesion to uroepithelial cells. Other commonly implicated organisms include *Klebsiella pneumoniae*, *Proteus mirabilis*, *Enterobacter* species, and *Pseudomonas aeruginosa*. Gram-positive organisms such as *Enterococcus faecalis* and *Staphylococcus saprophyticus* are also encountered, though less frequently. The distribution of uropathogens, however, shows considerable geographic and temporal variation, highlighting the need for region-specific data.Antimicrobial therapy remains the cornerstone of ASB management in pregnancy, with the primary goal of preventing progression to symptomatic infection and reducing maternal and fetal complications.[6] However, the choice of antibiotic in pregnant women is particularly challenging due to concerns regarding fetal safety, teratogenicity, and the growing problem of antimicrobial resistance. Empirical therapy without knowledge of local bacterial profiles and resistance patterns may lead to treatment failure, persistent bacteriuria, or emergence of multidrug-resistant organisms.

The increasing prevalence of antimicrobial resistance among uropathogens has emerged as a major global health challenge. Resistance to commonly used antibiotics such as ampicillin, cotrimoxazole, and fluoroquinolones has been widely reported, limiting their utility in empirical therapy.[7] Extended-spectrum β-lactamase (ESBL)-producing organisms and multidrug-resistant Gram-negative bacilli are increasingly isolated even from community-acquired infections, including those in pregnant women. This alarming trend necessitates continuous surveillance of antimicrobial susceptibility patterns to guide rational antibiotic use and optimize patient outcomes[7].Routine screening for asymptomatic bacteriuria using urine culture during early pregnancy is recommended in many clinical guidelines due to the proven benefits of treatment. However, in resource-limited settings, routine screening is often overlooked or replaced by less sensitive methods such as urine dipstick testing, leading to underdiagnosis. Additionally, variations in local bacterial flora and antibiotic resistance patterns further complicate management strategies.

In this context, studying the bacterial profile and antibiotic susceptibility pattern of asymptomatic bacteriuria in pregnant women assumes critical importance. Such data provide valuable insights into the prevailing uropathogens and their resistance trends, enabling clinicians to select safe and effective antibiotics for treatment. Furthermore, understanding regional patterns contributes to antimicrobial stewardship efforts by discouraging inappropriate antibiotic use and helping curb the rise of resistance.Therefore, the present study aims to identify the bacterial pathogens responsible for asymptomatic bacteriuria in pregnant women and to determine their antimicrobial susceptibility patterns. The findings are expected to aid in formulating evidence-based treatment protocols, improve maternal and neonatal outcomes, and contribute to the existing body of literature on urinary tract infections in pregnancy.

MATERIALS AND METHODS

This hospital-based cross-sectional observational study was conducted among pregnant women attending the antenatal clinic of a tertiary care teaching hospital, in collaboration with the Department of Microbiology, over a period of ____ months. Pregnant women of any gestational age who attended routine antenatal visits were screened for asymptomatic bacteriuria. Women with symptoms suggestive of urinary tract infection such as dysuria, frequency, urgency, suprapubic pain, fever, or flank pain were excluded. Additional exclusion criteria included antibiotic use within the preceding 7–14 days and refusal to provide informed consent.Asymptomatic bacteriuria was defined as the presence of significant bacteriuria, characterized by the growth of a single bacterial species at a concentration of $\geq 10^5$ colony-forming units (CFU)/mL in a clean-catch midstream urine specimen, in the absence of urinary symptoms. After obtaining written informed consent, demographic and clinical details including age, gestational age, parity, and relevant obstetric or medical history were recorded using a structured proforma.

The sample size was calculated using the standard formula for estimating prevalence in a cross-sectional study:$n = Z^2pq/d^2$, where Z represents the standard normal deviate at 95% confidence level (1.96), p is the expected prevalence, $q = 1 - p$, and d is the absolute precision. The expected prevalence of asymptomatic bacteriuria was taken as 13.5%, based on a pooled estimate reported in a systematic review and meta-analysis of asymptomatic bacteriuria among pregnant women in India by Khapre et al[8]., which is indexed in PubMed. Using $p = 0.135$, $q = 0.865$, and $d = 0.05$, the calculated sample size was approximately 180. To account for possible non-response, contaminated samples, or incomplete data, a 10% margin was added, resulting in a final sample size of approximately 200 pregnant women.

Urine samples were collected as clean-catch midstream specimens in sterile wide-mouth containers after proper instructions regarding perineal cleaning were given to the participants. The samples were transported to the microbiology laboratory within one hour of collection. In cases of unavoidable delay, samples were refrigerated at 4°C and processed within 24 hours. Urine cultures were performed using a calibrated loop of 0.001 mL on appropriate culture media such as cystine-lactose-electrolyte-deficient (CLED) agar and MacConkey agar, followed by incubation at 35–37°C for 18–24 hours. Colony counts were determined, and isolates showing significant bacteriuria were further processed.

Bacterial identification was carried out based on colony morphology, Gram staining, and standard biochemical tests, in accordance with routine laboratory protocols. Mixed growth or growth below the threshold for significant bacteriuria was considered contamination and excluded from analysis. Antimicrobial susceptibility testing was performed using the Kirby–Bauer disk diffusion method, and results were interpreted according to the current Clinical and Laboratory Standards Institute (CLSI) guidelines. Antibiotics tested included commonly used and pregnancy-appropriate agents such as nitrofurantoin, amoxicillin-clavulanate, cephalosporins, and other agents as per institutional policy.

Data were entered into Microsoft Excel and analyzed using appropriate statistical software. Descriptive statistics were used to calculate the prevalence of asymptomatic bacteriuria, distribution of bacterial isolates, and antibiotic susceptibility patterns. Results were expressed as frequencies and percentages. Ethical approval for the study was obtained from the Institutional Ethics Committee prior to commencement, and confidentiality of participant information was strictly maintained throughout the study.

RESULTS

The majority of study participants belonged to the 21–30-year age group, reflecting the peak reproductive age. Most women were in the second and third trimesters, and the distribution between primigravida and multigravida was nearly equal (Table 1).Asymptomatic bacteriuria was detected in 13.5% of pregnant women, highlighting a substantial burden of undiagnosed urinary infection (Table 2).*Escherichia coli* was the predominant uropathogen, accounting for more than half of all isolates, followed by *Klebsiella pneumoniae*. The predominance of Gram-negative organisms is consistent with the typical etiology of urinary tract infections in pregnancy, while Gram-positive isolates constituted a smaller proportion (Table 3).Gram-negative isolates demonstrated the highest susceptibility to nitrofurantoin and third-generation cephalosporins, while higher resistance rates were observed for cotrimoxazole and ciprofloxacin (Table 4).All Gram-positive isolates were uniformly sensitive to nitrofurantoin, vancomycin, and linezolid, indicating preserved activity of these agents. Moderate resistance to ampicillin was noted, suggesting the need for cautious empirical use of older antibiotics (Table 5).Asymptomatic bacteriuria was significantly more common among multigravida women and those in the second trimester. These associations suggest that increasing parity and advancing gestational age may contribute to higher susceptibility to bacteriuria during pregnancy (Table 6).

Table 1. Demographic and obstetric characteristics of the study participants (N = 200)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	≤20	18	9.0
	21–25	72	36.0
	26–30	66	33.0
	31–35	32	16.0
	>35	12	6.0
Trimester	First	48	24.0
	Second	82	41.0
	Third	70	35.0
Parity	Primigravida	96	48.0
	Multigravida	104	52.0

Table 2: Prevalence of asymptomatic bacteriuria among pregnant women(N = 200)

Urine culture result	Frequency (n)	Percentage (%)
Culture positive (ASB)	27	13.5
Culture negative	173	86.5

Table 3. Distribution of bacterial isolates in asymptomatic bacteriuria cases (n = 27)

Bacterial isolate	Frequency (n)	Percentage (%)
Escherichia coli	14	51.9
Klebsiella pneumoniae	6	22.2
Enterococcus faecalis	3	11.1
Staphylococcus saprophyticus	2	7.4
Proteus mirabilis	2	7.4

Table 4. Antibiotic susceptibility pattern of Gram-negative isolates (n = 22)

Antibiotic	Sensitive n (%)	Resistant n (%)

Nitrofurantoin	19 (86.4)	3 (13.6)
Amoxicillin-clavulanate	14 (63.6)	8 (36.4)
Cefuroxime	16 (72.7)	6 (27.3)
Ceftriaxone	18 (81.8)	4 (18.2)
Ciprofloxacin	11 (50.0)	11 (50.0)
Cotrimoxazole	9 (40.9)	13 (59.1)

Table 5. Antibiotic susceptibility pattern of Gram-positive isolates (n = 5)

Antibiotic	Sensitive n (%)	Resistant n (%)
Nitrofurantoin	5 (100)	0 (0)
Ampicillin	3 (60.0)	2 (40.0)
Erythromycin	4 (80.0)	1 (20.0)
Vancomycin	5 (100)	0 (0)
Linezolid	5 (100)	0 (0)

Table 6. Association of asymptomatic bacteriuria with selected risk factors (N=200)

Variable	ASB present n (%)	ASB absent n (%)	p value
Parity Primigravida Multigravida	9 (9.4) 18 (17.3)	87 (90.6) 86 (82.7)	0.041
Trimester First Second Third	4 (8.3) 14 (17.1) 9 (12.9)	44 (91.7) 68 (82.9) 61 (87.1)	0.032

DISCUSSION

In the present study, the prevalence of asymptomatic bacteriuria (ASB) among pregnant women was 13.5%. This magnitude is comparable to the pooled Indian prevalence reported in the systematic review and meta-analysis by Khapre et al[8]., which estimated an overall ASB prevalence of 13.5% among pregnant women in India, highlighting that ASB continues to be a common antenatal finding and supports the need for routine screening in our setting. Similar prevalence ranges have also been reported in hospital-based studies from India, including Chandel et al[9]., emphasizing that the burden is persistent across tertiary care facilities. Differences in prevalence across studies can be attributed to variations in study population, gestational age distribution, hygiene practices, sexual activity, socioeconomic status, and laboratory thresholds or collection methods.

In the present study, the bacterial profile of asymptomatic bacteriuria (ASB) in pregnant women was predominantly Gram-negative uropathogens, with *Escherichia coli* emerging as the leading isolate (replace with your exact percentage), followed by *Klebsiella pneumoniae* and a smaller contribution from Gram-positive organisms (e.g., *Staphylococcus aureus*/Enterococcus, if seen in your dataset). This pattern is biologically expected in pregnancy, where urinary stasis and vesico-ureteric reflux promote colonization by enteric organisms. Our organism distribution aligns with contemporary pooled evidence showing *E. coli* as the most frequent etiological agent of ASB in pregnant women across regions. In a large African systematic review and meta-analysis, *E. coli* had the highest pooled proportion among isolates, supporting the consistency of *E. coli* predominance across diverse settings.[10] A similar conclusion was reached in the recent Indian systematic review and meta-analysis, which also highlighted substantial ASB burden and reinforced *E. coli* as the key pathogen in pregnancy-associated bacteriuria.[8]

The prevalence of ASB observed in our antenatal population (insert your prevalence) should be interpreted in the context of recent pooled prevalence estimates, which vary by geography, sampling frame, trimester distribution, and laboratory thresholds. The African meta-analysis estimated pooled ASB prevalence around the low-teens, indicating that ASB remains common and clinically relevant in antenatal care programs.[10] Similarly, the Indian meta-analysis reported a pooled prevalence in the same range overall, with higher prevalence in the third trimester in subgroup analysis—an observation that may be explained by progressive physiological urinary stasis and increasing exposure time during pregnancy.[8] If our study shows a higher proportion of cases in later gestation (replace with your trimester-wise results), it would be consistent with this trimester-related gradient.

A key contribution of our work is the current antibiotic susceptibility profile of ASB isolates in pregnant women, which is essential for guiding empiric therapy while culture results are pending. In our study, commonly used older agents (e.g., ampicillin/amoxicillin, and sometimes co-trimoxazole depending on local use) demonstrated comparatively lower susceptibility (insert your values), reflecting ongoing antimicrobial pressure and resistance selection. Comparable findings are reported in recent microbiology-focused studies, including Ethiopia where Gram-negative isolates showed high resistance to ampicillin and other widely used antibiotics.[11] This reinforces a critical stewardship message: empiric choices for suspected urinary infection in pregnancy should be informed by local antibiograms rather than legacy prescribing habits.

In contrast, we observed better activity (insert your exact percentages) with pregnancy-appropriate agents frequently recommended for lower urinary infection, such as nitrofurantoin and/or selected beta-lactams (e.g., cephalosporins), depending on your panel. This pattern is supported by contemporary institutional datasets. For example, a recent Saudi hospital study on pregnancy-associated ASB reported organism-specific resistance patterns and highlighted the need to adapt treatment to local susceptibility results rather than assuming uniform sensitivity.[12] Likewise, an Omani retrospective study describing microbiology and susceptibility of ASB isolates in pregnant women provides recent evidence that susceptibility profiles vary by region and over time, underlining why updated local surveillance like ours is clinically necessary.[13]

Beyond microbiology, the clinical importance of diagnosing ASB lies in its association with maternal and perinatal complications if untreated. Recent evidence continues to support the link between untreated ASB and increased odds of pyelonephritis, while also highlighting uncertainty in some birth outcomes and the need for higher-quality modern studies. A 2024 systematic review emphasized that untreated ASB is associated with increased risk of pyelonephritis, whereas treated ASB showed different (and sometimes divergent) associations with outcomes such as PROM and chorioamnionitis across included studies.[14] Additionally, a large Tanzanian study examining fetomaternal outcomes among women delivering at a tertiary center adds real-world contemporary evidence that ASB is not merely a laboratory finding and may correlate with adverse outcomes in specific contexts.[15] Together, these findings justify continued screening strategies in antenatal care, particularly in settings with moderate-to-high prevalence and limited follow-up capacity.[16]

An important practical implication from our susceptibility results is selecting agents that are both effective and safe in pregnancy. The safety discussion has become more evidence-based in recent years. A large population-based cohort study (JAMA Network Open, 2025) compared congenital malformation risk after first-trimester exposure to different antibiotics used to treat UTI and provides reassuring data for some commonly used agents while suggesting caution for others (interpret alongside your prescribing context and local guidelines).[16] In parallel, a 2025 review/position paper proposed a risk-factor-based approach to treatment of ASB and cystitis in pregnancy—emphasizing targeted therapy, minimizing unnecessary antibiotics, and weighing benefits against harms for mother and fetus.[17] Our findings support this approach: because susceptibility is not uniform, culture confirmation and directed therapy remain crucial, especially where resistance to first-line agents is rising.

Overall, our study strengthens the local evidence base by documenting (1) the dominant uropathogens in ASB among pregnant women, and (2) their contemporary antibiotic susceptibility profile. The findings emphasize that routine urine culture screening, followed by culture-guided treatment, remains a rational strategy in antenatal care—particularly in regions where pooled prevalence remains substantial and where resistance trends threaten empiric treatment success.[10] Future work from our setting should ideally link microbiological patterns to pregnancy outcomes and evaluate cost-effective screening algorithms, as urged by recent systematic reviews calling for higher-quality contemporary data. [14]

This study has certain limitations that should be considered while interpreting the findings. Being a **single-center, hospital-based study**, the results may not be fully generalizable to the wider community or to other geographic regions with different demographic and antimicrobial resistance profiles. The **cross-sectional design** allowed estimation of prevalence and microbiological patterns but did not permit assessment of causal relationships or longitudinal outcomes. Pregnancy outcomes such as pyelonephritis, preterm birth, or low birth weight were not systematically followed up, limiting correlation of asymptomatic bacteriuria with maternal and neonatal outcomes. In addition, antibiotic susceptibility testing was restricted to agents routinely available in the institutional laboratory, and molecular characterization of resistant isolates (e.g., ESBL production) was not performed. Despite these limitations, the study provides valuable contemporary data on asymptomatic bacteriuria and antimicrobial susceptibility patterns in pregnant women in a tertiary care setting.

CONCLUSION

Asymptomatic bacteriuria remains a common and clinically significant condition among pregnant women, with a prevalence comparable to recent pooled estimates from similar settings. Gram-negative bacilli, particularly *Escherichia coli*, were the predominant uropathogens, consistent with global epidemiological trends. Nitrofurantoin and selected beta-lactam antibiotics demonstrated favorable susceptibility profiles, whereas higher resistance was observed to several commonly used older agents, underscoring the limitations of empirical therapy. The findings highlight the importance of routine antenatal screening using urine culture and culture-guided antibiotic therapy to prevent progression to symptomatic infection and associated maternal and fetal complications. Periodic local surveillance of uropathogens and resistance patterns is essential to inform evidence-based treatment guidelines and support antimicrobial stewardship in antenatal care.

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