



## Original Article

# Antimicrobial Susceptibility Patterns of *Klebsiella* Species Causing Urinary Tract Infections in Pregnant Women

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## Abstract

**Background:** Urinary tract infections (UTIs) are the most prevalent type of infection during pregnancy and are notoriously difficult to treat. Significant maternal and fetal risk is associated with UTI during pregnancy, with the most prevalent clinical manifestations being asymptomatic bacteriuria, acute cystitis, and acute pyelonephritis.

**Objectives:** To identify *Klebsiella* species causing urinary tract infection among pregnant women and its antimicrobial susceptibility pattern by modified Kirby Bauer disc diffusion method in Rajshahi Medical College Hospital.

**Materials and Method:** A descriptive cross-sectional study was conducted between July 2021 to June 2022 in the Microbiology Department of Rajshahi medical college and the Gynecology and Obstetrics Department of RMCH to determine the antimicrobial susceptibility pattern of *Klebsiella* species causing urinary tract infection in pregnant women. The urine samples were inoculated onto MacConkeys agar, blood agar, nutrient agar, and chromogenic UTI agar media and incubated aerobically at 37<sup>o</sup> C overnight (18-20 hrs).

**Results:** In all trimesters, 294 urine samples were obtained from pregnant women with asymptomatic and symptomatic UTIs. Among the 114 (38.77%) culture-positive samples, 111 (97.36%) were single isolates, whereas 3 (2.63%) included multiple isolates. *Klebsiella spp.* comprised 21 out of 117 culture-positive bacterial isolates (17.94%). Regarding antimicrobial susceptibility testing, *Klebsiella spp.* demonstrated a significant degree of sensitivity to meropenem and nitrofurantoin. In this investigation, *Klebsiella spp.* was found to be the cause of bacteriuria among pregnant women. **Conclusion:** Doctors should adhere to the antimicrobial susceptibility test results when selecting the appropriate medications to treat pregnant women with UTIs.

**Keywords:** Urinary Tract Infection, antimicrobial susceptibility pattern, *Klebsiella*, pregnant women

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## Introduction

Urinary tract infection (UTI) is one of the most common bacterial infections worldwide, which ranges from uncomplicated cystitis to bacteremia

with relevant morbidities.<sup>1</sup> Nearly about 10% of people will experience a UTI during their lifetime.<sup>2</sup> Pregnancy is associated with structural, physiological, and functional changes in the urinary tract, which most often result in ascending

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of pathogens into the urinary bladder, causing urinary tract infections. UTIs are the most common bacterial infection during pregnancy, which leads to serious adverse maternal and neonatal outcomes. Both symptomatic and asymptomatic UTIs are prevalent among pregnant.<sup>3</sup> The risk of developing UTI commences in the sixth week usually. Then it will peak during the 22-24th week of pregnancy due to various causes, including increased bladder volume, urethral dilatation, and decreased urethral tone, which results in high urinary stasis and vesicourethral reflux.<sup>4</sup>

Cystitis, on the other hand, complicates about 1.3% of pregnancies. 2-4% of pregnancies experience pyelonephritis, and 23% of cases recur immediately after giving birth.<sup>5</sup> Diabetes mellitus, recurrent UTIs, and urinary tract structural anomalies are a few co-morbidities that have been linked to an increased risk of UTI during pregnancy.<sup>6,7</sup> Prevalence of UTI in females in Bangladesh was reported at 71.60%.<sup>2</sup> In a cohort of pregnant women in rural Sylhet, Bangladesh, the prevalence of UTI in early pregnancy is 8.9% (4.4% symptomatic UTI, 4.5% asymptomatic bacteriuria).<sup>8</sup> Bacteria are the primary organism that causes UTI. A wide variety of organisms are isolated from patients with UTI, and *Klebsiella pneumoniae* (11%) was the most important.<sup>9</sup>

In pregnancy, urinary tract infection without antibiotic treatment may result in serious complications such as low birth weight, preterm labor, hypertension, pre-eclampsia, anemia, pyelonephritis, amnion titis, stillbirth, neonatal deaths, bacteremia, toxic septicemia.<sup>5</sup> *Klebsiella pneumoniae* is an encapsulated Gram-negative bacillus belonging to the Enterobacteriaceae

## Results

Urine samples from 294 pregnant women with or without symptoms of UTI were collected so that uropathogenic bacteria could be isolated, identified, subcultured, and subjected to biochemical testing. To identify *Klebsiella spp.*, an antimicrobial susceptibility test (AST) and a phenotypic approach were used. Only 114 (38.1%) of the 294 samples tested positive for culture, whereas 180 (61.2%) tested negative (Figure I). There were 114 cases that returned a positive culture; 111 of those were single isolates (97.36%), and 3 were multiple isolates (2.64%) (Figure II). Among the culture positive 114 instances, 51 (44.73%) were in the third trimester, 43 (37.84%) were in the second trimester, and 20 (17.54%) were in the first trimester (Table I). Among 208 asymptomatic UTI patients cases, 69 (33.17%) were culture positive, and in 86 symptomatic cases, 45(52.32%) were culture positive (Table II). Of the 117 bacterial

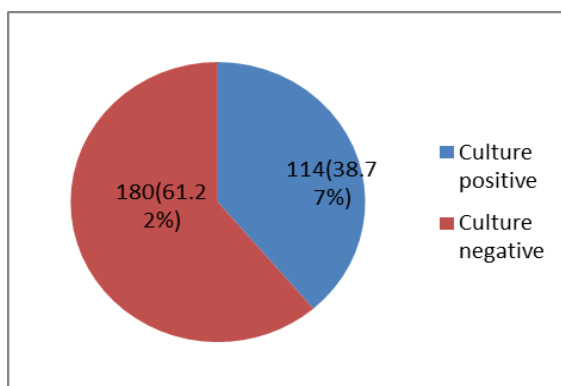
family. In this era of antibiotic resistance, *Klebsiella pneumoniae* represents one of the most concerning pathogens involved in antibiotic resistance and such as, together with other highly important MDR pathogens.<sup>10</sup>

With this above view, this study aimed to isolate *Klebsiella* species among pregnant women of UTI and their susceptibility patterns to antibiotics. This study is likely to help physicians with their antibiotic choices in managing UTI in pregnant women in Rajshahi Medical College Hospital.

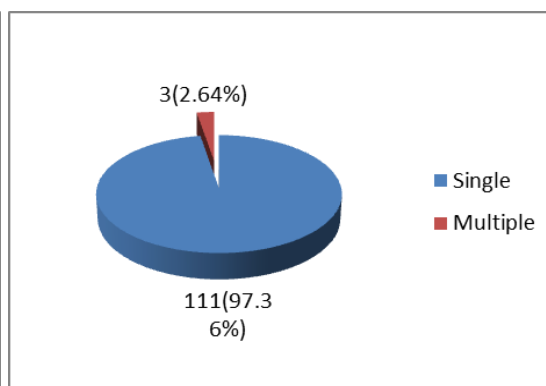
## Materials and Methods

This was a cross-sectional descriptive study carried out in the Department of Microbiology at Rajshahi Medical College, Rajshahi. The study period was from July 2021 to June 2022. Clinically suspected UTIs in pregnant women from both inpatients and outpatients attending in Department of Gynae & Obstetrics Rajshahi Medical College Hospital, Rajshahi, during the study period, were considered the study population. A purposive sampling technique was used, and a total of 294 patients were included in this study. The urine samples from pregnant women were collected with aseptic precautions. Urine samples were inoculated onto MacConkeys agar, blood agar, nutrient agar, and chromogenic UTI agar media and incubated aerobically at 37<sup>0</sup> C overnight (18-20 hrs). If culture plates showed significant growth of bacteria, then antimicrobial susceptibility tests were performed by the modified Kirby Bauer disc diffusion method. Prior to the commencement of the study, the study protocol was approved by the Institutional Review Board and concerned authority, Rajshahi Medical College Hospital.

isolates, 94 (80.34%) were Gram-negative bacteria, while the remaining isolates (19.65%) were Gram-positive bacteria (Table III). *E. Coli* was found to be 57 (48.71%), followed by *Klebsiella spp.* 21(17.94%) which was the second highest bacteria recorded causing UTI (Figure III). Antimicrobial susceptibility pattern of *Klebsiella spp.* showed the highest susceptibility towards meropenem (81%), followed by nitrofurantoin (71.42%), azithromycin (61.90%), and least susceptibility towards cotrimoxazole and cefuroxime(14.28%), followed by amoxiclav, ceftazidime, and cefotaxime (19.04%) (Figure IV)



**Figure I: Frequency of culture-positive and culture-negative cases (N=294)**



**Figure II: Proportion of single and multiple bacterial isolates in culture-positive cases (N=114)**

**Table I: Culture-positive cases irrespective of gestational age (N=114)**

Gestational age	Culture-positive (No %)
1 <sup>st</sup> trimester	20(17.54%)
2 <sup>nd</sup> trimester	43(37.71%)
3 <sup>rd</sup> trimester	51(44.73%)
Total	114

**Table II: Symptomatic UTI and asymptomatic bacteriuria among pregnant women in relation to culture positivity**

	Culture positive	Culture negative	Total
Symptomatic	45(52.32%)	41(47.67%)	86(100%)
Asymptomatic	69(33.17%)	139(66.82%)	208(100%)
Total	114(38.76%)	180(61.22%)	294(100%)

**Table III: Gram-positive and Gram-negative bacteria among bacterial growth (N=117)**

Isolated Organism	Number (%)
Gram-negative	94(80.34%)
Gram-positive	23(19.65%)

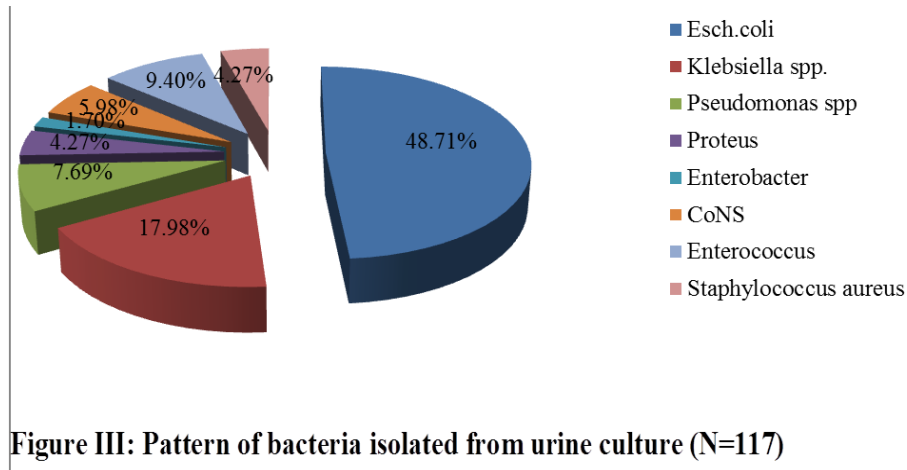


Figure III: Pattern of bacteria isolated from urine culture (N=117)

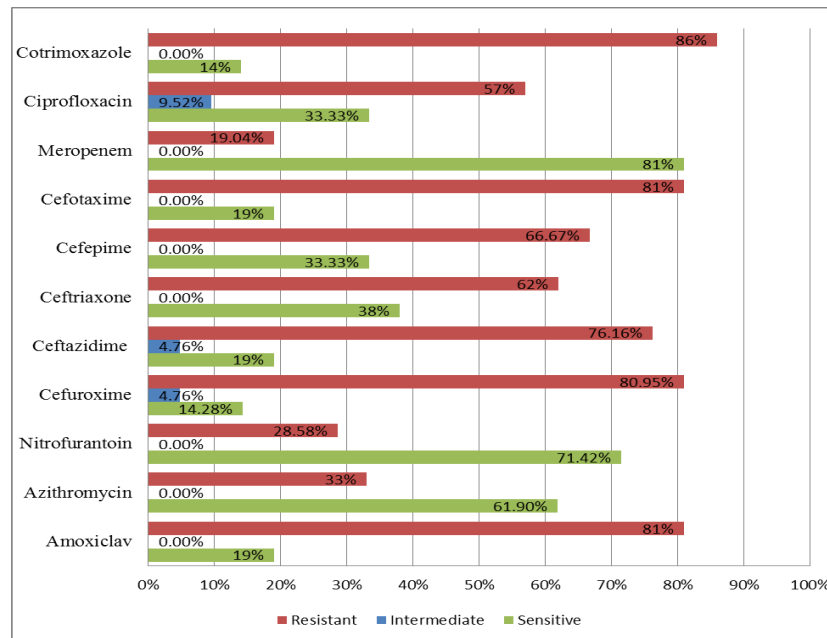


Figure IV: Antimicrobial susceptibility pattern of *Klebsiella spp.* (N=21)

**Discussion**

Two hundred ninety-four urine specimens were collected from different trimesters of pregnant women with symptomatic or asymptomatic UTI. Figure I showed 114 (38.77%) were culture positive and 180 (61.22%) were culture negative. This study was nearly similar to Rajaratnam et al., 2014 in India, which found 38.0% were cultures positive and 72.0% were found to be cultures negative, respectively.<sup>3</sup> Lower frequency of UTIs may be caused by the habit of administering antibiotics prior to the results of urine culture reports and the possibility that the majority of

urine samples are obtained from patients with asymptomatic infections.<sup>2</sup> The current findings were dissimilar with Rizvi et al., 2011 in Pakistan; Beksac et al., 2019 in Turkey, with culture positive 51.2%, 60% and, 48.8%, and 40% culture negative. Increased incidence is attributable to patients rarely visiting the doctor for routine checkups.<sup>4,12</sup> Among the culture-positive total cases, 111 (97.36%) were single, and 3(2.63%) were multiple (Figure II). The finding corresponded with the study of Rosana et al., 2020 in Indonesia (single isolates 97.3%, multiple isolates 2.7%) and Muhammad et al.,2015 in

Nigeria (single isolates 92.6% and multiple isolates 7.4%).<sup>13,14</sup> Dissimilarity showed Oladeinde et al., 2015 in Nigeria with single isolates 89.3% and multiple isolates 10.7%.<sup>15</sup> Table I showed, among the culture positive 114 cases, 51 (44.73%) were in the third trimester, 43 (37.71%) were in the second trimester, and 20 (17.54%) were in the first trimester. It was found that 50.1% in the third trimester, 40.2% in the second trimester and 15.9% in the first trimester and 45.2% in the third trimester, 35.8% in the second trimester, and 11.7% in the first trimester which were similar with present study Gulfareen et al., 2010 in Pakistan<sup>16</sup> and Jubaida et al., 2013 in Bangladesh.<sup>17</sup> This is due to the increased obstruction of ureters as a result enlarging uterus. Dissimilar findings were found in 61.2% and 59.3% in the third trimester, 48.9% and 13% in the second trimester, 3.5% and 5.9% in the first trimester Muharram et al., 2014 in Brunei<sup>18</sup> and Sujatha et al., 2014 in India<sup>19</sup> respectively. Table II, Out of 208 asymptomatic and 86 symptomatic UTI pregnant women, 69 (33.17%) and 45 (52.32%) showed culture-positive results, respectively. Similar findings of asymptomatic cases, 29.5%, and 30.5%, were seen by Izuchukwu et al., 2017 in Nigeria<sup>20</sup> and Rohini et al., 2017 in India.<sup>21</sup> These findings may be due to better infection control and awareness among the UTIs in those regions. Dissimilarity with asymptomatic cases of this study Goruntla et al., 2019 in India and Rosana et al., 2020 in Indonesia which was 6.4% and 10.5%.<sup>22,13</sup> Table III, showed that gram-negative bacteria were 94 (80.34%) and gram-positive bacteria were 23 (19.65%). In contrast to this study, similar findings were found with 81% gram-negative and 19% gram-positive bacteria of Rajaratnam et al., 2014 in India<sup>3</sup> and 82.4% gram-negative and 17.8% gram-positive were found in Ngeufack et al., 2019 in Cameroon.<sup>23</sup> The gram-negative bacteria, including Enterobacteriaceae, have several factors responsible for their attachment to uroepithelium, colonizing the periurethral area, and initiating infection by ascending into the urinary tract. This image reflects the prevalent notion of gram-negative predominance in urinary tract infections, supported by this investigation. Dissimilar to Rizvi

et al., 2011 in Pakistan and Beksac et al., 2019 in Turkey which were found 69.2% and 71.5% of gram-negative bacteria and 30.8% and 28.5% as gram-positive bacteria.<sup>3,12</sup> Figure III, regarding 117 culture positives cases, *Klebsiella spp.* 21(17.94%) was the second highest bacteria, nearly similar to Rosana et al., 2020 in Indonesia and Ngeufack et al., 2019 in Cameroon, which was 20% and 14.3%, respectively.<sup>13,23</sup> Capsular polysaccharides, Lipopolysaccharides, and siderophores are essential virulence factors associated with the adhesion of *Klebsiella spp.* Dissimilar was observed in 4.9% and 3.9% with Nahab et al., 2022 in Iraq<sup>24</sup> and Beleta et al., 2020 in Ethiopia<sup>25</sup> Figure III, the Antibiotic susceptibility pattern of *Klebsiella spp.*, exhibited the highest sensitivity to meropenem (81%), followed by nitrofurantoin (71.42%) and azithromycin (61%), respectively. Cefuroxime and cotrimoxazole had the lowest susceptibility (14.28%), followed by ceftazidime, cefotaxime, and amoxiclav (19.04%), respectively. Nearly similar results were also observed in meropenem (83%) and azithromycin (62.04%) with Akter et al., 2016 in Bangladesh<sup>2</sup> and meropenem (88%) and nitrofurantoin (72%) with Amesha et al., 2022 in Egypt.<sup>26</sup> The higher rate of sensitivity is likely attributable to a more prudent usage of this antibiotic in general. However, a higher susceptibility rate (100%) towards meropenem was marked by Goruntla et al., 2019 in India,<sup>22</sup> and 44% was observed by Aminul et al., 2021 in Bangladesh,<sup>27</sup> which was dissimilarity to this study.

## Conclusion

Antimicrobial resistance is on the rise, which poses a problem for treating UTIs during pregnancy. The problem has become more challenging as there are fewer safe antimicrobials available. According to this study, severe bacteriuria is a common occurrence among pregnant women and is significantly more common in the third trimester. This research shows that *Klebsiella spp.* are resistant to antibiotics considered safe during pregnancy by the World Health Organization (WHO), including those belonging to the cephalosporin and penicillin groups. To control this outbreak of resistance,

prenatal care visits should include a urine culture of the mother.

**Conflict of interest:** None declared

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