

# Microbiological and Antimicrobial Susceptibility Pattern of Asymptomatic Bacteriuria in Pregnant Women Attending SQUH

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## ABSTRACT

**Objectives:** Our research aimed to study the microbiology and antimicrobial resistance in asymptomatic bacteriuria (ASB) among Omani pregnant women. **Methods:** We conducted a retrospective study that included data from 196 Omani pregnant women with ASB who received care at Sultan Qaboos University Hospital from 2010–2019. Data were obtained from the patients' electronic medical records including demographics, clinical details, isolated organisms, antimicrobial susceptibility results, and prescribed antibiotics. **Results:** ASB was detected in 56.1% of cases during the third trimester. *Klebsiella pneumoniae* (32.1%) was the most frequently isolated organism, followed by *Escherichia coli* (29.6%). Twenty-one (10.7%) isolates were extended-spectrum beta-lactamase (ESBL)-producing organisms. The overall microbiological susceptibility pattern showed that organisms have a high susceptibility rate to nitrofurantoin reaching 82.8%, followed to a lesser extent by cefuroxime and augmentin. The susceptibility of *E. coli* and *K. pneumoniae* to cefuroxime was 74.1% and 71.4%, respectively. Only 52.4% of all isolated ESBL-producing organisms were susceptible to nitrofurantoin. **Conclusions:** *K. pneumoniae* and *E. coli* were the most frequently isolated bacteria in ASB, representing 60.7% of total isolates. A high prevalence of ESBL-producing organisms, 10.7% of the total isolates, was observed. Cefuroxime is an appropriate empirical antibacterial therapy for ASB and urinary tract infection in pregnant women. Nitrofurantoin should be considered for empirical antibiotic therapy in settings of high prevalence of ESBL-producing organisms.

Asymptomatic bacteriuria (ASB) is defined as the presence of bacteria in the urine in the absence of urinary symptoms. It is common during pregnancy where screening and prompt treatment are required once identified. The estimated prevalence of ASB in pregnancy is 2–10%.<sup>1,2</sup>

During pregnancy, women are at increased risk of symptomatic urinary tract infection (UTI), including pyelonephritis, due to physiological and hormonal changes.<sup>3</sup> The estimated risk of symptomatic UTI and pyelonephritis in untreated ASB ranges between 20–40%.<sup>4–7</sup> ASB may also increase the risk of preterm delivery and intrauterine growth retardation.<sup>4,8,9</sup> Thus, screening all pregnant women for ASB is the standard of care and it is recommended worldwide.

Different oral antibiotic options have been recommended for empirical therapy for ASB,

including amoxicillin, co-amoxiclav, co-trimoxazole, and ciprofloxacin. However, due to emerging antimicrobial resistance, nitrofurantoin is recommended by some guidelines as the standard empirical therapy.<sup>10</sup> Understanding the microbiology and antimicrobial resistance of the causative bacteria in our settings will help to guide appropriate empirical antibacterial therapy in pregnant women with ASB or UTI.

## METHODS

This retrospective cross-sectional study included all pregnant women with ASB seen at Sultan Qaboos University Hospital from January 2010 to December 2019. Detailed clinical data, patient demographics, and antimicrobial susceptibility of the causative pathogens were obtained from the patients' electronic medical records (TRACKCARE). Data was analyzed using SPSS (IBM Corp. Released

**Table 1:** Frequency of asymptomatic bacteriuria across the different pregnancy trimesters.

Trimester	Frequency	Percentage
First	28	14.3
Second	58	29.6
Third	110	56.1
Total	196	100

**Table 2:** Frequency of commonest organisms isolated in asymptomatic bacteriuria.

Isolated bacteria	Frequency	Percentage
<i>Escherichia coli</i>	58	29.6
<i>Klebsiella pneumoniae</i>	63	32.1
<i>Enterococcus faecalis</i>	22	11.2
ESBL species	21	10.7
Group B <i>Streptococcus</i>	15	7.7
Others	17	8.7
Total	196	100

ESBL: extended-spectrum beta-lactamase.

2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.). Mean, 95% CI, and SD were calculated to describe continuous variables while the chi-square test was used to describe categorical variables.

### RESULTS

A total of 196 pregnant women aged 19–44 years were included in the study with a mean age of 29.0 years. The gravidity of the study group ranged from 1–14 (mean = 3.3) and the parity was 0–9 (mean = 1.6). One-hundred and ten (56.1%) pregnant women had ASB in the third trimester. Diabetes mellitus (DM) and gestational diabetes mellitus (GDM) were

reported in 21.0% of women with ASB. GDM was found in 15.8% of the studied cohort [Table 1].

In regard to the microbiologic pattern, *Klebsiella pneumoniae* was the most frequently isolated organism followed by *Escherichia coli* representing 32.1% and 29.6% of all isolates, respectively. The two organisms represent around two-thirds of the total number of isolates together. Twenty-one (10.7%) isolates were extended-spectrum beta-lactamase (ESBL)-producing organisms. Other bacterial species including *Staphylococcus aureus* and group B *Streptococcus* were isolated in a small number of patients [Table 2].

In this study, cefuroxime followed by co-amoxiclav were the most frequently empirically prescribed antibiotics, and 33.8% of the patients did not receive any antibiotics for ASB likely due to delayed follow-up of urine culture results. However, most pregnant women with ASB had a follow-up urine culture and targeted antibacterial therapy for any growth as per the local treatment protocol. The overall microbiological susceptibility pattern showed a high susceptibility rate to nitrofurantoin (82.8%), followed, to a lesser extent, by cefuroxime and co-amoxiclav. The susceptibility of *E. coli* and *K. pneumoniae* to cefuroxime was 74.1% and 71.4%, respectively, compared with other oral options including ampicillin, ciprofloxacin, and cotrimoxazole. Among oral antibiotics tested in our study, nitrofurantoin showed a susceptibility of 52.4% in all isolated ESBL-producing organisms [Table 3].

### DISCUSSION

There was a significant difference in the prevalence of ASB with regard to the trimester as previous

**Table 3:** Antimicrobial susceptibility of bacteria causing asymptomatic bacteriuria in pregnant women.

Organism	Antibiotic susceptibility, n (%)					
	Coamoxiclav	Cefuroxime	Ampicillin	Nitrofurantoin	Ciprofloxacin	Trimethoprim/Sulfamethoxazole
<i>Escherichia coli</i>	37 (63.8)	43 (74.1)	26 (44.8)	48 (82.8)	19 (32.8)	32 (55.2)
<i>Klebsiella pneumoniae</i>	46 (73.0)	45 (71.4)	3 (4.8)	28 (44.4)	21 (33.3)	43 (68.3)
<i>Enterococcus faecalis</i>	7 (31.8)	3 (13.6)	19 (86.4)	14 (63.6)	5 (22.7)	3 (13.6)
Group B <i>Streptococcus</i>	5 (33.3)	3 (20.0)	7 (46.7)	4 (26.7)	2 (13.3)	3 (20.0)
ESBL species	6 (28.6)	5 (23.8)	1 (4.8)	11 (52.4)	7 (33.3)	10 (47.6)

ESBL: extended-spectrum beta-lactamase.

studies showed an increased prevalence in the first trimester.<sup>11,12</sup> In comparison to these studies, our research demonstrated a high prevalence of ASB in the third trimester reaching 56.1% of cases. This is likely related to the complexity of cases seen at the tertiary care hospital late in pregnancy, where screening for ASB is routinely conducted. The majority of pregnant women undergo urine culture screening early in pregnancy at local health centers.

Patients with DM have a 3–5-fold increased risk of ASB compared to the general population.<sup>13</sup> In this study, DM and GDM were reported in 21.0% of pregnant women with ASB, posing a major risk factor for developing ASB during pregnancy.

*K. pneumoniae* followed by *E. coli* were the most prevalent organisms in our study population, in contrast to results from previous studies where *E. coli* was the predominant organism.<sup>2,9,14</sup> *E. coli* represented 89%, 70%, and 66.9% of total isolates in Saudi Arabia, Iran, and the UAE, respectively.<sup>11</sup> On the contrary, *Klebsiella* species were infrequently isolated, accounting for < 1% of total isolates in some regions of the world, such as the UK and Saudi Arabia.<sup>10,15</sup>

The rise of antimicrobial resistance is a global threat, and the increasing incidence of UTIs caused by antibiotic-resistance pathogens, ESBL-producing organisms, is concerning. In this study, 10.7% of total isolates causing ASB were ESBL-producing organisms, which was lower than the reports in some other countries. In Iraq, the estimated prevalence is around 23%.<sup>16</sup> A high prevalence of ESBL-producing organisms as a cause of UTI or ASB has been reported in Africa and India, with an estimated prevalence of 45% and 33%, respectively.<sup>17</sup> Europe and South America have the lowest rates, with 4% and 3% incidence, respectively.<sup>18</sup>

This study revealed that nitrofurantoin, cefuroxime, and co-amoxiclav sustained a good susceptibility level against the most isolated urinary pathogens, with a high percentage of *E. coli* and *K. pneumoniae* species. A high resistance rate of *E. coli* to amoxicillin has been reported in some parts of the world, and hence its use as empirical therapy is not recommended.<sup>19,20</sup> Data from the UK showed an increasing resistance rate of pathogens causing UTI to most oral antibiotics including amoxicillin, co-trimoxazole, co-amoxiclav, and ciprofloxacin.<sup>10</sup> In the view of global increase in antimicrobial resistance and high prevalence of ESBL-producing organisms, nitrofurantoin is considered a preferred choice for

empirical treatment of UTI in pregnancy and it is recommended by multiple guidelines.<sup>10,21</sup> However, nitrofurantoin should be avoided in the late third trimester due to the risk of glucose-6-phosphate dehydrogenase induced hemolytic anemia in both mother and fetus near term.<sup>22,23</sup>

This study showed reduced subspecialty of the isolates to ciprofloxacin, which is not recommended during pregnancy due to an increased risk of congenital malformation (Food and Drug Administration risk category C). Although cotrimoxazole showed a better susceptibility, it is also not recommended during early pregnancy due to the risk of congenital malformation and near term due to the risk of hemolytic anemia and kernicterus.<sup>24</sup>

A significant proportion of pregnant women were not prescribed any antibiotics due to the lack of a close outpatient follow up and delayed knowledge of the results of urine cultures until the follow-up appointment. This emphasizes the importance of the close follow-up of urine culture results in pregnant women to avoid complications including UTIs. The effectiveness of anti-microbial therapy in the clearance of ASB has been reported in multiple studies. A Cochrane study that compared treatment with antibiotics to placebo or no treatment concluded a 75% reduction in the risk of pyelonephritis with treatment.<sup>25</sup>

Regarding the ASB-related complications, no significant complication was reported in the study except for one case of acute pyelonephritis and intrauterine growth restriction in another case.

## CONCLUSION

This study showed that 21.0% of pregnant women with ASB had DM or GDM as a major risk factor. *K. pneumoniae* and *E. coli* were the most frequently isolated bacteria, representing almost 61.7% of total isolates. There was a high prevalence of ESBL-producing organisms representing 10.7% of the total isolates. Based on these results, cefuroxime is an appropriate empirical antibacterial therapy for ASB and UTI in pregnant women, for which 74.1% of *K. pneumoniae* and 71.4% of *E. coli* were susceptible. Nitrofurantoin should be considered as an empirical antibiotic therapy in settings with a high prevalence of ESBL-producing organisms.

**Disclosure**

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