Baba et al. *Afr. J. Clin. Exper. Microbiol.* 2023; 24 (1): xxxx https://www.afrjcem.org

African Journal of Clinical and Experimental Microbiology. ISSN 1595-689X Jan 2023; Vol.24 No.1
AJCEM/2210. https://www.ajol.info/index.php/ajcem

Short Communication **Open Access**

Antimicrobial susceptibility of urinary bacterial isolates of pregnant women attending antenatal clinics of selected hospitals in Ilorin, Nigeria

*[1]Baba, R. T., [1]Adedayo, M. R., [1]Awe, S., and [2]Bale, M. I.

[1]Department of Microbiology, Faculty of Pure and Applied Sciences, Kwara State University, Malete, Kwara State, Nigeria
[2]Department of Microbiology, University of Ilorin Teaching Hospital, Ilorin, Nigeria
*Correspondence to: omotayo.rasheedat@gmail.com; 07065391534: 09026144501

Abstract:

Background: Urinary tract infection (UTI) in pregnancy is associated with significant morbidity for both mother and baby. This study was aimed at determining the urinary bacterial isolates and their susceptibility to selected antibiotics among pregnant women attending antenatal clinics of selected Hospitals in Ilorin, Nigeria.
Methodology: A total of 300 pregnant women between the ages of 15 and 44 years were selected by random sampling technique from antenatal clinics of three randomly selected healthcare facilities in Ilorin, Nigeria; Civil Service Hospital, Sobi Specialist Hospital and Okelele Primary Health Center, between July and October 2021. Clean-catch mid-stream specimens of voided urine were collected from each participant, cultured on Cysteine-Lactose-Electrolyte Deficient (CLED) and Blood agar plates, and incubated aerobically at 37°C for 24 hours. The presence of significant bacteriuria ($\geq 10^5$ CFU/ml) was determined on the culture plate using the plate count method. Antibiotic susceptibility testing to selected antibiotics was done using Kirby-Bauer disk diffusion technique. Cefoxitin (30μg) was used as surrogate to determine phenotypic methicillin resistance in staphylococcus isolates, and the methicillin resistance (*mec*A) gene was detected by conventional PCR assay.
Results: Of the 300 pregnant participants, 49 (16.3%) were symptomatic for UTI while 251 (83.7%) were asymptomatic. Significant bacteria (monomicrobial) were isolated in 44 (14.7%) pregnant women; 28 (11.2%) of 251 asymptomatic and 16 (32.6%) of 49 symptomatic women, which showed that significant bacteriuria rate was higher with symptomatic than asymptomatic women (OR=3.861, 95% CI=1.889–7.893, p=0.0005), but significant bacteriuria rate did not differ with respect to age group of the women (x^2=1.463, p=0.4811). The most common bacterial isolates were *Escherichia coli* (38.6%, 17/44) followed by coagulase negative staphylococci (CoNS) (22.5%, 9/44), *Klebsiella pneumoniae* (18.2%, 8/44), *Staphylococcus aureus* (15.9%, 7/44), *Enterococcus* sp (4.6%, 2/44) and *Pseudomonas* sp (2.3%, 1/44). Gram negative isolates showed high resistance rate of 73.1% to ampicillin and 65.4% to amoxicillin-clavulanic acid while Gram-positive isolates showed high resistant rate of 94.1% to penicillin. The Gram-positive isolates showed high susceptibility rate of 100% while the Gram-negative isolates showed moderate susceptibility of 69.2% to nitrofurantoin. Four of the 9 (44.4%) CoNS isolates were cefoxitin resistant and all the 4 (100%) carried *mec*A gene.
Conclusion: The isolation of bacterial pathogens resistant to the commonly prescribed antibiotics from pregnant women symptomatic and asymptomatic for UTI calls for early screening of all pregnant women for UTI during antenatal care service delivery.

Keywords: UTI; pregnancy; bacteria; antimicrobial susceptibility; antimicrobial resistance

Received Aug 2, 2022; Revised Dec 21, 2022; Accepted Dec 22, 2022

Sensibilité aux antimicrobiens des isolats bactériens urinaires de femmes enceintes fréquentant des cliniques prénatales d'hôpitaux sélectionnés à Ilorin, au Nigeria

*[1]Baba, R. T., [1]Adedayo, M. R., [1]Awe, S., et [2]Bale, M. I.

[1]Département de Microbiologie, Faculté des Sciences Pures et Appliquées, Université d'État de Kwara, Malete, État de Kwara, Nigéria
[2]Département de Microbiologie, Hôpital Universitaire de l'Université d'Ilorin, Ilorin, Nigeria
*Correspondance à: omotayo.rasheedat@gmail.com; 07065391534; 09026144501

Résumé:

Contexte: L'infection des voies urinaires (IVU) pendant la grossesse est associée à une morbidité importante pour la mère et le bébé. Cette étude visait à déterminer les isolats bactériens urinaires et leur sensibilité aux antibiotiques sélectionnés chez les femmes enceintes fréquentant les cliniques prénatales des hôpitaux sélectionnés à Ilorin, au Nigeria.
Méthodologie: Un total de 300 femmes enceintes âgées de 15 à 44 ans ont été sélectionnées par une technique d'échantillonnage aléatoire dans les cliniques prénatales de trois établissements de santé sélectionnés au hasard à Ilorin, au Nigeria; Hôpital de la fonction publique, hôpital spécialisé de Sobi et centre de santé primaire d'Okelele, entre juillet et octobre 2021. Des échantillons d'urine mictionnelle à mi-parcours ont été prélevés sur chaque participant, cultivés sur des plaques de cystéine-lactose-électrolyte déficientes (CLED) et de gélose au sang, et incubé en aérobiose à 37°C pendant 24 heures. La présence d'une bactériurie significative (≥105 UFC/ml) a été déterminée sur la plaque de culture en utilisant la méthode de comptage sur plaque. Les tests de sensibilité aux antibiotiques sélectionnés ont été effectués à l'aide de la technique de diffusion sur disque de Kirby-Bauer. La céfoxitine (30μg) a été utilisée comme substitut pour déterminer la résistance phénotypique à la méthicilline dans les isolats de staphylocoques, et le gène de résistance à la méthicilline (*mec*A) a été détecté par un test PCR conventionnel.
Résultats: Sur les 300 participantes enceintes, 49 (16,3%) étaient symptomatiques d'infections urinaires tandis que 251 (83,7%) étaient asymptomatiques. Des bactéries significatives (monomicrobiennes) ont été isolées chez 44 (14,7%) femmes enceintes; 28 (11,2%) des 251 femmes asymptomatiques et 16 (32,6%) des 49 femmes symptomatiques, ce qui a montré que le taux de bactériurie significative était plus élevé chez les femmes symptomatiques que chez les femmes asymptomatiques (OR=3,861, IC 95%=1,889–7,893, p=0,00050, mais le taux significatif de bactériurie ne différait pas selon le groupe d'âge des femmes (x^2=1,463, p=0,4811). Les isolats bactériens les plus courants étaient *Escherichia coli* (38,6%, 17/44) suivi du staphylocoque coagulase négatif (CoNS) (22,5%, 9/44), *Klebsiella pneumoniae* (18,2%, 8/44), *Staphylococcus aureus* (15,9%, 7/44), *Enterococcus* sp (4,6%, 2/44) et *Pseudomonas* sp (2,3%, 1/44). Les isolats à Gram négatif ont montré un taux de résistance élevé de 73,1% à l'ampicilline et de 65,4% à l'amoxicilline-acide clavulanique, tandis que les isolats à Gram positif ont montré un taux de résistance élevé de 94,1% à la pénicilline. Les isolats à Gram positif ont montré un taux de sensibilité élevé de 100%, tandis que Les isolats à Gram négatif ont montré une sensibilité modérée de 69,2% à la nitrofurantoïne. Quatre des 9 (44,4%) isolats de CoNS étaient cefoxitin résistants et tous les 4 (100%) portaient le gène *mec*A.
Conclusion: L'isolement des pathogènes bactériens résistants aux antibiotiques couramment prescrits chez les femmes enceintes symptomatiques et asymptomatiques pour les infections urinaires nécessite un dépistage précoce des infections urinaires chez toutes les femmes enceintes lors de la prestation des services de soins prénatals.

Mots clés: UTI; grossesse; bactéries; sensibilité aux antimicrobiens; résistance antimicrobienne

Introduction:

Urinary tract infection (UTI) is an infection caused by the growth and multiplication of microorganisms in the urinary tract. It is usually due to bacteria from the gastrointestinal tracts which ascend the urethra and multiply to cause infection (1). In contrast to men, women are more susceptible to UTI, and this is mainly due to the short urethra, absence of prostatic secretion, pregnancy and easy contamination of the urinary tract with faecal flora (2,3). Urinary tract infection in pregnancy is associated with significant morbidity for both mother and baby. The combination of mechanical, hormonal and physiologic changes during pregnancy contributes to significant changes in the urinary tract, which has a profound impact on the acquisition and natural history of bacteriuria during pregnancy (4).

In women, UTI account for about 25% of all infections thus being one of the most frequent clinical bacterial infections (5). Its occurrence usually starts in 6 weeks and becomes most frequent during the 22 weeks of pregnancy. Untreated UTI in pregnant women may have serious consequences like intrauterine growth restriction, preeclampsia, caesarean delivery and preterm deliveries (6,7). UTI can be either symptomatic or asymptomatic. Patients with significant bacteriuria who have symptoms referable to the urinary tract are said to have symptomatic bacteriuria (8,9). Asymptomatic bacteriuria (ASB) is a condition characterized by the presence of bacteria in two consecutive clear-voided urine specimens both yielding positive cultures (≥10^5 CFU/ml) of the same uropathogen in a patient without classical symptoms (10).

Escherichia coli is the major etiological agent causing UTI, which accounts for up to 90% of cases. *Proteus mirabilis, Klebsiella* sp. *Pseudomonas aeruginosa* and *Enterobacte*r sp. are less frequent offenders (11,12) and less co-

mmonly, Enterococci, *Gardnerella vaginalis* and *Ureaplasma urealyticum* are also known agents in UTI. Gram-positive organisms are even less common in which Group B *Streptococcus*, *Staphylococcus aureus,* coagulase negative staphy lococci and *Staphylococcus haemolyticus* are recognized organisms (13).

The current management of UTI is usually empirical without the use of urine culture or susceptibility testing to guide therapy. However, as with many community-acquired infections, antimicrobial resistance among the pathogens that cause UTI is increasing and is a major health challenge in the treatment of UTI (14). There is growing concern regarding antimicrobial resistance worldwide (15). Proper investigation and prompt treatment are needed to prevent serious life-threatening conditions and morbidity due to UTI that can occur in pregnant women (16). In most developing countries including Nigeria, screening for UTI in pregnancy is not considered as an essential part of antenatal care. Therefore, this study was designed to determine the urinary bacterial profile and antibiotic susceptibility of bacterial uropathogens among pregnant women attending antenatal clinics of selected hospitals in Ilorin, Kwara State, Nigeria.

Materials and method:

Study setting and selection:

The study was conducted at three different hospitals in Ilorin, Kwara State, Nigeria. These were Civil Service Clinic, Sobi Specialist Hospital and Okelele Primary Health Center.

Ethical approval

Ethical clearance was obtained from the Ministry of Health and informed consent was obtained from eligible pregnant women.

Study population, sample size and selection:

The study population were pregnant women attending the antenatal clinics of the three selected healthcare facilities. The sample size of 300 pregnant women for the study was calculated using the Cochran formula, $n = Z^2 P (1-P)/d^2$ (17). Pregnant women within the age range of 15-44 years were selected using random sampling method between July and October 2021 until the sample size of 300 was attained.

The inclusion criteria were pregnant women symptomatic and asymptomatic for UTI at the study sites who were not on antibiotics treatment during sample collection and who also gave informed consent to participate in the study. Pregnant women who did not give informed consent and who were on antibiotic treatment during sample collection were excluded.

Data and sample collection:

A structured questionnaire was used to collect socio-demographic and clinical data from the participants. All the pregnant women were trained on the standard procedure of collecting clean catch mid-stream voided urine into sterile universal bottle. The urine samples were then transported in an ice-pack to the microbiology laboratory of the University of Ilorin Teaching Hospital for analysis.

Culture isolation and bacterial identification:

A calibrated wire loop (0.001ml) was used to inoculate urine sample on CLED and Blood agar plate and the plates were incubated at 37^{o}C for 24 hrs. Colony counts were carried out on culture plates and those with colony count of $\geq 10^5$ CFU/ml were considered significant. The method employed in the identification and characterization of isolated bacteria included examination of morphological features of the colonies on the agar plates and convectional biochemical tests (18).

Antibiotic susceptibility test:

The Kirby–Bauer disk diffusion method was used to determine the antibiotic susceptibility of the isolates using selected antibiotic discs (Oxoid, UK). A colony each was inoculated into normal saline and the inoculum was standardized by comparing with 0.5 McFarland turbidity standard that gives bacterial concentration of approximately $1.5x10^8$ colony forming units per ml (CFU/ml). About 0.1ml of the inoculum was dropped and spread on Mueller-Hinton agar plate using sterile swab stick. Six antibiotic discs per plate were placed 60^0 apart on the plate. After 24 hours incubation at 37°C, the diameter of the inhibitory zone surrounding the discs was measured.

The interpretation of isolate as susceptible or resistant was done using the interpretative standards of the Clinical and Laboratory Standards Institute (19). Antibiotics discs used were penicillin (5µg), ampicillin (10µg), amoxicillin-clavulanic acid (30µg), cefuroxime (30 µg), ceftazidime (30µg), ceftriaxone (30µg), nitrofurantoin (300µg) and clindamycin (5µg). *Staphylococcus aureus* (ATCC 25923) and *Escherichia coli* (ATCC 25922) were used as control strains. Methicillin resistance in coagulase negative staphylococcus (CoNS) isolates was determined using cefoxitin disc (as surrogate) on Mueller-Hinton agar plate and those resistant to cefoxitin were screened for *mecA* gene by conventional polymerase chain reaction.

Statistical analysis of data:

Data were presented as simple frequency distribution tables and analysed using the GraphPad software (San Diego 92130, USA). Association between categorical variables was determined using Chi-squared test with Odds ratio (OR) and 95% confidence interval (95% CI). P value less than 0.05 was considered as statistical significance.

Results:

In this study, a total of 300 pregnant women, 49 (16.3%) with symptoms and 251 (83.7%) without symptoms of UTI were investigated. The age range of the participants was 15-44 years (mean age 26.7±4.7 years). Majority 175 (58.3%) of the study participants were in the age range of 25-34 years. Among the participants, 188 (62.6%) were self-employed (Table 1). The distribution of bacteriuria based on age group of participants showed that 13 (12.7%) of 102 women in age group 15-24 years were positive for bacteriuria, 29 of 175 women (16.6%) in age group 25-34 and 2 of 23 (8.7%) in age group 35-44 years were positive for significant bacteriuria (X^2=1.463, p= 0.4811) (Table 2).

Six bacteria species were isolated from the urine samples of 44 (14.7%) of the 300 pregnant women who had significant growth (>10^5 CFU/ml) of bacteria in their urine with 28 (11.2%) isolates from 251 asymptomatic and 16 (32.7%) isolates from 49 symptomatic women (OR = 3.861, 95% CI 1.889 - 7.893, p = 0.0005). The predominantly isolated bacteria were *Escherichia coli* 17 (5.7%) followed by coagulase negative staphylococcus 9 (3.0%), *Klebsiella pneumoniae* 8 (2.7%)*, Staphylococcus aureus* 7 (2.3%), *Enterococcus* species 2 (0.7%) and *Pseudomonas* species 1 (0.3%) (Table 3).

The majority of isolated Gram-negative uropathogens showed resistance rate of 73.1% (19/26) to ampicillin and 65.4% (17/26) to amoxicillin-clavulanic acid, and resistance rate to ceftriaxone, cefotaxime and cefuroxime ranged from 30.8% (8/26) to 46.2% (12/26). However, all Gram-negative bacteria isolates showed a relatively low rates of resistance to nitrofurantoin 15.4% (4/26) and ceftazidime 26.9% (7/26) (Table 4).

Table 1: Sociodemographic and clinical characteristics of the study participants

Socio-demographic variables	Frequency (%)
Age group (years)	
15- 24	102 (34.0)
25- 34	175 (58.3)
35- 44	23 (7.7)
Educational level	
Not educated	17 (5.7)
Primary	32 (10.7)
Secondary	145 (48.3)
Post-secondary	106 (35.3)
Occupational status	
Housewives	23 (7.7)
Self employed	188 (62.6)
Student	14 (4.7)
Employed	75 (25.0)
Symptoms of UTI	
Symptomatic	49 (16.3)
Asymptomatic	251 (83.7)

The Gram-positive uropathogens showed a high level of resistance of 94.1% (16/18) to penicillin. The resistance rate to ceftriaxone and amoxicillin-clavulanic acid ranged from 29.4% (5/18) to 47.1% (8/18). On the other hand, all Gram-positive isolates showed full susceptibility (100.0%) to nitrofurantoin. Moreover, 76.5% (13/18) and 58.8% (10/18) of the Gram-positive isolates were susceptible to clindamycin and amoxicillin-clavulanic acid respectively (Table 5).

Of the 9 CoNS isolates phenotypically screened for methicillin resistance by cefoxitin disc, 4 (44.4%) were resistant and all the 4 isolates (100%) carried *mec*A gene on PCR assay (Fig 1)

Table 2: Prevalence of significant bacteriuria in relation to age group of participants

Age group (years)	No of participants	No with significant bacteriuria	x^2	p value
15 – 24	102	13 (12.7)	1.463	0.4811
25 – 34	175	29 (16.6)		
35 – 44	23	2 (8.7)		
Total	**300**	**44 (14.7)**		

Table 3: Bacterial uropathogens of urinary tract infection in pregnancy with respect to symptomatology

Bacterial isolates	Symptomatic (%) (n=49)	Asymptomatic (%) (n=251)	COR (95% CI)	p value
Gram negative (n=26)	**9 (18.4)**	**17 (6.7)**	**3.097 (1.291 -7.429)**	**0.0215***
Escherichia coli	6 (12.2)	11 (4.4)		
Klebsiella pneumoniae	2 (4.1)	6 (2.4)		
Pseudomonas sp	1 (2.0)	0		
Gram-positive (n=18)	**7 (14.3)**	**11 (4.4)**	**3.636 (1.334 – 9.914)**	**0.0154***
Staphylococcus aureus	3 (6.1)	4 (1.6)		
CoNS	2 (4.1)	7 (2.8)		
Enterococcus sp	2 (4.1)	0		
Total (n=44)	**16 (32.7)**	**28 (11.2)**	**3.861 (1.889 – 7.893)**	**0.0005***

CoNS=coagulase negative staphylococcus; COR=crude ood ratio; CI=confidence interval n=number

Table 4: *Invitro* antibiotic susceptibility of Gram-negative urinary bacterial isolates from pregnant women to selected antibiotics

Isolate/Antibiotic		AMP	AUG	CXM	CRO	CTX	CAZ	NF
Escherichia coli (n=17)	S	1 (5.9)	3 (17.6)	3 (17.6)	9 (52.9)	6 (35.3)	8 (47.1)	13 (76.5)
	I	1 (5.9)	2 (11.8)	4 (23.5)	2 (11.8)	4 (23.5)	4 (23.5)	1 (5.9)
	R	15 (88.2)	12 (70.6)	10 (58.8)	6 (35.3)	7 (41.2)	5 (29.4)	3 (17.6)
Klebsiella pneumoniae	S	3 (37.5)	1 (12.5)	4 (50.0)	5 (62.5)	3 (37.5)	5 (62.5)	5 (62.5)
(n=8)	I	2 (25.0)	3 (37.5)	3 (37.5)	2 (25.0)	2 (25.0)	1 (12.5)	3 (37.5)
	R	3 (37.5)	4 (50.0)	1 (12.5)	1 (12.5)	3 (37.5)	2 (25.0)	0
Pseudomonas spp (n=1)	S	0	0	0	0	1 (100)	1 (100)	0
	R	1 (100)	1 (100)	1 (100)	1 (100)	0	0	1 (100)
Total (n=26)	S	4 (15.4)	4 (15.4)	7 (26.9)	14 (53.8)	10 (38.5)	14 (53.8)	18 (69.2)
	I	5 (19.2)	5 (19.2)	7 (26.9)	4 (15.4)	6 (23.1)	5 (19.2)	4 (15.4)
	R	19 (73.1)	17 (65.4)	12 (46.2)	8 (30.8)	10 (38.5)	7 (26.9)	4 (15.4)

AMP= Ampicillin; AUG= Amoxicillin-clavulanic acid; CXM = Cefuroxime; CRO = Ceftriaxone; CTX= Cefotaxime; CAZ= Ceftazidime; NF= Nitrofurantoin, R= Resistant; I= Intermediate; S= Sensitive.

Table 4: *Invitro* antibiotic susceptibility of Gram-positive urinary bacterial isolates from pregnant women to selected antibiotics

Isolate/Antibiotic		PEN	AUG	CRO	CL	NF
Staphylococcus aureus (n=7)	S	0	4 (66.7)	1 (16.7)	4 (66.7)	6 (100)
	I	0	0	0	1	0
	R	6 (100)	2 (33.3)	5 (83.3)	1 (16.7)	0
Coagulase negative staphylococcus (n=8)	S	0	4 (44.4)	4 (44.4)	7 (77.8)	9 (100)
	I	0	2 (22.2)	2 (22.2)	1 (11.1)	0
	R	9 (100)	3 (33.3)	3 (33.3)	1 (11.1)	0
Enterococcus spp (n=2)	S	1 (50.0)	2 (100)	2 (100)	2 (100)	2 (100)
	R	1 (50.0)	0	0	0	0
Total (n=17)	S	1 (5.9)	10 (58.8)	7 (41.1)	13 (76.5)	17 (100)
	I	0	2 (11.8)	2 (11.8)	2 (11.8)	0
	R	16 (94.1)	5 (29.4)	8 (47.1)	2 (11.8)	0

CoNS=coagulase negative staphylococcus; PEN=penicillin; AUG=amoxicillin-clavulanic acid; CRO= ceftriaxone; CL=clindamycin; NF=nitrofurantoin; R= resistant, I= intermediate, S=sensitive.

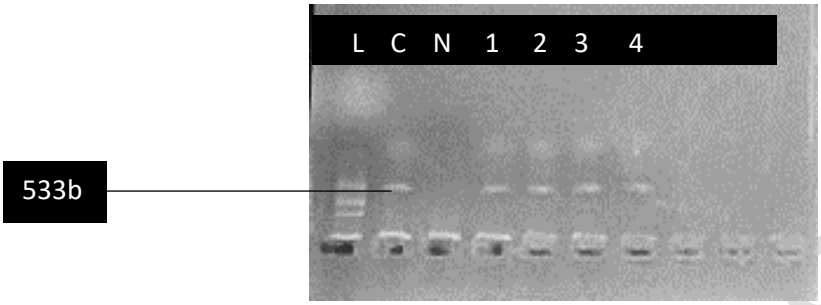

Fig 1: Gel electrophoresis showing amplified *mec*A gene product (533bp) in four CoNS isolates

Discussion:

The prevalence of UTI in this study was 14.5%, which is lower compared to previous studies in Nigeria such as 27.9% reported in Ilorin (20), 43.3% in Abuja (21), 26% in Kaduna (22), 61.5% in Aba (23) and 15.8% in Kano (24). However, the prevalence is higher than 10.3% reported in Plateau State (25) and 10.6% in Enugu (26). Prevalent rates of 6.1% to 10.9% have been reported in Iran (27) while Obirikorang et al., (28) reported 7.3% prevalence in Ghana. These wide differences in prevalence rates may be due to differences in the study population and geographic locations. The highest prevalence of the bacteriuria was seen among the pregnant women in age group 25-34 years (16.6%), which is similar to the finding of Banda et al., (29) who reported highest rate of significant bacteriuria in the age group of 24-28 years, but contrast the studies of Turpin et al., (30) and Amadi et al., (31), who reported higher prevalence rate in pregnant women aged 35 to 39 years. In our study, age group 25-34 years with the highest prevalence of significant bacteriuria is sexually active age group and therefore are at higher risk of developing urinary tract infection.

In this study, a total of 44 isolates were obtained from the 44 pregnant women with significant bacteriuria, with only one bacterial specie isolated from each woman indicating the mono-microbial nature of significant bacteriuria and UTI in the study population. The most frequent urinary bacterial isolate in symptomatic and asymptomatic pregnant women was *E. coli*, responsible for 38.6% (17/44) of the isolates and 5.7% (17/300) of the women. This was followed by CoNS (22.7%), *K. pneumoniae* (18.2%), *S. aureus* (13.6%) and *P. aeruginosa* (2.3%). This finding is similar to other studies which reported that Gram-negative bacteria, particularly *E. coli,* as the commonest pathogens isolated in patients with UTI (32). In a similar study by Kelkewa et al., (33), the commonest isolates were also *E. coli* followed by *S. aureus.* Similar pattern was also reported by Beleta et al., (34) but this was contrary to this present study in which CoNS was the next frequently isolated pathogen (22.7%). The frequency of 18.2% for *K. pneumoniae* in our study shows that *Klebsiella* species are gaining more prominence as aetiological agents of bacteriuria and UTI than previously reported (7).

The majority of isolated Gram-negative uropathogens in this study showed high resistance to ampicillin and amoxicillin-clavulanic acid (augmentin) and moderate resistance to ceftriaxone, cefotaxime and cefuroxime. This is similar to the study of Balakrishnan et al., (35) who reported that Gram-negative isolates were highly resistant to augmentin and ceftriaxone. However, all Gram-negative bacteria isolate were highly susceptible to nitrofurantoin, consistent with the study of Yeva et al., (36) where most of the isolates were sensitive to nitrofurantoin. Also, the Gram-positive isolates were fully susceptible (100.0%) to nitrofurantoin, similar to the study of Mona et al., (37), which reported that Gram-positive bacteria were highly susceptible to nitrofurantoin. However, the Gram-positive uropathogens showed a high level of resistance for penicillin, as similarly reported by Rosana et al., (38). Indiscriminate use of antibiotics, irrational prescribing and unregulated use of antibiotics in animal husbandry may be responsible for this increasing antibiotic resistance (39).

The CoNS isolates were the most frequent Gram-positive bacteria in this study which formed 9 (20.5%) out of the total 44 bacterial isolates, 4 (44.4%) of which were resistant to cefoxitin, a surrogate marker of methicillin resistance. This rate is lower than the study of May et al., (40) who reported 66.7% of their 12 CoNS to be resistant to cefoxitin. All the 4 (100) cefoxitin resistant CoNS carried *mec*A

gene on PCR assay, similar to the study of Manon et al., (41) in which 93% of cefoxitin-resistant CoNS carried *mec*A gene, but contrast the findings of Bale et al., (42) in which only 75% of cefoxitin resistant CoNS carried *mec*A gene. This variation could be as a result of differences in the species and strains of CoNS as well as sample size of isolates tested in the different studies.

Conclusion:

This study confirmed that after *E. coli*, CoNS were the most common bacterial isolates involved in urinary tract infection in pregnant women in the study population. The isolation of bacterial pathogens from both symptomatic and asymptomatic pregnant women that are resistant to the commonly prescribed antibiotics and the high presence of *mec*A genes in the CoNS isolates calls for early screening of all pregnant women for UTI. Early diagnosis and treatment of UTI during pregnancy can ensure the safety of the mother and fetus and also prevent complications during delivery.

Acknowledgements:

The authors acknowledged the participation of all pregnant women who enrolled in this study and all the staff of University of Ilorin Teaching Hospital Medical Microbiology department for their support.

Contribution of authors:

RT carried out the research; MR and AS supervised the microbiological analysis; and MI supervised the molecular analysis.

Source of funding:

Authors received no external funding

Conflict of interest:

No conflict of interest is declared.

References:

1. Al Mijalli, S. H. Bacterial uropathogens in urinary tract infection and antibiotic susceptibility pattern in Riyadh Hospital, Saudi Arabia. Cell Mol Med J. 2017; 1 (5): 1–6.
2. Ajayi, A. B., Nwabuisi, C., Aboyeji, A. P., Ajayi, N. S., Fowotade, A., and Fakeye, O. O. Asymptomatic bacteriuria in antenatal patients in Ilorin, Nigeria. Oman Med J. 2012; 1: 31-34.
3. Willy Fred, N., Gichuhi, J. W., and Mugo, N. W. Prevalence of urinary tract infection, microbial aetiology, and antibiotic sensitivity pattern among antenatal women presenting with lower abdominal pains at Kenyatta National Hospital, Nairobi, Kenya. Sci Technol J. 2015; 3: 6.
4. Ailes, E. C., Summer, A. D., and Delman, D. Association between antibiotics uses among pregnant women with urinary tract infections in the first trimester and birth defects. Antibiot Chemother J. 2016; 34: 112-119.
5. Ifeanyichukwu, I., Emmanuel, N., and Chika, E. Frequency and antibiogram of uropathogens isolated from urine samples of HIV infected patients on antiretroviral therapy. Am J Biosci. 2013; 1(3): 50–53.
6. Emiru, T., Beyene, G., Tsegaye, W., and Melaku, S. Associated risk factors of urinary tract infection among pregnant women at Felege Hiwot Referral Hospital, Bahir Dar, North West Ethiopia. *Biomed Res J.* 2013; 6: 292.
7. Derese, B., Kedir, H., Teklemariam, Z., Weldegebreal, F., and Balakrishnan, S. Bacterial profile of urinary tract infection and antimicrobial susceptibility pattern among pregnant women attending antenatal Clinic in Dil Chora Referral Hospital, Dire Dawa, Eastern Ethiopia. Int Med J. 2016; 12: 251–260.
8. Koffi, K. A., Aka, E. K., Apollinaire, H., Mlan-Britoh, A., and Konan, J. M. Epidemiological bacteriological profile and bacterial resistance of urinary tract infections at pregnant woman in prenatal consultation in African setting. Int J Reprod Contraceptive Obstetr Gynacol. 2020; 9: 461–470.
9. Gopalakrishnan, R., and Murthy, B. V. Bacteriological profile and antibiogram of uropathogens among antenatal cases in a Tertiary Care Hospital. Indian Microbiol Res J. 2017; 4 (3): 1–7.
10. Jayachandran, A., Gnanasambandam, U., Sangeetha, A.V., and Vijayalakshmi, T. S. Asymptomatic bacteriuria among antenatal women attending a tertiary care hospital in Kanchipuram: evaluation of screening tests and antibiotic susceptibility pattern. Int Res Med Sci J. 2016; 4 (2): 540–544.
11. Abdikhaliq, H. A., Dawit, Y. R., and Moges, D. O. Prevalence and antimicrobial susceptibility pattern of urinary tract infection among pregnant women attending Hargeisa group Hospital, Hargeisa, Somaliland. Sci Rep J. 2022; 12: 14-19.
12. Onuoha, S. C., and Fatokun, K. Prevalence and antimicrobial susceptibility pattern of urinary tract infection (UTI) among pregnant women in Afikpo, Ebonyi State, Nigeria. Am J Life Sci. 2014; 2 (2): 46–52.
13. Uddin, M., and Khan, T. Prevalence of urinary tract infection among pregnant women at Ibrahim Iqbal memorial hospital, Chandanaish, Bangladesh. Am J Clin Med Res. 2016; 4 (3): 47–51.
14. Kolawole, A. S., Kolawole, O. M., Kandaki-Olukemi, Y. T., Babatunde, S. K., Durowade, K. A., and Kolawole, C. F. Prevalence of UTI among patients attending Dalhatu Araf Specialist Hospital, Lafia, Nasarawa State, Nigeria. Int J Med Sci. 2009; 1: 163–167.
15. Balachandran, L. K., Jacob, L. N., Al Awadhi, R. M. Urinary tract infection in pregnancy and its effects on maternal and perinatal outcome. National Center for Biotechnol Information J. 2022; 1: 135-141.
16. Ali, M. A., Majed, S. A., and Saad, A. A. Prevalence of urinary tract infection and antibiotic resistance pattern in pregnant women, Najran region, Saudi Arabia. Microbiol Res J. 2019; 13 (26): 407–413.
17. Conchran, W. G. Sampling Techniques, 2nd Ed., New York: John Wiley and Sons. Inc, 1963.
18. Cheesbrough, M. District laboratory practice in tropical countries. Second edition. Cambridge University Press. 2006; 62–143.

19. Clinical and Laboratory Standards Institute (CLSI). Performance Standards for Antimicrobial Susceptibility Testing. 27th edition. CLSI supplement M100 Wayne, PA: Clinical and Laboratory Standards Institute. 2017.
20. Rosana, Y. Comparison of microbial pattern causing urinary tract infection in female out and hospitalized patients in Jakarta. Microbiol Indonesia J. 2016; 10 (1): 30–37.
21. Yunusa, K. S. and Hadijat, O. S. Urinary tract infections in symptomatic pregnant women attending University of Abuja teaching Hospital, Gwagwalada, Nigeria. J Med. 2021; 9: 6 – 10.
22. Muhammed, M. Urinary Tract Infections amongst pregnant women attending a medical Centre in Kaduna, Nigeria. Afr J Microbiol. 2014; 16 (1): 7-11.
23. Ezeigbo1, O. R., Nnadozie, R. I., Asuoha, N. S., Ojiako, V. U., Awurum, I. N., and M. G. Ugochukwu. Incidence of Urinary Tract Infection (UTI) among Pregnant Women attending antenatal clinics at some selected Hospitals in Aba, Southeastern Nigeria. Int J Curr Microbiol. 2016; 5: 193-195.
24. Muhammad, A., Muhammad, S. A., and Ezugwu, I. A. Prevalence of Urinary Tract Infection among Pregnant Women in Kano, Northern Nigeria. Archives of Reproductive Medicine and Sexual Health. J Biosci Med. 2019; 2: 23-29.
25. Oko, J. O., Abriba, C., Umar, M., Asitok, A. D., Audu, J. A., Jakheng, S. P., and Ojeleye, F. S. Antibiotics Susceptibility Study of Uropathogens Isolated from Asymptomatic Pregnant Women Attending a Tertiary Maternity Clinic in Northern Nigeria. J Med Sci. 2017; 2: 34-35.
26. Ojide, C. K., Wagbatsoma, V. A., Kalu, E. I., and Nwadike, V. U. Asymptomatic bacteriuria among antenatal care women in a tertiary hospital in Benin, Nigeria. Nig J Clin Biosci. 2014; 2: 79-85.
27. Emiru, T., Beyene, G., Tsegaye, W., and Melaku, S. Associated risk factors of urinary tract infection among pregnant women at Felege Hiwot Referral Hospital, Bahir Dar, North West Ethiopia. Bio Res J. 2013; 6: 292.
28. Obirikorang, C., Quaye, L., Bio, F. Y., Amidu, N., Acheampong, I., and Addo, K. Asymptomatic bacteriuria among pregnant women attending antenatal clinic at the university Hospital, Kumasi, Ghana. J Med Biomed Sci. 2012; 1 (1): 38–44.
29. Banda, J. M., Cletus, D., Zakka, S. A., John, B., Mohammed, S. S., and Damen, J. G. Prevalence of asymptomatic bacteriuria among pregnant women attending antenatal clinic at plateau state specialist Hospital Jos, Nigeria. Microbiol Immunol J. 2020; 4 (3): 121–130.
30. Turpin, C. A., Minkah, B., Danso, K. A., and Frimpong, E. H. Asymptomatic Bacteriuria in pregnant women attending antenatal clinic at Komfo Anokye teaching hospital, Kumasi, Ghana. Ghana Med J. 2007; 41: 26–29.
31. Amadi E. S., Enemuo O. B., and Uneke C. J. Asymptomatic bacteriuria among pregnant women in Abakaliki, Ebonyi State, Nigeria. J Med Sci. 2007; 7: 698-700.
32. Flores-Meireles, A., Walker, J., Caparon, M., and Hultgren, S. Urinary tract infections epidemiology, mechanisms of infection and treatment options. Int Microbiol J. 2015; 13: 269–284.
33. Kekelwa, I. Y., Charles, M. H., and Choolwe, J. Antimicrobial Resistance among Pregnant Women with Urinary Tract Infections attending Antenatal Clinic at Levy Mwanase University Teaching Hospital, Lasaka, Zambia. Int J Microbiol. 2021; 1: 9.
34. Belete, M. A. Bacterial profile and ESBL screening of urinary tract infection among asymptomatic and symptomatic pregnant women attending antenatal care of northeastern Ethiopia region. Infec Drug Res J. 2020; 13: 257.
35. Balakrishnan, J. P. Bacterial profile of urinary tract infection and antimicrobial susceptibility pattern among pregnant women attending Antenatal Clinic in Dil Chora Referral Hospital, Dire Dawa, Eastern Ethiopia. Therap Clin Risk Manag J. 2016; 12: 251–260.
36. Yeva, R. O., Dwiana, O. C., Melissa, H., et al. Urinary tract infections among Indonesian pregnant women and its Susceptibility patterns. Int Med J. 2020; 4: 10-12.
37. Mona, A. D., Mahmoud, Amel, D., Safaa, A. H., Azza, A.A., and El Hamed. Urinary tract infection among pregnant women. Egyptian Nursing J. 2020; 10: 7-20.
38. Rosana, Y. Comparison of microbial pattern causing urinary tract infection in female out and hospitalized patients in Jakarta. Microbiol Indonesia J. 2016; 10 (1): 30–37.
39. Vasudevan, R. Urinary tract infection: an overview of the infection and the associated risk factors. Microbiol J. 2014; 1 (2): 42–54.
40. May. L., Klein. E. Y., Rothman, R. E., and Laxminarayan, R. Trends in Antibiotic resistance in coagulase negative *staphylococci* in the United States, 1999 to 2012. Antimicrob Agents Chemother J. 2014; 58 (3): 1404-1409.
41. Manon, C. W., Samuel, R. D., and Sarah, K. P. Reliability of *mec*A in predicting phenotypic and susceptibility of Coagulase negative Staphylococcus and *Staphylococcus aureus.* Open Forum Infect Dis J. 2020; 5: 193-199.
42. Bale, M. I., Babatunde, S. K., and Awe, S. Prevalence of Methicillin Resistant *Staphylococcus aureus* bacteriuria among pregnant women attending secondary health Hospital in Ilorin, Nigeria. J Adv Microbiol. 2021; 21 (9): 50-57.