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Article

A Multicenter Study on the Antimicrobial Resistance Pattern of Bacterial Uropathogens in Pregnant Women in Gambia

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Abstract: Background / Objectives: Urinary tract infections (UTIs) can predispose women to preeclampsia and prematurity, which are common causes of maternal and neonatal morbidity and mortality. In low–middle income countries (LMICs), the capacity for screening and treating UTIs is limited. In sub-Saharan Africa, AMR surveillance data are scarce, especially in vulnerable populations such as pregnant women. The aim of this study was to determine the prevalence and antimicrobial resistance patterns of community-acquired urinary tract infections among pregnant women attending the antenatal clinics of three hospitals in Gambia. Methods: This was a hospital-based, cross-sectional multicenter study conducted between November 2022 and January 2023. Patient information was obtained via a pretested questionnaire. The urine samples were analyzed via Gram staining and biochemical tests to determine the causative organisms. We also used antibiotic sensitivity testing to identify resistance patterns. The data collected were analyzed via SPSS version 20 and tested for associations at a significance level of $p \leq 0.05$. Results: The prevalence of significant bacteriuria was 5% (n=100). *Escherichia coli* (40%) and *Staphylococcus aureus* (40%) were the most common uropathogens. The prevalence of resistance was found for trimethoprim/sulfamethoxazole and ampicillin, and multidrug resistance was detected in only one isolate (*Citrobacter freundii*). Conclusion: This study revealed bacterial isolates with prevalent resistance to commonly prescribed drugs for community-acquired UTIs in pregnant women and suggested alternatives such as ceftriaxone, nitrofurantoin, erythromycin and nalidixic acid as empirical treatment options. We recommend consistent health to combat drug resistance caused by inappropriate antibiotic use.

Keywords: antimicrobial resistance; multicenter study; Gambia; urinary tract infections; pregnant women; bacterial uropathogens

1. Introduction

Urinary tract infections (UTIs) are among the most severe and frequent human infections that can be acquired in both communities and hospitals [1]. High recurrence of infection occurs, and treatment with antimicrobials increases the risk of selection for resistance. Using 27 studies and a total population of 30,641 individuals, a systematic review and meta-analysis of the incidence of UTIs during pregnancy worldwide was performed, and the prevalence rate of UTIs during pregnancy was 23.9% [2]. The emergence and global spread of multidrug resistance is also a growing concern due to the shortage of alternative antibiotics, especially in sub-Saharan Africa, where 27.3 deaths per 100,000

people occurred in 2019 [3]. The increased global increase in resistance warrants local surveillance. It results in more than 150 million cases each year worldwide, and up to 6 billion dollars are spent annually to mitigate the effects of the disease worldwide [1,4].

Approximately half of all women will experience a UTI at least once in their life, whereas a quarter will experience it more than once [5]. It is even more common in pregnant women because of pregnancy-related changes such as decreased immunity, difficulty with hygiene from a gravid abdomen, increased glucose levels in the urine and increased urine stasis in the tract [6]. Poor socioeconomic status and diabetes mellitus are additional risk factors [7,8].

There are natural, semisynthetic, and synthetic agents with unique mechanisms that can significantly alter metabolic and physiological levels. These agents include β -lactams and glycopeptides, which modify the synthesis of cell walls; macrolides and tetracyclines, which inhibit protein synthesis; sulfonamides, which inhibit metabolic pathways; and fluoroquinolones, which interfere with DNA replication and translation [9].

The majority of community-acquired UTIs during pregnancy are asymptomatic, but studies have shown that they can lead to low birth weight, preterm labor and prematurity, preeclampsia and abortion [10,11]. UTIs are diagnosed on the basis of clinical features and diagnostic tests such as urinalysis (to look for bacteria in the urine) and a urine dipstick (to check for nitrites and leukocyte esterase). A urine culture is used to look for the growth of a pathogenic organism and is combined with antibiotic sensitivity testing to determine the antibiotics used for that specific organism [12]. Sixty to eighty percent of all UTIs in pregnancy are caused by *Escherichia coli*, while the remainder are caused by *Proteus mirabilis*, *Klebsiella pneumoniae*, coagulase-negative staphylococci and others [1]. It has also been shown that gram-negative bacteria are the primary causes of UTIs in Gambia [13,14]. It is estimated that bacterial resistance to antimicrobials (AMRs) will lead to a total global GDP loss of 100.2 trillion USD and almost 10 million deaths per year by 2050 [3,15]. Therefore, local knowledge of the burdens of disease, etiology and AMR is important for informing therapeutic decisions.

There is a paucity of community-based antimicrobial surveillance data, especially in sub-Saharan Africa, including Gambia. The prevalence of UTIs in pregnant women in Gambia has not been studied before, as routine antimicrobial susceptibility testing is rarely performed in Gambia. Therefore, the data derived from this study add to the knowledge on AMR in Gambia. Such information would be highly relevant to healthcare providers when making decisions on the treatment of urinary infections with the right antibiotics in the absence of patient-specific antimicrobial susceptibility testing [16]. It is also important to understand the trends in Gambia since AMR varies regionally. Therefore, the aim of this study was to determine the prevalence and antimicrobial resistance patterns of community-acquired urinary tract infections in pregnant women attending the antenatal clinics of three hospitals in Gambia.

2. Materials and Methods

2.1. Study Design

The study was a hospital-based cross-sectional multicenter study carried out at the outpatient antenatal clinics and microbiology laboratories of three major hospitals in the western part of Gambia. Gambia is the smallest country on the African mainland and is situated on its western coast. It has a total area of 10,689 sq km and a population of 2,785,000 (2022 est.) [17]. The hospitals include tertiary-level referral facilities, Edward Francis Small Teaching Hospital (EFSTH), Kanifing General Hospital (KGH) and Bundung Maternal and Child Health Hospital (BMCHH). All these hospitals have Obstetrics and Gynecology and Microbiology departments and run antenatal care services, with EFSTH being the nation's only teaching hospital. It was conducted from November 2022 to January 2023.

2.2. Sample Selection

Study Population and Sampling

The study population consisted of all pregnant women attending the antenatal clinics of all three hospitals. Study participants were selected via the convenience sampling technique.

Sample Size

A single population formula [18] was used to calculate the sample size via the following parameter: a 15.8% prevalence rate of UTIs in pregnant women from a study performed in Nigeria [19].

$$N = \frac{\left(z_{1-\frac{\alpha}{2}}^2 p(1-p) \right)}{d^2}, \text{ where } d=5\%, \text{ the Z score for the 95\% confidence interval}=1.96 \text{ and } p=15.8\%$$

A sample size of 204 was achieved. With a calculated dropout rate of 30%, the minimum number of participants required was 143.

Inclusion Criteria

All pregnant women who attended the antenatal clinics of the hospitals provided consent and were recruited.

Exclusion Criteria

Pregnant women who did not consent to participate in the study and those who took antibiotics two weeks prior to the study were excluded.

2.3. Data Collection Tools

All pregnant women were interviewed via a semi structured questionnaire from Derese et al. [20] was adopted and modified on the basis of the study objectives to collect sociodemographic factors and clinical data. After the interview, each participant was taught how to obtain a midstream urine sample. The samples were then sent to the Bacteriology Department for microscopy, culture and antimicrobial susceptibility testing.

2.4. Data Analysis

Microbiological Studies

The color and consistency of the freshly collected urine samples were recorded. A Combi 10 dipstick (URIT Medical Electronic Co-LTD) was used for urinalysis.

Cysteine lactose electrolyte-deficient (CLED) agar and MacConkey (MAC) agar (Oxoid Ltd., England) were used for the inoculation of urine samples via a standard calibrated loop (0.001 ml) according to the manufacturer's instructions. Streaked culture plates were incubated at 37°C for 24 hours and inspected for bacterial growth the next day, and colonies were counted manually on CLED. Urine cultures that grew $\geq 10^5$ (CFUs)/ml of urine sample consisting of one type of colony morphology were considered significant bacteriuria.

The bacteria were identified by colony morphology, Gram staining, and other indicators on their respective media and confirmed by the pattern of biochemical reactions via a standard procedure [21,22].

Antimicrobial susceptibility testing was performed via the disk diffusion method as described by Kirby-Bauer [23] on Mueller–Hinton agar (MHA) (Oxoid Ltd., England) [24] via the use of commonly prescribed antibiotics from the Clinical and Laboratory Standards Institute 2019 guidelines. Different antibiotics, including ciprofloxacin, gentamicin, ceftriaxone, nitrofurantoin, ceftazidime, cefuroxime, methicillin, trimethoprim/sulfamethoxazole, ampicillin, amoxicillin/clavulanate, nalidixic acid, tetracycline and erythromycin, are available and

recommended in the 2019 CLSI guidelines. Loopful pure cultures were taken from colonies suspended in 5 ml of sterile saline (0.85% NaCl). The turbidity of the suspension was then adjusted to an optical density of 0.5 McFarland standard. A sterile cotton swab was used to inoculate the suspension on MHA, and the plates were incubated at 37°C for 24 hours. The diameters of the zones of bacterial growth inhibition around the discs were subsequently measured to the nearest millimeter via a metallic caliper and interpreted as sensitive or resistant according to the standardized table provided by CLSI, 2019.

2.5. Statistical Analysis

The data collected were entered into Microsoft Excel 2019, and the analysis was performed with the Statistical Package for the Social Sciences (SPSS) version 20 (Chicago, IL, USA). Quantitative analysis was performed using coded categorical variables. The data were cleaned to ensure accuracy validity. The data are presented via graphs and tables. The mode, means and frequencies of continuous data were checked via descriptive statistics. The chi-square test was used to determine the statistical significance of the associated risk factors ($p \leq 0.05$).

3. Results

3.1. Description of the Participants

Overall, 112 pregnant women were recruited for this study, of which 100 samples were analyzed. The women were between the ages of 15 and 45 years, with a mean age of 28 years. Half of them (49%) had attained secondary education, and 48% were housewives. A third (31%) of them were nulligravida, while 44% of them had more than one child. The majority (67%) were in their third trimester, and only 37% of them previously had a UTI. Seven of the 100 participants were symptomatic, with dysuria present in all of them (see Table 1).

Table 1. Sociodemographic, obstetric, and clinical variables of pregnant women who attended the antenatal clinics of EFSTH, BMCHH and KGH from November 2022 to January 2023. (n=100).

VARIABLE	PARTICIPANTS (n=100)	
	Frequency	Percentage
Hospital		
KGH	52	52
BMCHH	34	34
EFSTH	14	14
Age		
Less than 20	6	6
20–24	26	26
25–29	28	28
30–34	21	21
35–39	16	16
40 and above	3	3
Residence		
Urban	100	100
Rural	0	0
Level of education		
No formal education	23	23
Primary (1-6)	11	11
Secondary (7-12)	49	49
Tertiary	17	17
Occupation		
Housewife	48	48

Student	9	9
Self employed	29	29
Employee (Government or private)	14	14
Marital status		
Single	2	2
Married	98	98
Gravidity		
Primigravida	31	31
Multigravida	69	69
Parity		
Nullipara	33	33
Primipara	23	23
Multipara	44	44
Estimated Gestational Age		
1st trimester	7	7
2nd trimester	30	30
3rd trimester	63	63
History of UTI		
Yes	37	37
No	63	63
History of catheterization	0	0
History of antibiotic use without prescription		
Yes	29	29
No	71	71
Comorbidity present		
Diabetes mellitus	1	1
HIV/AIDS	0	0
Renal disease	0	0
Others	10	10
Symptomatic		
Yes	7	7
No	93	93

3.2. Prevalence of UTIs Among Pregnant Women: Sociodemographic, Obstetric, and Clinical Factors

Five of the 100 cultured urine samples contained a significant number of bacteria, with an overall prevalence of 5%, two of which were detected in the 30–34-year-old age group (40%). Only 20% of them had tertiary educations, whereas 80% had more than one child. None of the infected patients were in their first trimester, and 80% of them were asymptomatic (see Figure 2). Furthermore, 40% of them had previously had a UTI, whereas 60% of them had not used antibiotics without a prescription before this study (see Table 2).

Table 2. Sociodemographic, obstetric, and clinical variables and culture status of pregnant women who attended the antenatal clinics of EFSTH, BMCHH and KGH from November 2022 to January 2023. (n=100).

VARIABLE	PARTICIPANTS (n=100)		CULTURE STATUS		P value (X ²)
	Frequency	Percentage	POSITIVE no (%) (n=5)	NEGATIVE no (%) (n=95)	
Hospital					0.046
KGH	52	52	0 (0)	52 (54.7)	
BMCHH	34	34	4 (80)	30 (31.6)	
EFSTH	14	14	1 (20)	13 (13.7)	0.363
Age					

Less than 20	6	6	1 (20)	5 (5.3)	
20–24	26	26	1 (20)	25 (26.3)	
25–29	28	28	1 (20)	27 (28.4)	
30–34	21	21	2 (40)	19 (20)	
35–39	16	16	0 (0)	16 (16.8)	
40 and above	3	3	0 (0)	3 (3.2)	
Residence					
Urban	97	97	5 (100)	92 (96.8)	0.687
Rural	3	3	0 (0)	3 (3.2)	
Level of education					
No formal education	23	23	2 (40)	21 (22.1)	0.716
Primary (1-6)	11	11	0 (0)	11 (11.6)	
Secondary (7-12)	49	49	2 (40)	47 (49.5)	
Tertiary	17	17	1 (20)	16 (16.8)	
Occupation					
Housewife					
Student	48	48	4 (80)	44 (46.3)	0.437
Self employed	9	9	0 (0)	9 (9.5)	
Employee	29	29	1 (10)	28 (29.5)	
(Government or private)	14	14	0 (0)	14 (14.7)	
Marital status					
Single	2	2	0 (0)	2 (2.1)	0.743
Married	98	98	5 (100)	93 (97.9)	
Gravidity					
Primigravida	31	31	1 (20)	30 (31.6)	0.687
Multigravida	69	69	4 (80)	65 (68.4)	
Parity					
Nullipara	33	33	1 (20)	32 (33.7)	0.129
Primipara	23	23	3 (60)	20 (21)	
Multipara	44	44	1 (20)	43 (45.3)	
Estimated Gestational Age					
1st trimester	7	7	0 (0)	7 (7.4)	0.303
2nd trimester	30	30	3 (60)	27 (28.4)	
3rd trimester	63	63	2 (40)	61 (64.2)	
History of UTI					
Yes	37	37	2 (40)	35 (36.8)	0.887
No	63	63	3 (60)	60 (63.2)	
History of catheterization					
	0	0	0	0	
History of antibiotic use without prescription					
Yes	29	29	2 (40)	27 (28.4)	0.841
No	71	71	3 (60)	68 (71.6)	
History of diabetes mellitus					
Yes	1	1	0 (0)	1 (1.1)	0.818
No	99	99	5 (100)	94 (98.9)	
Symptomatic					
Yes	7	7	1 (20)	6 (6.3)	0.242

No	93	93	4 (80)	89 (93.7)	
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3.3. Risk Factors for UTIs During Pregnancy

A higher prevalence was found among women aged 30–34 years, those with no formal education, those with multiple gravidas, and women in their second and third trimesters. Logistic regression analysis revealed no statistically significant associations between the presence of bacteriuria and age ($p=0.363$), level of education ($p=0.716$), gravidity ($p=0.687$), parity or gestational age. This was also observed with a history of UTI or antibiotic use without prescription (Table 2).

3.4. Bacterial Pathogens Isolated from Urine Cultures

In this study, a total of 5 bacteria were isolated from 3 different species. Only 1 out of the 5 bacteria isolated was from a symptomatic patient. There were more gram-negative bacteria (3/5, 60%), which included *Escherichia coli* and *Citrobacter freundii*, and the other two were *Staphylococcus aureus*, the only gram-positive bacteria (see Figure 1 and Table 3).

Table 3. Isolated bacterial pathogens from pregnant women who attended the antenatal clinics of EFSTH, BMCHH and KGH from November 2022 to January 2023.

BACTERIAL ISOLATES	ASYMPTOMATIC	SYMPTOMATIC	TOTAL(n=100)
<i>Escherichia coli</i>	1	1	2(40%)
<i>Staphylococcus aureus</i>	2	0	2(40%)
<i>Citrobacter freundii</i>	1	0	1(20%)
TOTAL	4	1	5(100%)

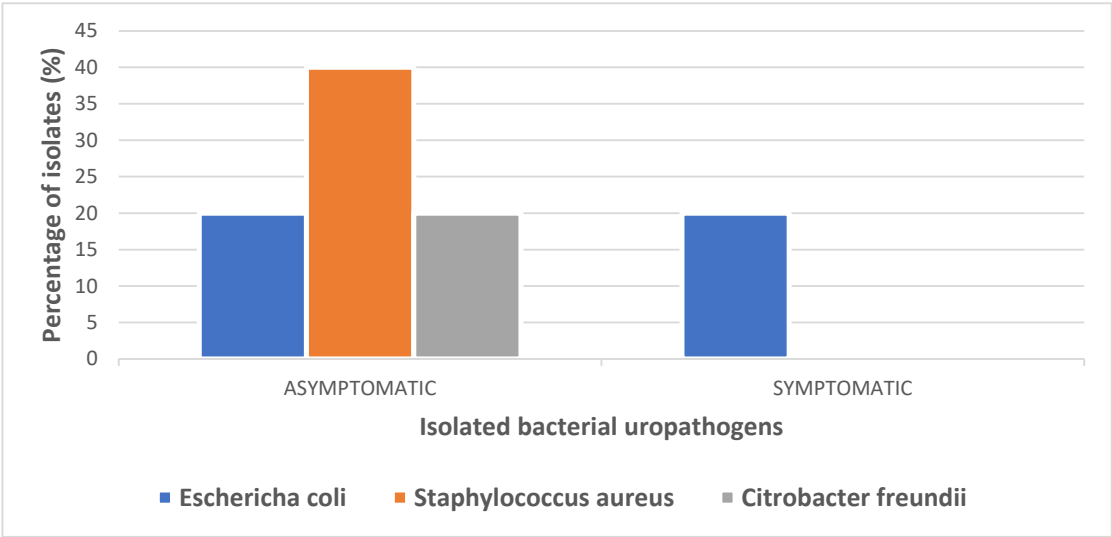


Figure 1. Isolated bacterial uropathogens from pregnant women who attended the antenatal clinics of EFSTH, BMCHH and KGH from November 2022 to January 2023.

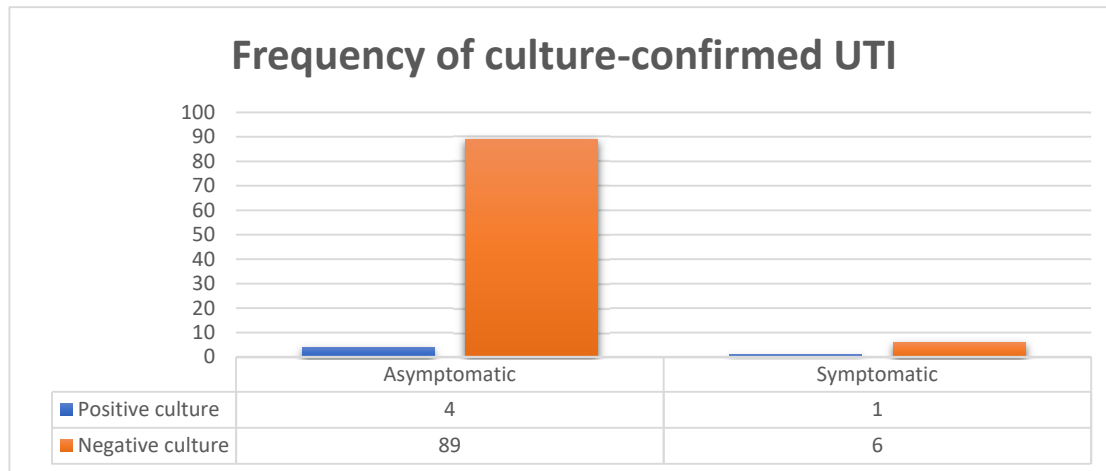


Figure 2. Symptomatic and asymptomatic UTIs among pregnant women at the antenatal clinics of EFSTH, BMCHH and KGH from November 2022 to January 2023.

3.5. Prevalence of AMR and Its Patterns

Among the 5 patients with significant bacteriuria, one (1) of the culture plates was susceptible to all the drugs, one (1) was resistant to more than one class of antimicrobial used in this study, and the remaining three cultured organisms were resistant to just one drug class. All the isolates were 100% susceptible to ciprofloxacin, ceftriaxone, nitrofurantoin, tetracycline and erythromycin. High resistance to cefuroxime (100%) and trimethoprim/sulfamethoxazole (50%) was detected. None of the isolates were resistant to co-amoxiclav. The *E. coli* isolates were resistant to ampicillin and cefuroxime, whereas *S. aureus* was methicillin sensitive. Among the total isolates (n=5), only 1, *Citrobacter freundii*, presented multidrug resistance (resistance to three or more classes of antimicrobials) but was sensitive to nitrofurantoin and ceftriaxone (Table 4 and Figure 3).

Table 4. Antimicrobial susceptibility patterns of bacteria isolated from the urine of pregnant women at the antenatal clinics of EFSTH, BMCHH and KGH from November 2022 to January 2023.

BACTERIAL ISOLATES		<i>Escherichia coli</i>		<i>Staphylococcus aureus</i>		<i>Citrobacter freundii</i>		TOTAL	
Total		2		2		1		5	
SUSCEPTIBILITY		S	R	S	R	S	R	S	R
ANTIBIOTICS TESTED/ NO OF ISOLATES	CIP	-	-	1	-	-	-	1	-
	MET	-	-	1	-	-	-	1	-
	GEN	1	-	-	1	1	0	2	1
	CEF	2	0	-	-	1	0	3	-
	NIT	2	0	1	-	1	0	4	-
	CTZ	1	-	-	-	-	-	1	-
	CRX	-	1	-	-	-	-	-	1
	TSX	1	-	-	-	0	1	1	1
	AMC	1	-	1	-	-	-	2	-
	NAL	2	0	1	-	0	1	3	1
	AMP	-	1	-	-	0	1	-	2
	TET	1	-	2	0	-	-	3	-
	ERY	-	-	2	0	-	-	2	-

Key: “-” = Not available or not tested for. S: Sensitive, R: Resistant, AMC: amoxicillin-clavulanate, AMP: ampicillin, CIP: ciprofloxacin, GEN: gentamicin, CEF: ceftriaxone, CTZ: ceftazidime, TSX: cotrimoxazole, NAL: nalidixic acid NIT: nitrofurantoin, MET: methicillin, CRX: cefuroxime, TET: tetracycline and ERY: erythromycin.

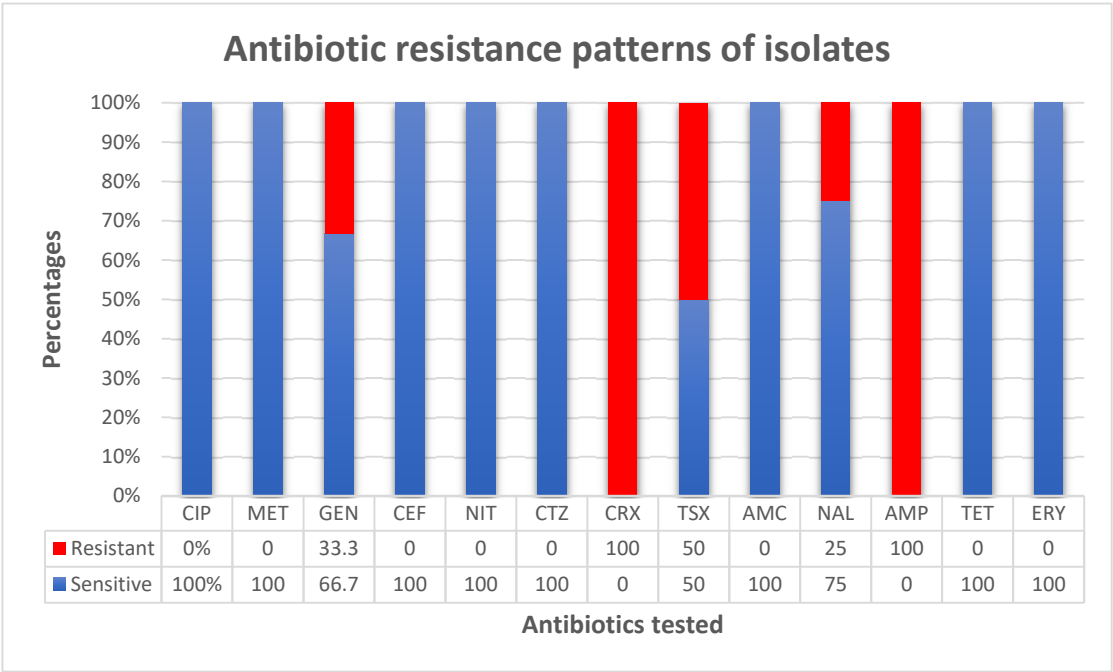


Figure 3. Overall antimicrobial susceptibility patterns of bacterial pathogens isolated from the urine of pregnant women at the antenatal clinics of EFSTH, BMCHH and KGH from November 2022 to January 2023. Abbreviations: AMC: amoxicillin-clavulanate, AMP: ampicillin, CIP: ciprofloxacin, GEN: gentamicin, CEF: ceftriaxone, CTZ: ceftazidime, TSX: cotrimoxazole, NAL: nalidixic acid NIT: nitrofurantoin, MET: methicillin, CRX: cefuroxime, TET: tetracycline and ERY: erythromycin.

4. Discussion

The aim of this study was to determine the prevalence and antimicrobial resistance patterns of urinary tract infections in pregnant women attending the antenatal clinics of three hospitals in Gambia. We found that the prevalence of significant bacteriuria in 100 pregnant women from the three hospitals was 5%. It was mostly observed in the 30–34 year age group, and 4 of the 5 infected pregnant women were asymptomatic. *Escherichia coli* and *Staphylococcus aureus* were the most prevalent organisms isolated, and antibiotic sensitivity was highest for ceftriaxone, nitrofurantoin, tetracycline and nalidixic acid. Only *Citrobacter freundii* was found to harbor MDR strains to various antibiotic classes.

The overall prevalence of UTIs was 5% in this study, which was lower than that reported in data published from community-acquired UTIs from the same setting [14], and the global prevalence ranged from 13–33% [25]. This percentage was higher than that reported in some studies in India (3.3%) [26] and Uganda (3.75%). This number was lower than those reported in many studies conducted in African countries, such as Ethiopia (7.8%) [27], Iran (13.1%) [28], South Africa (16.8%) [29], Somalia (21%) [30], Egypt (29%) [31] and Nigeria (49%) [32]. These variations in prevalence can be attributed to these studies using larger sample sizes and inpatient data. There is a greater likelihood of being identified and treated for any infection if pregnant women attend ANC as necessary, which may also be related to the rate of adherence to ANC visits throughout pregnancy in various nations [33]. These differences could be because the studies were conducted in different locations with different populations. Another factor may also be differences in socioeconomic status, social habits and hygiene practices [30].

Like Negussie et al. [34] and Rejali et al. [28], there was no statistically significant association between maternal obstetric risk factors and UTIs in this study. In contrast, other studies have shown that age, gravidity, parity, level of education, gestational age and a history of UTI are significantly associated with UTI during pregnancy [35–38]. These variations may be due to population differences

and differences in sample size. One of the studies that found significance with low education attributed this finding to the limited knowledge about health practices and diseases in the illiterate population [37]. No evidence of an association was found between gestational age and UTIs, which is different from the findings of Obeng-Forson et al. [39]. Another study revealed that age was significant and that most of the infected patients were younger than 30 years of age. This could be attributed to the higher rate of sexual intercourse in that age group and the increased incidence of UTIs [36,40].

Data on microbial trends and antibiotic resistance are needed for empirical therapy guidelines. The isolated organisms included *S. aureus* (40%), *E. coli* (40%) and *C. freundii* (20%). The results of this study revealed that *Escherichia coli* and *Staphylococcus aureus* were the most common bacteria involved in urinary tract infection among pregnant women, which is in line with the findings of other studies in other African countries [19,30,41–43], and the popularity of gram-negative bacteria has been reported in two studies in Gambia [13,14]. *E. coli* was also the most commonly isolated bacterial species in pregnant women in Latin America, at 70%, according to a systematic review and meta-analysis De Souza [44]. Even though steps are taken to prevent skin contamination, it is challenging to determine whether *S. aureus* is a skin contaminant or a real uropathogen. It was the most common isolate (55.9%) in a small study by Younis et al. in Libya [45]. The risk of contracting a UTI caused by *E. coli* during pregnancy may increase due to anatomical and functional changes such as urinary stasis, as well as difficulties maintaining personal hygiene or the use of poor hygiene practices such as wiping from back to front after using the toilet. *E. coli* is commonly found in the perineal area, and its virulence factors promote attachment to the uroepithelium, making it easier to colonize the urinary tract [46]. The observed similarities and differences in the type and distribution of uropathogens may be due to a variety of factors, including the environment, medical practices, patient factors, number of patients examined, and laboratory techniques employed for urine examination [47].

The isolates were assessed for susceptibility to commonly used antibiotics. AMR in bacterial pathogens is becoming a serious threat because of the limited choice of antibiotics to use in pregnancy and their wide availability and usage [48]. The present study revealed that most of the pathogens were sensitive to Ceftriaxone, nitrofurantoin, tetracycline, erythromycin, nalidixic acid and co-Amoxiclav and resistant to ampicillin and cefuroxime trimethoprim/sulfamethoxazole. This susceptibility to these agents suggests their use as an empirical treatment for UTIs during pregnancy. The resistance to these latter agents could stem from the large amount of these drugs being prescribed to pregnant women and the lack of data on resistance trends limiting their choices [49]. The high sensitivity to ceftriaxone and nitrofurantoin is in accordance with data reported in this setting and other studies, such as those of Johnson et al. in Uganda, involving 400 pregnant women with symptomatic UTIs [6]; in Gambia [13,14]; and in Ethiopia, by Ejerssa et al., who reported the highest sensitivity to amikacin, an antibiotic not tested in our study [46]. The high sensitivity to nitrofurantoin is encouraging since it is listed as the first-line treatment in most international guidelines [50]. Our high level of ampicillin resistance is similar to the findings of Orji et al. from South Africa [29]. A meta-analysis also revealed that resistance to ampicillin was at least 75% across various studies performed in low- and middle-income countries where owing to limited resources, clinicians may prescribe antibiotics without performing a urine culture and sensitivity test [51]. None of our isolates were resistant to co-amoxiclav, similar to studies performed in Ethiopia [49,52] but contrary to other studies in Uganda and Ethiopia [6,46,53]. The 50% resistance to TMP/SMX we observed was similar to the findings of Ali et al. from Somalia [54]. This study revealed a low rate of resistance to erythromycin and tetracycline, which was different from the findings of a multicenter study involving 400 pregnant women with asymptomatic bacteriuria from Ghana [55]. The observed high prevalence of antimicrobial resistance to commonly used antibiotics may be attributed to the easy availability of commonly prescribed antimicrobials over-the-counter combined with the misuse of antibiotics by both patients and clinicians and a lack of trained personnel for urine culture [52]. This could also be due to a lack of regulation of the prescription of these drugs and their sale by local pharmacies [13,30].

E. coli, the predominant gram-negative isolate, was sensitive to ceftriaxone, nitrofurantoin and nalidixic acid (all 100%) but resistant to ampicillin and cefuroxime. The 100% sensitivity of *E. coli* to Ceftriaxone is similar to what Derese et al. reported in a small study in Ethiopia [20] but disagrees with the findings of Ngong et al. [57] and Asmat and colleagues [58]. Abu et al. [52] reported high resistance to tetracycline, which was different from the findings of the present study and those of Agarwal et al. This study revealed high resistance to ampicillin in *E. coli*, which is in line with the findings of Derese et al. [20] and two Gambian studies [13,14]. This finding is worrying considering that ampicillin is the most commonly prescribed antibiotic for UTIs during pregnancy in Gambia. This implies that changes may be needed in the treatment protocols used. With the exception of gentamicin, *S. aureus* was sensitive to all the drugs tested in this study. There was no methicillin resistance in *S. aureus*, as shown previously in this setting by Darboe et al. [59] and was also reported in a study of asymptomatic pregnant women by Onanuga and colleagues in Nigeria [60]. These differences could be due to variations in antibiotic prescription patterns across various countries, different costs of the drugs and their availability.

Limitations of the Study

There are several limitations to this study worth noting. This was a short-term study involving only pregnant women who attended the participating hospitals in urban areas; hence, this might limit inference of the results to the general population of the country. Information such as sexual activity, which is considered a risk factor, could not be assessed because the women in the study area did not feel comfortable giving out such details. However, this did not affect the study, as its purpose was still to be carried out. Few drugs were tested due to the limited availability of funds, hence limiting us to the drug discs available to the hospital at every given point. This study also involved a small number of participants. To relate the results to the entire country, another has to be done with a larger sample size and longer time period to include women from rural areas. However, the results of this study add to the body of knowledge concerning the prevalence of AMR among pregnant women at antenatal clinics and their knowledge of UTIs in low-income countries such as Gambia.

5. Conclusions

We detected a low prevalence of community-acquired UTIs, possibly because this study was performed over a short period and in urban centers where patients have a high literacy rate and easy access to medical care. *Escherichia coli*, as expected, was the most common causative organism, and except for ampicillin and trimethoprim/sulfamethoxazole, susceptibility to commonly used drugs was high. These findings also show that ceftriaxone, nitrofurantoin, erythromycin and nalidixic acid can be used as empiric treatments when culture-specific sensitivities are not available. We recommend that routine surveillance and monitoring studies be conducted to update clinicians on prevalent pathogens and the rational and empirical treatment of UTIs. The choice of antimicrobial therapy during pregnancy should be determined according to sensitivity and resistance for foeto-maternal safety.

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Data Availability Statement: The data supporting the findings of the article are available upon request from the authors. They include:

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List of Abbreviations

AMR	Antimicrobial resistance
<i>E. coli</i>	<i>Escherichia coli</i>
<i>S. aureus</i>	<i>Staphylococcus aureus</i>
<i>C. freundii</i>	<i>Citrobacter freundii</i>
GDP	Gross Domestic Product
USD	United States Dollars
WHO	World Health Organization
UTI	Urinary tract infection
EUA	European Urology Association
ASB	Asymptomatic bacteriuria
MDR	Multidrug resistant
ANC	Antenatal clinic
EFSTH	Edward Francis Small Teaching Hospital
KGH	Kanifing General Hospital
BMCHH	Bundung Maternal and Child Health Hospital
CFU	Colony forming units
GMD	Gambian Dalasi
LMICs	Low- to middle-income countries
DNA	Deoxyribonucleic acid
CLED	Cysteine lactose electrolyte-deficient agar
MAC	MacConkey agar
MHA	Mueller–Hinton agar
CLSI	Clinical and Laboratory Standards Institute

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