

*Full Length Research Paper*

# Microbiological profile of asymptomatic bacteriuria in pregnant women in Volta Region, Ghana

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Asymptomatic bacteriuria can lead to urinary tract infections in as many as 20% of pregnant women. Asymptomatic bacteriuria in pregnancy can also lead to preterm births and low birth weights. The objective of this study was to profile uro-pathogens and describe the population-based prevalence, the antimicrobial sensitivity pattern, and ascertain the risk factors for asymptomatic bacteriuria among pregnant women attending the antenatal clinic of Ho Teaching Hospital, in Ghana. Urine samples were cultured, isolates identified and antibiotic sensitivity testing was done using the Clinical and Laboratory Standard Institute (CLSI) guidelines. 46 (13.7%) out of 335 pregnant women had asymptomatic bacteriuria. The most frequently isolated bacteria were *Pseudomonas species* (26.1%) followed by *Escherichia coli* (21.7%). All isolates (n=46; 100%) were resistant to Augmentin whereas 87% of the isolates (n=40) were susceptible to Gentamicin. However, most of the isolates were multi-resistant to antibiotic drugs. No education (p=0.019) and first trimester (p=0.046) of pregnancy were risk factors for asymptomatic bacteriuria. *Pseudomonas aeruginosa* was the most frequent organism isolated. All the uro-pathogens were resistant to Augmentin, while high rates of resistance to Tetracycline, Amikacin, Norfloxacin, and Levofloxacin were observed. The study reveals that asymptomatic bacteriuria was significantly associated with the first trimester of pregnancy and having no education.

**Key words:** Bacteriuria, urinary tract infections, prevalence, Ghana, Ho Teaching Hospital, antimicrobial resistance.

## INTRODUCTION

Asymptomatic bacteriuria (ASB) is the presence of true bacteriuria without subjective evidence of urinary tract infection (UTI) such as dysuria, urgency, and frequency (Cortes-Penfield et al., 2018). The bacteria are persistent,

actively multiplying within the urinary tract and this can lead to infection in as many as 20% of pregnant women (Al-mijalli, 2017).

The prevalence of ASB in pregnant women is 4 to 7%

(Ghafari et al., 2016). The burden of ASB vis a vis UTI differs geographically and it is on the rise across the regions (Chamoun, 2020). Globally, the burden of UTI (progression of ASB) is estimated to be 150 million cases per year (WHO, 2005b) and it is predominantly increasing in developing countries than in developed countries (WHO, 2005a). There is also an increase in healthcare-associated infection varying between 5.7 and 19.1% and this includes asymptomatic bacteriuria (WHO, 2005a).

ASB can occur in both males and females but is predominant in females possibly because females have shorter urethra which is closer to the anal region (Abujheisha, 2020; Salvatore et al., 2011). Hence, there is easy colonization and migration of uro-pathogens to the different parts of the urinary tract (Geerlings, 2016; Van Brummen et al., 2006). Other factors that influence the occurrence, progress, and outcome of ASB in pregnancy are the anatomical and physiological changes of the renal system during pregnancy (Cheung and Lafayette, 2013; Easmon et al., 1985; Oli et al., 2011). These changes include the kidneys, renal pelvis, and calyces becoming larger, and ureters dilate markedly during pregnancy (right>left) which is thought to be progesterone-induced (Faiz et al., 2020). There is also increased vesicoureteral reflux and occurrence of urinary stasis or hydronephrosis in the ureters which predisposes pregnant women to asymptomatic bacteriuria to develop symptomatic pyelonephritis (Cietak and Newton, 1985; Oli et al., 2010).

Meanwhile, the colonization of the vagina region by these pathogenic microorganisms associated with ASB if persist have a direct bearing on both the health of the woman and the pregnancy (Debaun et al., 1993; Kline and Lewis, 2016; Sheikh et al., 2000). The uro-pathogen of ASB are predominantly the Gram-negative bacteria and *E. coli* is reported to be the dominant of them (Foxman, 2003; Tabibian et al., 2008; Tupin et al., 2007). *Enterococcus spp*, *Citrobacter spp*, *Proteus spp*, *Pseudomonas aeruginosa*, *Klebsiella spp*, and *Acinetobacter spp*, *Staphylococcus aureus*, *Staphylococcus saprophyticus*, and *Staphylococcus epidermidis* are some of the other frequently occurring bacteria implicated in UTI (Tabibian et al., 2008).

It is, however, reported that about 8% of pregnant women may have experienced urinary tract infection and recurrent urinary tract infection (RUTI) in the third trimester which is a result of the progression of untreated asymptomatic bacteriuria (Ahmed and Ghadeer, 2013). In Ghana, the prevalence and the antimicrobial susceptibility pattern of ASB among pregnant women varies from area to area and there is no published work on ASB among pregnant women in Ho, Volta Region.

There is also the need for updated information on ASB, the bacterial etiologies associated with ASB, and the use of antimicrobial agents in different settings. Hence, the purpose of the study was to characterize uro-pathogens and describe the antimicrobial sensitivity pattern among pregnant women attending the antenatal clinic of Ho Teaching Hospital.

## MATERIALS AND METHODS

### Study design

The authors conducted a cross-sectional study on pregnant women attending Ho Teaching Hospital, Ho, Ghana from July, 2019 to January, 2020. The study was designed to isolate and identify the bacteria in the urine of pregnant women attending the antenatal clinic of the Hospital and determine their susceptibility to commonly used antibiotics in the hospital.

### Study site

The study was conducted at the Ho Teaching Hospital (HTH) in the Volta Region of Ghana. The hospital serves as the central point to health care and referral in the Volta and Oti Regions of Ghana and some parts of the Republic of Togo, and Benin. Volta Region is composed of 17 districts with a population of 1,907,679 and the Oti Region has a population of 759,799 with 8 districts (Ghana Statistical Service, 2020).

### Study Population

The study included 335 pregnant women attending the Antenatal Clinic (ANC) at the Ho Teaching Hospital only.

### Sample size determination and sampling techniques

A single proportion formula ( $n = z^2 p (1-p) / d^2$ ) was used to calculate the sample size, arriving at 103 participants. Where  $z$  represented  $Z$  score for 95% confidence interval = 1.96,  $p$  = prevalence, and  $d$  = acceptable error (5%). (Kish, 1965) A prevalence, 7.3%, of asymptomatic bacteriuria in pregnant women attending Komfo Anokye Teaching Hospital was used in calculating the sample size since no similar work has been done in the study area. (Turpin et al., 2007).

$$\begin{aligned} n &= z^2 p (1-p) / d^2 \\ &= (1.95)^2 \times (0.073) (1-0.073) / (0.05)^2 \\ &= 103 \end{aligned}$$

However, the desired 103 participants were extrapolated to 335 clients until the reagents used were finished.

### Inclusion criteria

All pregnant women attending the antenatal clinic at HTH.

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### Exclusion criteria

Pregnant women with a history of antibiotic treatment in the last month were excluded since it is likely not to have bacteria in their urine. Also, pregnant women with any form of vaginal discharge and bleeding were excluded from the study.

### Sample and data collection

Closed-ended questionnaires were administered to study participants satisfying the inclusion criteria to obtain information on their socio-demographic, obstetric characteristics of the pregnancy, gestation age, knowledge on UTI, knowledge on antibiotics, clinical history of UTI and antibiotics, and personal hygiene. The participants were enrolled at the antenatal clinic.

### Bacteriological investigation

Sterile universal containers were given to participants after completing the questionnaires on the day of enrolment. Study participants were taught and instructed on the correct mode of self-collection of a fresh morning midstream urine.

These containers were labeled with their respective codes, date, and time of collection after the urine samples were received at the laboratory. The urine samples were cultured on a cysteine lactose electrolyte deficient (CLED) agar plate using a 0.002mL calibrated loop. These plates were incubated aerobically overnight in an aerobic incubator. After 24-48 hours, the plates were read as; significant bacterial growth, no significant bacteria growth, or no bacterial growth. Bacteriuria is determined as the approximate number of bacteria per ml of un-centrifuged urine estimated using a sterile special calibrated wire loop (that can hold 1/500 mL that is 0.002 mL of urine) for inoculation on sterile culture medium and incubated aerobically at 35°C to 37°C for 24-48 h. The number of isolated colonies (Colony forming units) on the agar medium is then counted using a counting chamber and then multiplied by a factor of 500 to estimate significant bacteriuria. A count of more than  $10^5$  per mL of urine is taken as significant bacteriuria; less than  $10^4$  per mL is taken as not significant while counts between  $10^4$ - $10^5$  per ml were considered doubtful and the urine samples were re-examined. High colony counts with mixed growths of species were considered as contamination. The significant bacteria growth showed in the urine indicates the potential of asymptomatic bacteria since infected pregnant women were not showing signs and symptoms of UTI.

Identification of significant bacterial growth was done using colony morphology, microscopic, and biochemical tests (Murray et al., 1995). The Gram reactions were determined by the use of gram staining.

### Standard biochemical identification of bacterial isolates

Biochemical identification of bacterial isolates in the study was done based on the Clinical and Laboratory Standard Institute (CLSI) guidelines. (CLSI, 2019) Coagulase and catalase tests were used to identify Gram-positive organisms while indole, urease, citrate, triple sugar iron (TSI), oxidase tests were used in the cases of Gram-negative rods.

Confirmed bacteria strains (uro-pathogens) were then sub-cultured on the CLED medium to achieve absolute pure colonies. These uro-pathogens were emulsified into a cryovial tube containing 5 mL of 15% glycerol and 85% Brain-Heart infusion broth and stored in the freezer at -20°C.

### Antimicrobial susceptibility testing (AST)

AST was done using the Kirby Bauer disc diffusion following the Clinical and Laboratory Standard Institute (CLSI) guidelines (CLSI, 2019). Using sterile swabs, suspensions (inoculum) of 0.5 Mcfarland were seeded on sterile Mueller Hinton agar and allowed to dry for 10-15mins. Antibiotic discs were gently placed and pressed down on the agar using sterile forceps. The plates were inverted and incubated for 18-24 h. The zone diameters of the various antibiotics were measured using a straight rule. The antibiotics used included Augmentin (30 µg), Ciprofloxacin (5 µg), Ceftriaxone (30 µg), Gentamicin (10 µg), Piperacillin (20 µg), Amikacin (30 µg), Nitrofurantoin (300 µg), Nalidixic Acid (30 µg), Ceftazidime (20 µg), Norfloxacin (20 µg), Tetracycline (30 µg) and Levofloxacin (5 µg).

### Quality control

Strict measures were considered in the data collection, processes, and analyses. Culture media sterility tests and performance tests were conducted on the media with known organisms as positive control and no organism as a negative control. The control organisms used were *E.coli* ATCC 25922, *Pseudomonas aeruginosa* ATCC 27853, *Staphylococcus aureus* ATCC 25923, and *Candida albicans* ATCC 10237. All laboratory tests and analyses were carried out per the CLSI (2019) standard operating procedures.

### Data management

Data gathered were entered into Excel and exported into R Studio software (R version 3.6.0) and analyzed. The Chi-square test at a 95% significance level was used to establish statistical associations between categorical variables and risk factors. Probability values of < 0.05 indicated a statistical relationship between the categorical variables. Descriptive statistics such as prevalence, proportions, frequencies, and ratios were used to provide summaries of the data in the study. Cross tabulation and table creations were used to construct a contingency table of the risk factors at each combination level that is to enhance understanding of the relationship between two variables.

### Ethical approval

Facility approval was given by the HTH whereas the ethical approval was by the Committee on Human Research, Publication, and Ethics of the Komfo Anokye Teaching Hospital, and Kwame Nkrumah University of Science and Technology, Kumasi (CHRPE/AP/429/19 – 9th July, 2019). Participants gave their written consent and were given the right to either continue or withdraw from the study as and when necessary. However, for each confirmed case of infection, the clinician of that participant was informed and provided with the result of the antimicrobial susceptibility tests for treatment. Also, other relevant information obtained at each level of the study was kept confidential.

## RESULTS

### Socio-demographic characteristics of participants

The age of pregnant women in the study ranged from <20 to 49. The ages <20 and 40-49 had the highest

**Table 1.** Socio-demographic characteristics of the study population associated with bacteriuria (N=335).

Variable	Response	No of Participants	No of participants with ASB (%)	p-value
Gestation period	1st	76	13 (17.10)	0.046
	2nd	112	15 (13.39)	
	3rd	147	18 (12.24)	
Age	<20	12	2 (16.67)	0.777
	20-29	160	25 (15.62)	
	30-39	157	18 (11.46)	
	40-49	6	1 (16.67)	
Educational Level	No education	34	8 (23.53)	0.019
	Basic	108	13 (12.04)	
	Secondary	74	11 (14.86)	
	Tertiary	119	14 (11.76)	
Occupation	Banker	3	1 (33.33)	0.995
	Nurse	13	0	
	Teacher	36	7 (19.44)	
	Trader	96	14 (14.58)	
	Other	187	24 (12.83)	
Marital Status	Married	285	39 (13.68)	0.135
	Separated	5	1 (20)	
	Single	45	6 (13.33)	
	Divorced	0	0	
	Widowed	0	0	
Knowledge on UTI	Yes	276	7 (2.53)	0.473
	No	59	39(66.10)	
Presence of Toilet Facility	Yes	277	38 (13.71)	0.460
	No	58	8 (13.79)	

bacteriuria percentage (n=2:1; 16.67%) and the age range 30 - 39 recorded the lowest number of bacteria isolates (n=18; 11.46%). There were no significant associations between age (p=0.777), marital status (p=0.135), and occupation (p=0.995) with bacteriuria but a significant association was established between the gestation period (p=0.046), and educational level (p=0.019) with bacteriuria. Although 277 out of the 335 study participants had toilet facilities in their homes, the rates were the same whether patients had toilet facilities at home or not (Table 1).

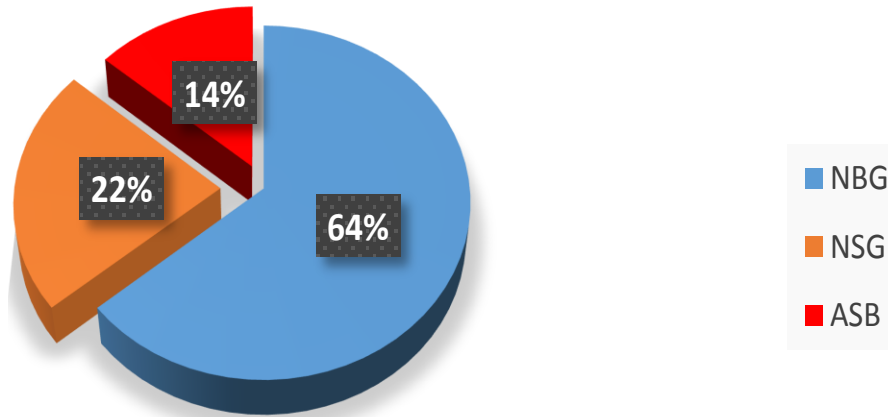
#### Distribution of isolates

The 335 pregnant women enrolled in this study 46 had asymptomatic bacteriuria giving a prevalence of bacteriuria to be 14%. 75 (22%) showed no significant

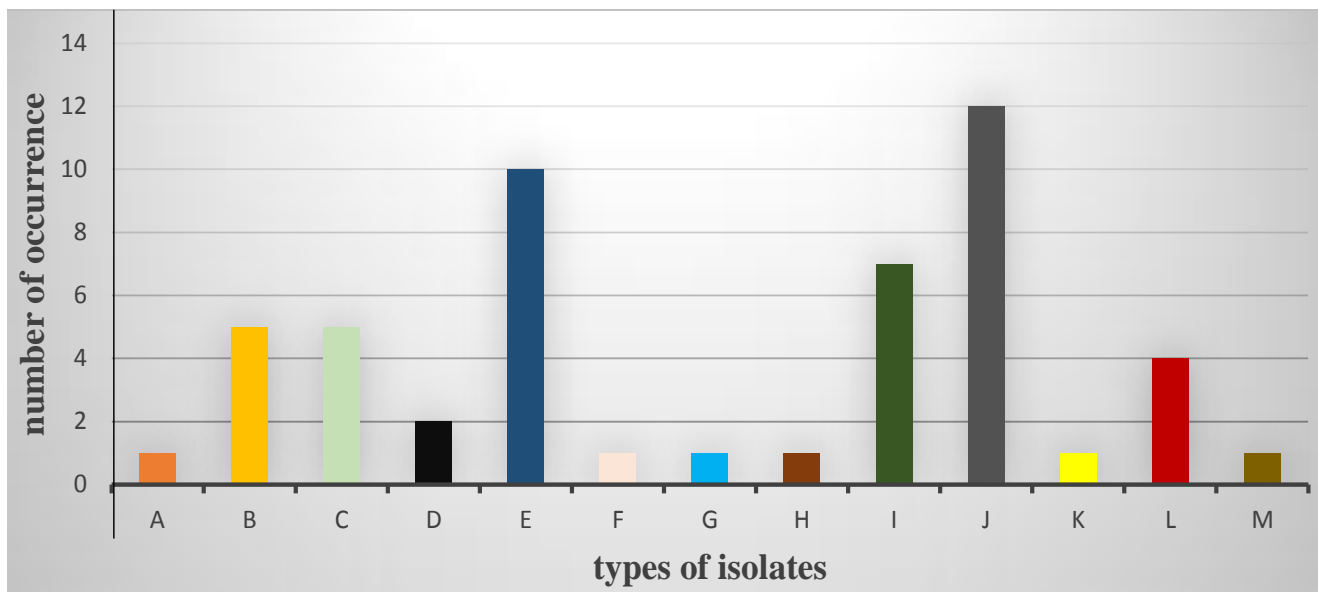
growth (NSG), while 214 (64%) showed no bacteria growth (NBG) (Figure 1).

#### Frequencies and type of isolates

Thirteen (n=13) uro-pathogens were isolated from the urine of the study participants with Enterobacteriaceae being the group with the most isolated organisms. Bacteria detected were *Acinetobacter species*, *Citrobacter koseri*, *Enterococcus species*, *Escherichia coli*, *Klebsiella oxytoca*, *Klebsiella species*, *Proteus vulgaris*, *Pseudomonas aeruginosa*, *Pseudomonas species*, *Staphylococcus aureus*, *Staphylococcus epidermidis*, and *Staphylococcus saprophyticus*. *Candida species* was the only fungus isolated. The most frequently detected bacteria species was *Pseudomonas species* (n=12; 26.09%) then *Escherichai coli* (n=10; 21.74%) while



**Figure 1.** Distribution of Isolates in the urine of pregnant women. \*NSG-Non-significant growth, NBG-No Bacteria growth, ASB-asymptomatic bacteriuria.



**Figure 2.** Frequency and types of isolates. A=Acinetobacter species, B=Citrobacter koseri, C=Candida species D=Enterococcus species, E=Esherichia coli, F=Klebsiella oxytoca, G=Klebsiella species, H=Proteus vulgaris, I=Pseudomonas aeruginosa, J=Pseudomonas species, K=Staphylococcus aureus, L=Staphylococcus epidermidis and M=Staphylococcus saprophyticus.

*Acinetobacter species*, *Klebsiella oxytoca*, *Klebsiella species*, *Proteus species*, *Staphylococcus aureus*, and *Staphylococcus saprophyticus* were the least detected (n=1; 2.17% each) (Figure 2).

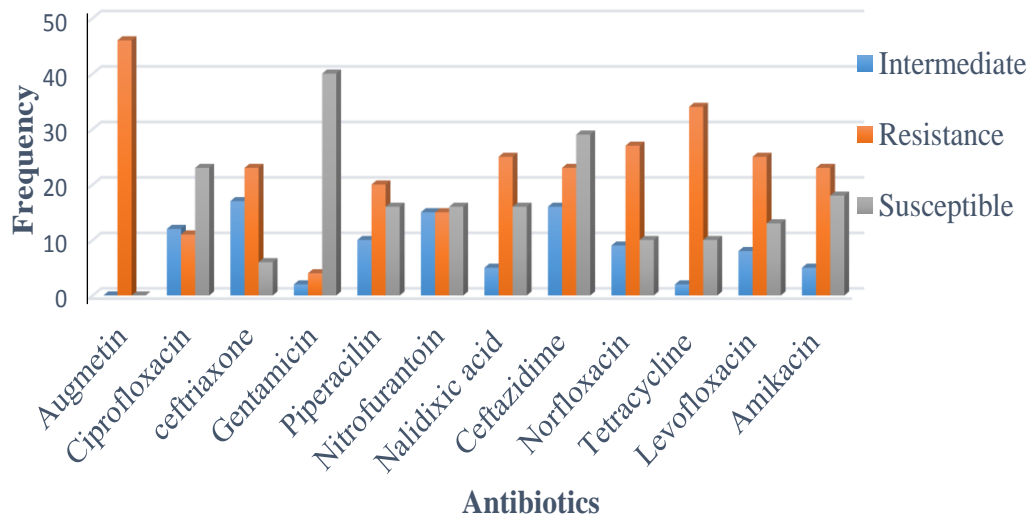
**Antimicrobial susceptibility pattern of bacterial uropathogens**

Bacteria strains from the participants showed susceptibility to Gentamicin (n=40; 87%) and highest resistance to Augmentin (n=46; 100%) (Figure 3). *Pseudomonas species* showed significant resistance to Augmentin, Ceftazidime, Tetracycline, Amikacin,

Norfloxacin, Levofloxacin, and Nalidixic Acid. Also, most of the isolated organisms were susceptible to Amikacin, Ceftazidime, Ciprofloxacin, Nitrofurantoin, and Piperacillin (Table 2). *Klebsiella species*, *Klebsiella oxytoca*, *Proteus vulgaris*, *Enterococcus species*, *Acinetobacter species*, *Staphylococcus aureus*, *Staphylococcus saprophyticus* were either intermediate or resistant to all the antibiotics used.

**Color of urine associated with bacterial urinary tract infections**

245 (73.13%) urine samples were amber-colored



**Figure 3.** Antibiotic susceptibility of bacteria strains

representing the highest of the colored urine identified. Clear and transparent yellow-colored urine was the least ( $n=3$ ; 0.89%) of the colored urine. However, straw-colored urine had the highest number of bacteria ( $n=16$ ; 21.91%) whereas amber-colored urine recorded the least number of bacteria ( $n=33$ ; 13.47%). Meanwhile, clear and transparent yellow-colored urine showed no bacteria growth. Nonetheless, there was no association between the color of urine and uro-pathogens detected (Chi square=32.141;  $df=4$ ;  $p=0.996$ ) (Table 3).

## DISCUSSION

Asymptomatic bacteriuria has remained one of the most common infections diagnosed using culture sensitivity (Gebremariam et al., 2019; Yusuf et al., 2015). The overall prevalence rate of bacteria growth in the urine of pregnant women attending Ho Teaching Hospital is 13.7% and comparably higher than similar studies conducted in other hospitals in Ghana such as; the Komfo Anokye Teaching Hospital (7.3%), the University Hospital, Kumasi (9.5%), and the Korle Bu Teaching Hospital (5.5%) (Labi et al., 2015; Obirikorang et al., 2012; Tupin et al., 2007). The prevalence, however, was lower than similar studies conducted at the Cape Coast Teaching Hospital (56.5%) and the Ghana Police Hospital (31.6%) (Boye et al., 2012; Gyansa-Lutterodt et al., 2014). Other studies conducted in Saudi Arabia, Uganda, Sudan, and Nigeria reported a higher prevalence of ASB among pregnant women (Al-mijalli, 2017; Andabati and Byamugisha, 2009; Ezeome et al., 2006; Hamdan et al., 2011; Oli et al., 2011) whereas studies conducted in United Arab Emirate and Northwest Ethiopia showed lower prevalence (Abdullah and Al-Moslih, 2005; Alemu et al., 2012). The varying prevalence

among these studies is a result of the varying population characteristics including age, educational level, genital and personal hygiene, socioeconomic status and habits of the community, health care during pregnancy, and sexual activities.

The present study recorded six (6) pregnant women within the age group of 40-49. One (1) out of the six pregnant women was positive for asymptomatic bacteriuria and was one of the highest percentages of bacteria isolates. The age range <20 also showed an equal percentage of bacteria isolates as the age group 40-49 (Table. 1). Both age groups happen to be the highest bacterial growth age groups. A review conducted to profile uro-pathogens among pregnant women in Denmark reported the age group of pregnant women <25 to have the highest bacteriuria (Greve et al., 2020). A similar review conducted in the United States reported that pregnant women within the extreme age groups (<20 and >45) should have the utmost clinical attentions because these pregnant women are at risk of premature birth, cesarean deliveries, stillbirth defects, preeclampsia, and infections (Cavazos-rehg et al., 2016). The reviews corroborated the findings of this study and however, put forward that knowledge about the ages of pregnant women that are more susceptible to bacteriuria in a respective locality will be important in enhancing and improving diagnosis and clinical attention.

The variations among the trimesters with the highest ASB could be attributed to environmental factors, cultural settings and not using the same standard operating protocols across the different studies. This study demonstrated that pregnant women in the first trimester had the highest bacteriuria percentage. However, previous studies reported the second trimester to record the highest bacterial growth (Boye et al., 2012; Kehinde et al., 2011; Masinde et al., 2009; Obirikorang et al., 2012).

**Table 2.** Sensitivity pattern of the various antibiotics used.

Drugs	<i>Pseudomonas spp. (%)</i>			<i>E. coli (%)</i>			<i>Pseudomonas aeruginosa (%)</i>			<i>Citrobacter koseri (%)</i>			<i>Staphylococcus epidermidis</i>		
	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R
AUG	0	0	12(100)	0	0	9(100)	0	0	7(100)	0	0	5(100)	0	0	4(100)
CIP	6(50)	1(8)	5(42)	4(44)	3(33)	2(22)	4(57)	0	3(43)	3(60)	1(20)	1(20)	4(100)	0	0
CFT	2(17)	5(42)	5(42)	2(22)	4(44)	3(33)	2(29)	1(14)	4(57)	0	1(20)	4(80)	0	1(25)	3(75)
GEN	11(92)	0	1(8)	8(89)	0	1(11)	7(100)	0	0	4(80)	0	1(20)	2(50)	1(25)	0
PIP	5(42)	4(33)	3(25)	3(33)	1(11)	5(56)	4(57)	2(29)	1(14)	0	1(20)	4(80)	2(50)	2(50)	0
CEF	1(8)	5(42)	6(50)	2(22)	3(33)	4(44)	1(14)	3(43)	3(43)	0	0	5(100)	1(25)	2(50)	1(25)
NIT	3(25)	3(25)	6(50)	4(44)	3(33)	2(22)	2(29)	3(43)	2(29)	1(20)	0	4(80)	2(50)	2(50)	0
NAL	5(42)	1(8)	6(50)	4(44)	0	5(56)	3(43)	1(14)	3(43)	2(40)	0	3(60)	1(25)	1(25)	2(50)
LEV	4(33)	2(17)	6(50)	3(33)	1(11)	5(56)	1(14)	2(29)	4(57)	1(20)	1(20)	3(60)	2(50)	1(25)	1(25)
TET	2(17)	0	10(83)	2(22)	0	7(78)	2(29)	1(14)	4(57)	0	0	5(100)	3(75)	0	1(25)
NOR	3(25)	3(25)	6(50)	3(33)	3(33)	3(33)	1(14)	0	6(86)	1(20)	0	4(80)	0	1(25)	3(75)
AMK	1(8)	1(8)	10(83)	7(78)	0	2(22)	1(14)	1(14)	5(71)	3(60)	1(20)	1(20)	3(75)	1(25)	0

AUG=Augmentin, AMK=Amikacin, CIP=Ciprofloxacin, CEF=Ceftazidime, CFT=Ceftriaxone, GEN=Gentamicin, LEV=Levofloxacin, NAL=Nalidixic Acid, NIT=Nitrofurantoin, NOR=Norfloxacin, PIP=Piperacillin, and TET=Tetracycline.

**Table 3.** Urine color and Uro-pathogen prevalence in pregnant women.

Color of urine	No. of pregnant women (%)	No. of Uro-pathogens (%)	P-Value
Amber	245 (73.13)	33 (13.47)	0.996
Clear	3 (0.89)	0	
Cloudy	11 (3.28)	2 (18.18)	
Straw	73 (21.79)	16 (21..91)	
Transparent yellow	3 (0.89)	0	

$\chi^2 = 32.141$ ; degree of freedom (df) =4; p= 0.996.

Elsewhere, a study conducted in Southern Ethiopia reported both the second and third trimesters recording the highest rate of asymptomatic bacteriuria (ASB) (Tadesse et al., 2014). A study conducted to investigate the magnitude of ASB on Indian pregnant women reported that pregnant women in their third

trimesters presented with ASB more than pregnant women in their first and second trimesters (Bhavana et al., 2019). On the other hand, the high prevalence of ASB in the first trimester of this study may be attributed to the knowledge base of the pregnant woman about the causes and preventions of ASB. This is on the assumption

that pregnant women in their second and third trimesters may have experienced one or more episodes of ASB and have been educated accordingly.

There was a significant association between educational level and ASB. This is, however, in variance with previous studies conducted across

the world that reported a significant association between socioeconomic status (education status) and ASB (Alemu et al., 2012; Gilstrap and Ramin, 2001; Masinde et al., 2009; Oli et al., 2010). Nonetheless, this assertion aligns with a study conducted in the largest hospital in Ghana to measure the prevalence of ASB among antenatal patients and associated risk factors (Labi et al., 2015). This disparity suggests the importance of educating all categories of pregnant women about the dangers, causes, and preventions of ASB.

This study further indicates the different uro-pathogens isolated from the urine of the study participants with Enterobacteriaceae being the largest group of the isolated organisms. *Pseudomonas species* was the most frequently isolated bacterium which is contrary to most studies across the globe that reported *E. coli* as the dominant organism isolated (Getachew, 2010; Gilstrap and Ramin, 2001; Masinde et al., 2009; Obiogbolu et al., 2009). *Pseudomonas species* are mostly among the pathogens responsible for hospital-acquired infections (HAI) which includes urinary tract infections. *Pseudomonas species* are mostly found in a moist environment and on the skin of some people which can cause infection in immunocompromised individuals. Notably, during pregnancy, the pregnant woman's immune system changes, and the moist nature of the vagina opening promotes the likelihood of the pregnant women experiencing some infections including pseudomonas infection (ASB). There is, therefore, a high possibility of increased pseudomonas infection hence the plausible explanation for the high number of *pseudomonas species*.

*Pseudomonas species* and *Pseudomonas aeruginosa* respectively recorded a 25 and 29% susceptibility to Nitrofurantoin. They were also susceptible to Gentamicin and Ciprofloxacin. This is in agreement with other studies that reported most of their isolates including *Pseudomonas species* and *Pseudomonas aeruginosa* to be susceptible to Gentamicin, Ciprofloxacin, and Nitrofurantoin (Blomberg et al., 2005; Masinde et al., 2009). *Klebsiella species*, *Klebsiella oxytoca*, and *Acinetobacter species* showed alarming resistance to most of the antimicrobial agents used in this study. Although the sample size of the study was relatively small it can, however, be deduced that *Klebsiella species*, *Klebsiella oxytoca*, and *Acinetobacter species* are emerging as a multidrug-resistant organism in the study since they were resistant to all antibiotics used for the antimicrobial sensitivity tests (AST). This could also be attributed to the abilities of these isolates to naturally encode genes that are resistant determinants and by accumulating multiple mechanisms of resistance which lead to the development of pan-resistant strains (Bonomo and Szabo, 2006). There have been similar studies across the world including regions of Africa that agree with the increasing number of *Klebsiella species* becoming multidrug-resistant (Afriyie et al., 2014;

Leopold et al., 2014; Moran et al., 2005; Van der Bij and Pitout, 2012).

Farrugia et al. (2012) reported that the straw color of the urine shows dehydration and the cloudy urine color indicates UTI, increased cells, or chronic disease. In harmony with the findings of Farrugia et al. (2012), this present study showed the highest bacterial growth in straw and cloudy colored urine indicating that there have been more dehydration and UTI respectively among pregnant women.

Future studies should include the use of a PCR diagnostic tool since it will target the DNA to identify antimicrobial-resistant conferring genes in the isolates. Also, subsequent studies should ascertain the prevalence of candida, rickettsia, chlamydia, and mycoplasma in pregnant women and determine the burden of candiduria among pregnant women in Ho Teaching Hospital.

## Conclusion

In conclusion, *Pseudomonas aeruginosa* was the most frequent organism isolated. All the uro-pathogen were resistant to Augmentin, while most were resistant to Tetracycline, Amikacin, Norfloxacin, and Levofloxacin, hence should not be recommended unless they are efficacious against that particular isolate. However, Nitrofurantoin, Cefadizime, and Gentamicin respectively should be used as the first-line medications for women with asymptomatic bacteriuria in the Volta Region and Oti Region because they showed significant susceptibility. The study also concludes that there are significant associations between gestation periods where the first trimester respondents showed the highest percentage of bacteriuria. The educational level of pregnant women also showed a significant association with bacteriuria. It was concluded that those who received a certain level of education recorded a lower percentage of bacteriuria as compare to the high percentage of bacteriuria among uneducated respondents. Conversely, variables such as occupation, age, and marital status did not show any significant relationships with bacteriuria during this study.

## CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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## REFERENCES

- Abdullah AA, Al-Moslih MI (2005). Prevalence of asymptomatic bacteriuria in pregnant women in Sharjah, United Arab Emirates. *Eastern Mediterranean Health Journal* 11:1045-1052.
- Abujheisha KY (2020). Asymptomatic bacteriuria in type II diabetics and non-diabetics; Risk factors, bacterial types and their corresponding resistance pattern. *Journal of Renal Injury Prevention* 9(1):5-7.
- Afriyie D, Gyansa-Lutterodt M, Asare G (2014). Antimicrobial Use and Susceptibility Pattern of Uropathogens Associated with Urinary Tract Infections at the Ghana Police Hospital Trace elements View project Antimicrobial Resistance of Salmonella Associated With Humans and Poultry in Ghana View project. *Global Journal of Pharmacology* <https://doi.org/10.5829/idosi.gjp.2014.8.3.83193>
- Ahmed A-B, Ghadeer A-S (2013). Recurrent Urinary Tract Infections Management in Women. *Sultan Qaboos University Medical Journal* 13:359-367.
- Al-mijalli SHS (2017). Bacterial Uropathogens in Urinary Tract Infection and Antibiotic Susceptibility Pattern in Riyadh Hospital, Saudi Arabia. *Cellular & Molecular Medicine* 3(1):1-6.
- Alemu A, Moges F, Shiferaw Y, Tafess K, Kassu A, Anagaw B (2012). Bacterial profile and drug susceptibility pattern of urinary tract infection in pregnant women at University of Gondar Teaching Hospital, Northwest Ethiopia. *BMC Research Notes* DOI: 10.1186/1756-0500-5-197.
- Andabati G, Byamugisha J (2009). Microbial aetiology and sensitivity of asymptomatic bacteriuria among ante-natal mothers in Mulago hospital, Uganda. *African Health Sciences* 10(4):349-352.
- Bhavana AM, Kumari PHP, Mohan N, Chandrasekhar V, Vijayalakshmi P, Manasa RV (2019). Bacterial vaginosis and antibacterial susceptibility pattern of asymptomatic urinary tract infection in pregnant women at a tertiary care hospital, Visakhapatn, India. *Iranian Journal of Microbiology* 11(6):488-495.
- Blomberg B, Olsen BE, Hinderaker SG, Langeland N, Gasheka P, Jureen R, Kvale G, Midtvedt T (2005). Antimicrobial resistance in urinary bacterial isolates from pregnant women in rural Tanzania: Implications for public health. *Scandinavian Journal of Infectious Diseases* 37(4):262-268.
- Bonomo RA, Szabo D (2006). Mechanisms of Multidrug Resistance in *Acinetobacter* Species and *Pseudomonas aeruginosa*. *Clinical Infectious Diseases* 43(Supplement 2):S49-S56.
- Boye A, Siakwa PM, Boampong JN, Koffuor GA, Kwabena R, Ephraim D, Amoateng P, Obodai G, Penu D (2012). Asymptomatic urinary tract infections in pregnant women attending antenatal clinic in Cape Coast, Ghana. *E3 Journal of Medical Research* 1(6):074-083.
- Cavazos-rehg PA, Krauss MJ, Spitznagel EL, Bommarito K, Madden T, Olsen MA, Peipert JF, Bierut LJ (2016). Maternal age and risk of labor and delivery complications. *Maternal and Child Health Journal* 19(6):1202-1211.
- Chamoun MN (2020). Uropathogenic *Escherichia coli* colonization of the urinary tract: pathways to chronicity. <http://hdl.handle.net/10072/396143>
- Cheung KL, Lafayette RA (2013). *Renal Physiology of Pregnancy*. *Advances in Chronic Kidney Disease* 20(3):209-214.
- Cietak KA, Newton JR (1985). Serial quantitative maternal nephrosonography in pregnancy. *British Journal of Radiology* 58(689):405-413.
- CLSI (2019). M100-S11, Performance standards for antimicrobial susceptibility testing. *Clinical Microbiology Newsletter* 23(6):49.
- Cortes-Penfield N, Trautner BW, Jump R (2018). Urinary Tract Infection and Asymptomatic Bacteriuria in Older Adults. *Physiology & Behavior* 176(1):139-148.
- Debaun M, Rowley D, Province M, Stockbauer JW, Cole SF (1993). Selected Antepartum Medical Complications and Very-Low-Birthweight Infants among Black and White Women. *American Journal of Public Health* 84(9):1495-1497.
- Easmon CSF, Hastings MJG, Neill J, Bloxham B, Rivers RPA (1985). Is group B streptococcal screening during pregnancy justified? *BJOG: An International Journal of Obstetrics & Gynaecology* 92(3):197-201.
- Ezeome IV, Ikeme AC, Okezie OA, Onyebueke EA (2006). Asymptomatic bacteriuria in pregnant women. In *Bahrain Medical Bulletin* 33(4):192.
- Faiz S, Zaveri MP, Perry JC, Schuetz TM, Cancarevic I (2020). Role of Antibiotic Prophylaxis in the Management of Antenatal Hydronephrosis, Vesicoureteral Reflux, and Ureterocele in Infants. *Cureus* 12(7).
- Farrugia KJ, Bandey H, Bleay S, Nicdai N (2012). Chemical enhancement of footwear impressions in urine on fabric. *Forensic Science International* 214(1-3):67-81.
- Foxman B (2003). Epidemiology of urinary tract infections: Incidence, morbidity, and economic costs. *Disease-a-Month* 49(2):53-70.
- Gebremariam G, Legese H, Woldu Y, Araya T, Hagos K, Gebreyesuswasihun A (2019). Bacteriological profile, risk factors and antimicrobial susceptibility patterns of symptomatic urinary tract infection among students of Mekelle University, northern Ethiopia. *BMC Infectious Diseases* 19(1):1-11.
- Geerlings SE (2016). Clinical presentations and epidemiology of urinary tract infections. *Urinary Tract Infections: Molecular Pathogenesis and Clinical Management* pp. 27-40.
- Getachew T (2010). Bacterial pathogens implicated in causing urinary tract infection (uti) and their antimicrobial susceptibility pattern in Ethiopia. *Patógenos causantes de infección del tracto urinario (ITU) y sus patrones de susceptibilidad antimicrobiana en Etiopía*.
- Ghafari M, Baigi V, Cheraghi Z, Doosti-Irani A (2016). The prevalence of asymptomatic bacteriuria in Iranian pregnant women: A systematic review and meta-Analysis. *PLoS One* 11(6):1-10.
- Ghana Statistical Service (2020). <https://www.statsghana.gov.gh>
- Gilstrap LC, Ramin SM (2001). Urinary tract infections during pregnancy. *Obstetrics and Gynecology Clinics of North America* 28(3):581-591.
- Greve VH, Greve T, Helmig RB (2020). Bacteriuria in pregnancy in a danish contemporary cohort of women. *Infectious Diseases in Obstetrics and Gynecology* 2020:9-12.
- Gyansa-Lutterodt M, Afriyie DK, Asare G, Amponsah SK, Abutiata H, Darko D (2014). Antimicrobial Use and Susceptibility Pattern of Uropathogens Associated with Urinary Tract Infections at the Ghana Police Hospital West Africa Postgraduate College of Pharmacists, Ghana 8(3):306-315.
- Hamdan HZ, Ziad AHM, Ali SK, Adam I (2011). Epidemiology of urinary tract infections and antibiotics sensitivity among pregnant women at Khartoum North Hospital 2-6. *Annals of Clinical Microbiology And Antimicrobials* 10(1):1-5.
- Kehinde AO, Adedapo KS, Aimaikhu CO, Odukogbe AA (2011). Significant Bacteriuria Among Asymptomatic Antenatal Clinic Attendees In Ibadan, Nigeria 39(3):73-76.
- Kish L (1965). Survey sampling. (No. 04; HN29, K5.).
- Kline KA, Lewis AL (2016). Gram-positive uropathogens, polymicrobial urinary tract infection, and the emerging microbiota of the urinary tract. *Urinary Tract Infections: Molecular Pathogenesis and Clinical Management* pp. 459-502.
- Labi A, Yawson AE, Ganyaglo GY (2015). Prevalence and Associated Risk Factors of Asymptomatic Bacteriuria in Ante-Natal Clients in a Large Teaching. *Ghana Medical Journal* 49(3).
- Leopold SJ, Leth F, Van Tarekegn H, Schultsz C (2014). Antimicrobial drug resistance among clinically relevant bacterial isolates in sub-Saharan Africa: a systematic review. *Journal of Antimicrobial Chemotherapy* 69(9):2337-2353.
- Masinde A, Gumodoka B, Kilonzo A, Mshana SE (2009). Prevalence of urinary tract infection among pregnant women at Bugando Medical Centre, Mwanza, Tanzania. *Tanzania Journal of Health Research* 11(3):154-159.
- Moran GJ, Amii RN, Abrahamian FM, Talan DA (2005). Methicillin-resistant *Staphylococcus aureus* in community-acquired skin infections. *Emerging Infectious Diseases* 11(6):928-930.
- Murray P, Baron E, Pfaller M, Tenover F, Tenover R (1995). *Manual of Clinical Microbiology*. American Society of Microbiology 6th edition 1482.
- Obiobolu CH, Okonko IO, Anyamere CO, Adedeji AO, Akanbi AO, Ogun AA (2009). Incidence of Urinary Tract Infections ( UTIs ) among pregnant women in Akwa metropolis. *Southeastern Nigeria* 4:820-824.
- Obirikorang C, Quaye L, Bio FY, Amidu N, Acheampong I, Addo K (2012). Asymptomatic Bacteriuria among Pregnant Women Attending

- An-tenatal Clinic at the University Hospital, Kumasi, Ghana. *Journal of Medical and Biomedical Sciences* 1:38-44.
- Oli A, Okafor C, Ibezim E, Akujiobi C, Onwunzo M (2011). The prevalence and bacteriology of asymptomatic bacteriuria among antenatal patients in Nnamdi Azikiwe University Teaching Hospital Nnewi; South Eastern Nigeria. *Nigerian Journal of Clinical Practice* 13(4):1-5.
- Oli AN, Okafor CI, Ibezim EC, Akujiobi CN, Onwunzo MC (2010). The prevalence and bacteriology of asymptomatic bacteriuria among antenatal patients in nnamdi azikiwe university teaching hospital nnewi; south eastern nigeria. *Nigerian journal of clinical practice* 13(4).
- Salvatore S, Salvatore S, Cattoni E, Siesto G, Serati M, Sorice P, Torella M (2011). Urinary tract infections in women. *European Journal of Obstetrics and Gynecology and Reproductive Biology* 156(2):131-136.
- Sheikh M, Khan M, Khatoon A, Arain G (2000). Incidence of urinary tract infection during pregnancy. *Eastern Mediterranean Health Journal* pp. 265-271.
- Tabibian JH, Gornbein J, Heidari A, Dien SL, Lau VH, Chahal P, Churchill BM, Haake DA (2008). Uropathogens and Host Characteristics. *Journal of Clinical Microbiology* 46(12):3980-3986.
- Tadesse E, Teshome M, Merid Y, Kibret B, Shimelis T (2014). Asymptomatic urinary tract infection among pregnant women attending the antenatal clinic of Hawassa Referral Hospital, Southern Ethiopia. *BMC Research Notes* 7:155.
- Tupin CA, Minkah B, Danso KA, Frimpong EH (2007). Asymptomatic bacteriuria in pregnant women attending antenatal clinic at komfo anokye teach. *Ghana Medical Journal* 41(1):26-29.
- Turpin C, Minkah B, Danso K, Frimpong E (2007). Asymptomatic bacteriuria in pregnant women attending antenatal clinic at komfo anokye teaching hospital, kumasi, ghana. *Ghana Medical Journal* 41(1):26-29.
- Van Brummen HJ, Bruinse HW, Van Der Bom JG, Heintz APM, Van Der Vaart CH (2006). How do the prevalences of urogenital symptoms change during pregnancy?. *Neurourology and Urodynamics* 25(2):135-139.
- Van der Bij AK, Pitout JDD (2012). The role of international travel in the worldwide spread of multiresistant enterobacteriaceae. *Journal of Antimicrobial Chemotherapy* 67(9):2090-2100.
- World Health Organization (WHO) (2005a). Urinary Tract Infections in Infants and Children in Developing Countries in the Context of IMCI.
- World Health Organization (WHO) (2005b). *World Health Organization\_2006\_Child\_Growth@journals.lww.com*.  
[http://journals.lww.com/jpgn/Abstract/2013/08000/World\\_Health\\_Organization\\_2006\\_Child\\_Growth.25.aspx](http://journals.lww.com/jpgn/Abstract/2013/08000/World_Health_Organization_2006_Child_Growth.25.aspx)
- Yusuf A, Begum A, Ahsan CR, Bauer K (2015). Antibiotic sensitivity pattern of gram negative uropathogenic bacilli at a private hospital in Dhaka city. *Al Ameen Journal of Medical Sciences* 8(3):189-194.