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Asymptomatic Bacteriuria and Its Determinants Among Pregnant Women In Rural Southwestern Nigeria

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Abstract:
Background: The occurrence of asymptomatic bacteriuria in pregnancy has been associated with adverse maternal and fetal outcomes.
Objective: This study determined the prevalence of asymptomatic bacteriuria and its determinants among pregnant women in rural Southwestern Nigeria.
Methods: A hospital-based cross-sectional study was conducted between June 2021 and May 2023 among 400 pregnant women with no signs or symptoms of urinary tract infection. Demographic and clinical data were collected using structured questionnaires. Mid-urine samples were cultured using standard laboratory procedures. Bacterial colonies were isolated, and antimicrobial sensitivity was measured using the disc diffusion technique. Data were analyzed using SPSS version 22. The determinants of asymptomatic bacteriuria were measured using odds ratio and 95% confidence Interval (CI) with significant level (p-value <0.05).
Results: The prevalence of asymptomatic bacteriuria was 24.0% (95% CI = *18.2% - 30.5%*). The determinants of asymptomatic bacteriuria were the absence of post-coital urination (AOR, 4.433; 95%CI: 1.462-7.116), diabetes mellitus (AOR, 2.468; 95% CI: 1.300 – 4.684), and anaemia (AOR, 2.699; 95%CI: 1.042 – 6.729). The most detected asymptomatic bacteriuria was *E. coli* 52/96 (54.2%). The cultured isolates were 100.0% sensitive to ceftriaxone and ceftazidine but were 100.0% resistant to ampicillin and erythromycin.
Conclusion: Based on the urine culture and sensitivity results, the study suggests using ceftriaxone or ceftazidine as an empirical treatment for asymptomatic bacteriuria.
Keywords: Asymptomatic bacteriuria, pregnant women, determinants, rural Nigeria

Introduction

In the absence of any sign or symptom of urinary tract infection (UTI) in pregnancy, the presence of bacteria actively multiplying and significantly greater than or equal to 105 colony-forming units per millilitre (ml) of urine is referred to as asymptomatic bacteriuria (ASB) (Bose et al., 2017).

The risk of ASB is doubled in pregnant women compared with their non-pregnant counterparts (Banda et al., 2020; Tadesse et al., 2018). Pregnant women's physiological and anatomical status changes caused by gestation and reduced immune systems contribute to ASB in pregnant women (Azami et al., 2019; Afunwa et al., 2017).

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During pregnancy, ASB enhances the likelihood of the infection progression to the symptomatic case, which may come with adverse maternal or fetal consequences (Sunkar et al., 2021; Sujatha et al.2021).

Globally, the prevalence of ASB among pregnant women is estimated to be 2-11%, although in Sub- Sahara Africa (SSA), higher rates have been reported (Tadesse et al. 2018; Edae et al., 2020). In Nigeria, prevalence of ASB in pregnant women varies from one region to the other, such as 10.3% in Jos, North central Nigeria (Banda et al. 2020), 13.6% in Port Harcourt, Southern Nigeria (Tosin et al.2004) and 23.9% in Sagamu, Southwestern Nigeria (Olusanya et al.1993). The observed variations in the prevalence of ASB among these regions are due to several factors, such as socio-demographics and pregnancy-related factors of pregnant women (Renko et al.2011). Shreds of evidence also support patients with co-morbid conditions such as diabetes, hypertension, Acquired Immunodeficiency Disease Syndrome (AIDS)/ Human Immunodeficiency Virus (HIV), defects of the urinary tract, and history of UTI with increased risk of ASB (Banda et al. 2020; Renko et al., 2011).

Previous studies have reported *Eschericial coli (E.coli)*, *Staphlococcus aureus (S. aureus)*, and *Klebsiella* species (K. species) as the most common bacterial isolates from pregnant women with ASB in SSA (Banda et al., 2020; Sunkar et al., 2021; Edae et al., 2020). However, in Nigeria, like many other countries in SSA, urine microscopy, culture, and sensitivity (m/c/s) do not form part of the standard laboratory investigations conducted in women during the antenatal visits, probably due to the cost and the long waiting time in getting the results. This lack of inclusion of m/c/s hindrances the understanding of the burden, bacterial aetiology, and sensitivity pattern of ASB in women, thus preventing proper management of women with ASB.

Moreover, the emergency of antimicrobial drug resistance by most uropathogens will increase the risk of women with pregnancy-associated complications. To prevent these adverse outcomes, many researchers have advocated for routine screening and treatment for ASB as part of antenatal care guidelines (Mirei et al., 2016).

Despite an association of ASB with adverse pregnancy, there is a paucity of data on the burden of ASB and its determinants in rural Southwestern Nigeria. Although few efforts to unravel the burden of ASB in urban and sub-urban centres have been documented in the literature, there is none in rural areas (Banda et al., 2020; Ezugwa et al., 2021). Therefore, this study aimed to determine the prevalence of ASB and its determinants among pregnant women presenting to annexes of a tertiary hospital in rural Southwestern Nigeria.

Materials and Methods:

Study setting: This study was conducted between June 2021 and May 2023 in one of the study institution's outreach centres in a rural community in Southwestern Nigeria. According to the recent 2006 national population census, the community has a population of 219,000, with an annual growth rate of 3.2% (Ekiti Profile, 2007).

Study design/population: The study was a health facility-based cross-sectional among pregnant women who presented for antenatal care between June 2021 and May 2023.

Inclusion/Exclusion Criteria

The inclusion criteria were consented to healthy pregnant women aged 18-45 years who presented for routine antenatal care services. Women were excluded in case they were less than 18 years, residents in an urban area, had signs or symptoms suggestive of UTI, had vaginal bleeding, or had used antibiotics in the preceding two weeks of their coming to the antenatal clinic.

Sample size determination

The sample size for the study was calculated using the formula Z^2PZ/d^2 (Araoye, 2003), where 'p' is the prevalence of 37.1% ASB observed in the study conducted by (Tosin et al., 2004), Z is the type 1 error at 5%, and d is the margin of error). Therefore, based on sample size calculations (p = 0.371, z = 1.96, d = 0.05), the requisite sample size was 358, which was increased to 400 to cater to attrition.

Selection of respondents

The researchers used systematic sampling to select the respondents for the study. Using the antenatal clinic register for the year 2020, an average of 10 pregnant mothers were seen weekly, giving a total of 1040 (sample frame) over the two years that the study was conducted.

The formula K (sampling interval), which is sample frame (1040) divided by sample size (400), is used. Therefore, K = approximately 3. At the beginning of each clinic day, the first respondent was randomly selected using a simple random technique. Each third respondent was selected by systematic sampling until the sample size of 400 was achieved. The folder of the selected mother was tagged to prevent its re-sampling at the subsequent antenatal visits.

Data collection methods
A standardized interviewer-administered questionnaire assessed the respondents' socio-demographics, obstetrics and gynaecological factors. Socio-demographics included age in years, marital status, educational level, occupation, and monthly income. Obstetrics and gynaecological factors (pregnancy-related factors) included parity, estimated gestational age, history of catheterization, previous history of UTI, and history of post-coital urination. Furthermore, a history of co-morbid conditions such as diabetes mellitus, hypertension, and HIV/AIDS was also assessed through face-to-face interviews.

Clean-catch midstream urine sample collection
The respondents were instructed to collect about 20 ml of standard midstream urine by the "clean catch" method into a wide-mouthed screw-capped universal urine container. The respondents' identification number, date, and time of collection were labelled outside the container. The collected samples were kept in a cold box and sent to the medical microbiology laboratory department of the study centre for processing within 45 minutes of collection time.

Bacterial isolation through urine culture
The urinalysis with microscopy examination was performed to identify bacteria. Positive samples were processed for culture and sensitivity. Urine culture was performed using the standard wire loop method. Briefly, a loop-full (0.001ml) of well-mixed urine was streak-inoculated on CLED, MacConkey and Chocolate agar plates. The plates were incubated aerobically at 37 °C for 24 hours. A diagnosis of ASB was made if there were more than 10^{5} colony forming units/ml (CFU/ml) of urine with 2 or fewer isolates. Significant isolates were identified using colonial appearance on culture plates, microscopic appearance on Gram-stain and biochemical techniques through standard laboratory identification methods (Prasanna et al.2015).

Antibiotic Susceptibility Testing
The Kirby-Bauer Disc diffusion test carried out the antibiotic susceptibility test with 0.5 McFarland Standard turbidity of the inoculums on Muller-Hinton agar. Inhibition Zone diameter (IZDs) was measured (Mary & PKSS, 2020). The following antibiotics discs (Oxoid, Ldd., UK) were tested on the isolates, which included representative of the antimicrobials against methicillin-resistant Staphylococcus aureus (MRSA) infections and cephalosporin group (Clindamycin (2ug), ceftriaxone (30ug), ceftazidine (30ug), ampicillin (10ug), amoxicillin-clavulanate (20/10ug), erythromycin (15ug), ciprofloxacin (5ug), fosfomycin (200ug), nitrofurantoin (300ug), and co-trimoxazone (25ug). Two medical microbiologists in the hospital carried out the selection for testing and results determination and were based on the Clinical Laboratory Standards Institute Protocols (PK et al. 2020, CaLSI, 2018). Moreover, a senior medical microbiologist was placed on standby to cross-check the results and ensure that quality control was followed.

Ethical consideration
Ethical clearance was obtained from the Ethics and Research Committee of the study institution with approval number ERC/2021/03/19/62A. All consented patients were thoroughly informed about the risks and advantages of the procedures. Written informed consent for the procedure and treatment was obtained from each respondent, and participation was entirely based on their willingness. Confidentiality and privacy were ensured throughout the study. The study was at no cost to the respondents. The reporting of this study conforms to the strengthening of the Reporting of Observational Studies in Epidemiology (STROBE) statement (Von Elm et al.2007).

Treatment of respondents with ASB
The respondents diagnosed with ASB were directed to see a physician for treatment. They were adequately counselled on good personal and environmental hygiene to prevent recurrence. After this, they were given a prescription for either ceftazidine or ceftriaxone.

Statistical analysis

The data collected were checked, cleaned, and entered EPI Info Version 7.0 and exported to SPSS version 22.0 for analysis. The prevalence of ASB was computed as a proportion by dividing the number of positive cultures by the total sample size, and it was reported as a percentage. The Chi (x^2) squared, and Fischers' exact tests were used to determine the association between maternal socio-demographics, obstetrics and gynaecological factors, and co-morbid conditions with ASB. All factors found to have a significant association with ASB in the bivariate analysis (p-value < 0.05) were entered in a stepwise multivariate logistic regression model to determine the factors independently associated with ASB. Results were presented as adjusted odds ratios with corresponding 95% confidence intervals.

Results:

This study studied 400 pregnant women. The mean age of the respondents was 28.2 ± 5.9 (range 18-40) years. Most were married, 378 (94.5%), and 380 (95.0%) had formal education. Most respondents were self-employed 210 (52.5%) but lived below the poverty line because they earned less than 2.2 dollars per day 240 (40.0%), Table 1.

Table 1: Socio-demographic characteristics of the patients (N = 400)

Variable	Frequency N = 400	Percentage (%)
Age (in years)		
< 20	18	4.5
20 – 29	234	58.5
30 – 39	138	34.5
≥ 40	10	2.5
Mean age ± SD	*28.2 ± 5.9*	
Range (min. – max.)	*18 – 42*	
Marital Status		
Single	10	2.5
Married	378	94.5
Divorced	8	2.0
Widowed	4	1.0
Education		
Informal	20	5.0
Formal	380	95.0
Occupation		
Self-employed	210	52.5
Civil Servant	92	23.0
House wife	98	24.5
Income level		
< 2.2 dollars per day	240	60.0
≥ 2.2 dollars per day	160	40.0

A total of 96/400 respondents were positive for ASB, giving an overall prevalence of 24.0% (95% CI = *18.2% - 30.5%*). The most detected ASB was *E. coli* 52/96 (54.2%); the only gram-positive organism was *S. aureus* 16/96 (16.6%). Few respondents had dual cultured isolates (Table 2).

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Table 2: Asymptomatic Bacterium (ASB) and pattern of isolates (N = 400)

Variable	Frequency N = 400	Percentage (%)
Asymptomatic Bacteria		
Yes	96	24.0
95% Confidence Interval	*18.2% - 30.5%*	
Pattern of isolates	*n* = 96	
E.C. – E. coli	52	54.2
S.A. – *S. aureus*	16	16.6
K.P. – *K. pneumonia*	12	12.5
P.T. – *Proteus species*	12	12.5
PSA – *Pseudomonas aeruginosa*	4	4.2

In this study, the association between variables of socio-demographic characteristics and ASB was not statistically significant (P>0.05), Table 3.

Table 3: Association between ASB and socio-demographic characteristics (N = 400)

Variable	**Asymptomatic Bacteria**			**Chi-square**	**p-value**
	Positive n(%)	**Negative n (%)**	**Total (%)**		
Age (in years)					
< 20	4 (25.0)	12 (75.0)	16 (4.0)	0.277	0.964
20 – 29	50 (21.5)	183 (78.5)	233 (58.3)		
30 – 39	32 (22.9)	108 (77.1)	140 (35.0)		
≥ 40	2 (18.2)	9 (81.8)	11 (2.7)		
Marital Status					
Single	2 (25.0)	6 (75.0)	8 (2.0)	1.064	0.786
Married	84 (22.0)	298 (78.0)	382 (95.5)		
Divorced	2 (28.6)	5 (71.4)	7 (1.8)		
Widowed	0 (0.0)	3 (100.0)	3 (0.8)		
Education					
Informal	6 (33.3)	12 (66.7)	18 (4.5)	1.411	0.235
Formal	82 (21.5)	300 (78.5)	382 (95.5)		
Occupation					
Self-employed	41 (119.6)	168 (80.4)	209 (52.3)	2.138	0.343
Civil Servant	26 (27.1)	74 (72.9)	96 (24.0)		
Housewife	21 (22.1)	74 (77.9)	163 (40.8)		
Income level					
< 2.2 dollars per day	59 (24.9)	178 (75.1)	237 (59.3)	2.840	0.092
≥ 2.2 dollars per day	29 (17.8)	134(82.2)	163 (40.8)		

In the current study, there was a statistically significant association between ASB and respondents with post-coital urination (p<0.001) (Table 4).

Table 4: Association between ASB and pregnancy-related factors (N = 400)

Variable	**Asymptomatic Bacteria**			**Chi square**	**p-value**
	Positive n (%)	**Negative n (%)**	**Total (%)**		
Parity					
Primigravida	24 (20.7)	92 (79.3)	116 (29.0)	0.163	0.686
Multigravida	64 (22.5)	220 (77.5)	284 (71.0)		
Trimester (EGA)					
First	9 (16.7)	45 (83.3)	54 (13.5)	2.099	0.350
Second	34 (25.8)	98 (74.2)	132 (33.0)		
Third	45 (21.0)	169 (79.0)	214 (53.4)		

Previous history of urethral catheterization					
Yes	21 (30.0)	49 (70.0)	70 (17.5)	3.165	0.075
No	67 (20.3)	263 (79.7)	330 (82.5)		
Previous history of Urinary Tract Infection					
Yes	27 (27.6)	71 (72.4)	98 (24.5)	2.331	0.127
No	61 (20.2)	241 (79.8)	302 (78.0)		
Post-coital urination					
No	48 (54.5)	40 (45.5)	88 (22.0)	69.639	**<0.001**
Yes	40 (12.8)	272 (87.2)	312 (78.0)		

Furthermore, there was a statistically significant association between ASB and respondents who had diabetes (p= 0.023), hypertension (p<0.033), and anaemic (p< 0.001), Table 5.

Table 5: Association between ASB and co-morbid conditions (N = 400)

Variable	Asymptomatic Bacteria			Chi square	p-value
	Positive n (%)	Negative n (%)	Total (%)		
Diabetes mellitus					
Yes	7 (46.7)	8 (53.3)	15 (3.8)	5.526	**0.019**
No	81 (21.0)	304 (79.0)	385 (96.3)		
Hypertension					
Yes	16 (44.4)	20 (55.6)	36 (9.0)	11.613	**0.001**
No	72 (19.8)	292 (80.2)	364 (91.0)		
HIV/ AIDS					
Yes	2 (40.0)	3 (60.0)	5 (1.3)	0.956	0.328
No	86 (21.8)	309 (78.2)	395 (98.7)		
Anemic status					
PCV ≤ 30%	50 (39.4)	77 (60.6)	127 (31.8)	32.718	**<0.001**
PCV > 30%	38 (13.9)	235 (86.1)	273 (68.3)		

In this study, after adjusting for possible confounders, the odds of being infected with ASB were 4.433 times (95% CI: 1.462-7.116) higher among pregnant women with the absence of post-coital urination, 2.468 times (95% CI: 1.300 – 4.684) higher among pregnant women with a history of diabetes mellitus, and 2.699 times (95% CI: 1.300 – 4.684) higher among the respondents with anaemia (Table 6).

Table 6: Multivariate logistic regression for the determinants of ASB in this study

Variable	+ve ASB	Total Examined	COR (95% CI)	p	AOR (95% CI)	P
Post-coital urination						
Yes	48 (54.5)	88 (22.0)	8.160 (4.779 – 13.933)	**<0.001**	8.982 (1.469 – 24.937)	**0.018**
No			1.000		1.000	
Diabetes mellitus						
Yes	7 (46.7)	15 (3.8)	3.284 (1.157 – 9.324)	**0.019**	3.372 (1.552 – 8.074)	**0.024**
No			1.000		1.000	
Hypertension						
Yes	16 (44.4)	36 (9.0)	3.244 (1.601 – 6.574)	**0.001**	1.722 (0.524 – 5.663)	0.371
No			1.000		1.000	
Anemic status						
PCV ≤ 30%	50 (39.4)	127 (31.8)	4.016 (2.450 – 6.582)	**<0.001**	2.642 (1.420 – 4.916)	**0.002**
PCV > 30%			1.000		1.000	

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The gram-negative isolates were 100.0% sensitive to ceftriaxone, ceftazidine, and clindamycin but 100.0% resistant to ampicillin, erythromycin, and co-trimoxazole. Similarly, S. aureus was 100.0% sensitive to ceftriaxone, ceftazidine, and fosfomycin but 100.0% resistant to ampicillin, erythromycin, and amoxicillin-clavullate (Table 7).

Table 7: Antibiotics Sensitivity Pattern of Profile of Bacterial Isolates of Respondents with ASB

Bacterial Isolates	No of Isolated	CRO (%)	CTD (%)	AM-CL (%)	ETM(%)	A (%)	CPF (%)	COT (%)	CD (%)	FFM(%)	NIT (%)
E.Coli	52	52(100.0)	52(100.0)	26(50.0)	0(.0)	0(0.0)	20(38.5)	0(0.0)	52(100.0)	26(50.0)	16 (30.7)
Klebsiella Spp.	12	12(100.0)	12(100.0)	8(66.0)	0(0.0)	0(0.0)	10(82.5)	0(0.0)	12(100.0)	6(50.0)	8(66.0)
Proteus	12	12(100.0)	12(100.0)	10(82.5)	0(0.0)	0(0.0)	4(33.0)	0 (0.0)	12(100.0)	8(66.0)	6(50.0)
Pseud. Spp.	4	4(100.0)	4(100.0)	2(50.0)	0(0.0)	0(0.0)	2(50.0)	0(0.0)	4(100.0)	2(50.0)	2(50.0)
S. aureus	16	16(100.0)	16(100.0)	0(0.0)	0(0.0)	0 0.0)	4(25.0)	4(25.0)	12(75.0)	16(100.0)	12(75.0)
Total	96	96(100.0)	96(100.0)	46(81.3)	0(0.0)	0(0.0)	40(0.4)	4(31.3)	96(52.1)	58(31.3)	44(52.1)

CRO, Ceftriaxone; CTD, Ceftazidine; AM-CL, Amoxicillin-clavullate; ETM, Erythromycin; A, Ampicillian; CPF, Ciprofloxacin; COT, Cotrimoxazole; CD, Clindamycin, FFM, Fosfomycin; NIT, Nitrofurantoin.

Discussion

The overall prevalence of ASB in this study was 24.0%. This agreed with 23.9% reported in another Southwestern Nigeria (Olusanya et al., 1993). However, the result was higher than the 10.3% reported in Jos, North Central Nigeria (Banda et al., 2020). It was also higher than reported in other studies outside Nigeria, such as 16.7% in Lucknow, India (Sunkar et al., 2021) and 3.75% in Eastern Uganda (Nteziyaremye et al., 2020).

These other studies were carried out in the urban settings. Including respondents with co-morbid conditions in this study might also explain the higher prevalence of ASB compared with these other studies. On the contrary, the prevalence of ASB in this study was lower than the 29.5% reported in a study in Southeastern Nigeria (Izuchukwu et al., 2017), and the results from other countries such as Egypt, 29.0% (Nora et al.2017), and Southwest Cameroon 33.2% (Bisson et al., 2013). The differences between these studies and our study might be due to the sample size, geographical variations, prevalent social habits, and health-related practices (Tadesse et al., 2018; Ayoyi et al., 2017).

The current study showed that respondents who do not have a habit of post-coital urination were 4.433 times more likely to develop ASB. This finding was consistent with other studies that have found an association between a lack of post-coital urination and the risk of ASB (Edae et al., 2020; Schnar & Smail, 2008). These studies have linked the habit of post-coital urination to cleaning the urethra and preventing bacteria from entering the bladder during coitus.

The current study has revealed that respondents with diabetes mellitus were more likely to develop ASB when compared with their counterparts. The association between ASB and diabetes mellitus has been inconsistent in previous literature. The study in Southwestern Cameroon reported that diabetic patients were significantly at increased risk of ASB, which was consistent with the finding in this study (Bisson et al., 2013)). The increased risk of ASB in diabetes patients may be related to immune compromise and various genetic variants, such as C1q gene polymorphism (Van den Broek et al., 2020). However, another study found no significant association between ASB and patients with diabetes mellitus (Sentochnik & Eliopoglos, 2005).

The study showed that the presence of ASB was significantly associated with a packed cell volume of less than 30%. Pregnant women who were anaemic were more likely at risk of ASB when compared with their counterparts who were not. This agrees with findings in another study that linked a decrease in haemoglobin level to the occurrence of ASB (Cuttitta et al., 2014). This may be because pregnant women with iron deficiency are associated with a reduced immune system and are more likely to acquire infectious than those with normal iron levels (Tansarli et al., 2013).

This finding suggests that clinicians who provide antenatal care should screen pregnant mothers for anaemia to reduce the incidence of ASB.

In this study, the most common bacterial isolate was *E.coli*. This agreed with findings from a study in Nigeria (Banda et al., 2020), and studies in other countries (Sunkar et al., 2021; Edae et al., 2020). Reports from previous studies also indicate that *E.coli* possesses virulence factors that enhance their ability to colonize and invade the urinary tract (Tille et al., 2018). *E.coli* is also reported to be a common isolate in healthy pregnant mothers similar to the study population (Corgan et al., 2006). The presence of other members of the *Enterobacteriaceae* family, such as Klebsiella and Proteus species, which are predominantly of faecal origin, suggests poor personal hygiene in pregnant women.

The second most common isolated organism in this study was *S. aureus*, and this finding agreed with the reports from other studies where *S. aureus* was the second most common isolates (Banda et al., 2020; Bissong et al., 2013). However, it disagrees with a study reported in Uganda, where S. aureus was the most prevalent isolate (Fridreck et al., 2019) and a study reported in Ethiopia, where *S. pneumoniae* was the second most common isolated organism. The presence of *S. aureus* in the urine is due to poor genital hygiene by pregnant mothers (Nteziyaremye et al., 2020). The poor genital hygiene may be related to their low socio-economic factor and place of residence. The findings in this study call for continuous health education on improved personal and environmental hygiene to reduce the incidence of ASB due to the faecal-oral route.

In the current study, all the gram-negative isolates showed higher sensitivity (100.0%) to ceftriaxone, ceftazidine, and clindamycin but were resistant to ampicillin, erythromycin,and co-trimoxazole. This agreed with other studies (Tadesse et al., 2018; Edae et al., 2020).

Furthermore, *S. aureus* showed higher sensitivity (100.0%) to ceftriaxone, ceftazidine, and fosfomycin but was resistant to ampicillin, erythromycin, and amoxicillin-clavullate. Similar studies in Nigeria (Banda et al., 2020; Ezugwu et al., 2021) and other countries have reported majorly comparable findings (Tadesse et al., 2018; Tadesse et al., 2018).

Resistance to ampicillin, erythromycin, amoxicillin-clavullate, and co-trimoxazole, commonly used antibiotics, could result from overuse or misuse. These antibiotics are freely available for sale in Nigeria without a prescription (Banda et al., 2020; Ezugwu et al., 2021).

Limitations

The first limitation was that this research employed a cross-sectional design, which limited its ability to measure any causal association between ASB and other factors. The study was conducted in a hospital setting among respondents whose sample size was small, and thus, findings may not represent the general population. Notwithstanding these limitations, the study provides additional information regarding the burden and associated risk factors for ASB among pregnant women in rural Southwestern Nigeria.

Conclusion

The study showed that the prevalence of ASB among pregnant women in rural Southwestern Nigeria was 24.0%. The determinants of ASB were the absence of post-coital urination, diabetes mellitus, and anaemia. *E. coli* was the most isolated bacterial. Based on the urine culture and sensitivity results, the study suggests using ceftriaxone or ceftazidine as an empirical treatment. There may be a need to advocate for routine screening of pregnant women for ASB during the antenatal clinic to reduce the associated complications.

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References

Ayoyi, A.O., G. Kikuvi, C. Bii, S. Kariuki (2017). Prevalence, aetiology, and antibiotic sensitivity profile of asymptomatic isolates from pregnant women in selected antenatal clinic in Nairobi, Kenya. Pan. Afr. Med. J; 26:41. Doi: 10.11604/pamj.2017.26.41.10975

Araoye, M.,(2003). Subject Selection: Sample size determination In: Araoye MO. Research Methodology with Statistics for Health and Social Sciences. Nathadex Publishers; 117- 118.

Afunwa, R., I. Nwokediuko, C. Okolie (2017). Asymptomatic Urinary Tract Infection in Pregnant Women. Int. J. Med. Sci. Tech; 7:28-34.

Azami, M., Z. Jaafari, M. Masoumi, M. Shohani, G. Badfar, L. Mahmudi, et al, (2019). The etiology and prevalence of urinary tract infection and asymptomatic bacteriuria in pregnant women in Iran: asymptomatic review and meta-analysis. BMC Urol; 19 (1): 1-15.

Banda, J., D. Cletus, Z. Sheyin, S. Junaid, B. John, S.D. Mohammed, et al, (2020). Prevalence of asymptomatic bacteriuria among pregnant women attending antenatal clinic in Plateau State Specialist Hospital in Jos, Nigeria. Arch Microbiol Immunology; 4 (3); 121-130. DOI:10.26502/ami.93650051

Bissong, MEA., P.N. Fon, F.O. Tabe-Besong, T.N. Akenji (2013). Asymptomatic bacteriuria in diabetes mellitus patients in Southwest Cameroon. Afr Health Sci; 13(3): 661-6

Bose, A.M., P.K. Sreekumary, S.K. Pulikkottil (2017). "Microbiological profile of asymptomatic bacteriuria in pregnancy" Int J Repr Gynecol; 6(4): 1352

CaLSI, C.(2019). Performance Standards for Antimicrobial Susceptibility Testing. Approved Twenty: Document M100-S28."Wayne, PA, USA: CLSI2019.

Corgan, R., L.E. Nicolle, A. Mcglone, T.M. Hooton (2006). Asymptomatic bacteriuria in Adults. Am Fam Phy; 74(6): 985-90

Cuttitta, F., D.Torres, D. Vogiatzis, C. Buttà, M. Bellanca, D. Gueli, et al (2014). Obesity and Edae, M., Z.Teklemariam, F. Weldegebreal, D. Abate, (2020). Asymptomatic bacteriuria among pregnant women attending antenatal care at Hiwot Fana Specialized University Hospital, Harar, Eastern Ethiopia: Magnitude, Associated factors, and Antimicrobial susceptibility Pattern. Int. J. Microbiol; 20;2020:1763931.

Ezugwu, I.A., R. A, Afunwa, F.C. Onyia, C.R. Chukwunwejim, 1.M. Offe, C.O. Onyia, et al (20210. Prevalence of urinary tract infections and associated factors among pregnant women in Enugu Metropolis, Nigeria. J. Biosci. Med; 9 :156-171.

Fredrick, B., M. Shadrack, N. Prossy, O. Ismail, I.Sam, M. Nnakanwagi, et al (2019). Asymptomatic Bacteriuria and Candida Colonization among pregnant women in a distric hospital in Eastern Uganda. J. Adv. Med. Med. Res; 29 (10): 1-10 doi: 10.9734/jammr/2019/v29i1030130

Izuchukwu, K.E., E.O. Oranu, G. Bassey, N.C. Orazu-like (2017). Maternofetal Outcome of asymptomatic bacteriuria among pregnant women in a Nigerian teaching hospital. Pan. Afr. Med. J; 27: 69-76.

Mary, B.A., & S.S.PK (2016). Microbiological profile of asymptomatic bacteriuria in pregnancy. Criticare Obst & Gyne; 02 (05): 1352-61

Mwei, M.K., B. Mchome, B. John, E. Maro (2016). Asymptomatic bacteriuria among pregnant women attending antenatal clinic in Kilimanjaro Christian Medical Centre in Northern Tanzania. Clinical Practice; 15 (6): 917-22.

Nora, R., H. Mohamed, O. Abd-Allah (2017). Prevalence and risk factors of urinary tract infection among pregnant women in Ismaila City, Egypt. IOSR Journal of Nursing and Health Science; 6 (3): 62-72

Nteziyaremye, J., A.J. Iramiot, R. Nekaka, M.W. Musaba, J. Wandbwa, E. Kisegerwa et al (2020). Asymptomatic bacteriuria among pregnant women attending antenatal care at Mbale Hospital, Eastern Uganda. PLOS ONE; 15 (3): e0230523. Doi: 10.1371/journal.pone.0230523

Olusanya, O., A. Ogunledun,T. A. Fakoya (1993). Asymptomatic significant bacteriuria among pregnant and non-pregnant women in Sagamu, Nigeria. West Afr J. Med; 12 (1): 27-33.

Prasanna, B., M. Naimisha, K. Swathi, M. V. Shaik (2015). Prevalence of asymptomatic bacteriuria in pregnant women, isolates and their culture sensitivity pattern. Int. J. Microbiol. Appl Sci; 4(8):28-35.

Renko, M., P. Tapanainen, P. Tossavainen, T. Pokka, M. Uhari (2011). Meta-analysis of the significance of asymptomatic bacteriuria in diabetes care; 34 (1): 230-5.

Schnar, J., F. Smail (2008). Asymptomatic bacteriuria and symptomatic urinary tract infections in pregnancy. European J. Clin. Inves;38:50-57.

Sentochnik, D.E., Eliopoglos (2005). Infection and diabetes. In: Kahn CR, Weir GC, King GL, Jacobson AM, Moses AC, Smith RJ (editors). Joslins Diabetes Mellitus (14thed). Boston: Lipincott Williams and Wilkins;p.1017-34.

Sonkar, N., M. Banerjee, S. Gupta, A. Ahmad (2021). Asymptomatic Bacteriuria among pregnant women attending tertiary Care Hospital in Lucknow, India. Dubai Med J; 4: 18-25. DOI: 10.1159/000513626

Sujatha, R., M..Nawani (2014). Prevalence of asymptomatic bacteriuria and its antibacterial susceptibility pattern among pregnant women attending the antenatal clinic at Kanpur, India. J. Clin. Diagnostic. Res; 8(4): 2-4

Tadesse, S., T. Kahsay, G. Adhanom, G. Kahsu, H.G. Legese, A. Wahid, et al (2018). Correction to: prevalence, antimicrobial susceptibility profile and predictors of asymptomatic bacteriuria among pregnant women in Adigat General Hospital, Northern Ethiopia. BMC. Res Notes; 11 (1):798.

Tansarli, G.S., D.E. Karageorgopoulos, A. Kapaskelis, I. Gkegkes, M.E. Falagas (2013). Iron deficiency and susceptibility to infections: evaluation of the clinical evidence. Eur J Clin Microbiol Infect Dis; 32(10): 1253-8

Tille, P.M.,(2018). Bailey & Scott's diagnostic microbiology.14th ed: Elsevier; 2018

Tosin, O.A., A.O. Mathew, F.J. Bello, I.O. Oludare, A.L. Dolapo, A.F. Abosede (2014). Asymptomatic bacteriuria among antenatal women attending private hospital in Lagos, Nigeria. Sch J App Med Sci; 2 (6D): 3076-3080.

Van den Broek, B., M. van den Flier, R., de Groot, M.I. de Jonge, J.D, Langereis (2020). Common Genetic Variants in the complement System and their potential link with disease susceptibility and outcome of invasive bacterial infection. J. Innate Immun;12: 131-141.

von Elm, E., D.G. Altman, M. Egger, S. J. Pocock, P.C. Gotzsche, J.P. Vandenbroucke, et al (2007). The strengthening of the Reporting of Observational Studies in Epidemiology (STROBE) statement; guidelines for reporting observational studies. Ann Intern Med; 147: 573-7.