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Bacterial Urinary Tract Infection among Pregnant Women in Sana'a City-Yemen

العدوى البكتيرية للمسالك البولية بين النساء الحوامل في مدينه صنعاء-اليمن

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ABSTRACT:Urinary tract infection (UTI) is considered to be the most common bacterial infection during pregnancy. This study was designed to determine the prevalence of UTI among pregnant women, to identify the risk factors associated with UTI, to isolate and identify bacteria that are responsible for UTI and to determine the activity of some antibiotics against isolated bacteria. A total of 400 midstream urine specimens were collected from pregnant women (PW) and non-pregnant women (NPW). Identification and antibiotic sensitivity tests were made for the isolated bacteria. The prevalence rates of UTI in PW and NPW were 24.3% and 18.0%, respectively. The association between pregnancy and UTI was not statistically significant (P= 0.19). The higher prevalence rate of UTI was found in the age group 21-25 years old. However, there was no statistical significant association between age and UTI. The second trimester and the third trimester were associated with highest prevalence of UTI (38.3%) and (37.0%), respectively but it was not statistically significant. High frequency of urination and lower abdominal pain were the most common symptoms. There was no statistical association between UTI and contraceptive use. The most common isolates were S. aureus and E. coli, while the most effective antibiotics for most bacterial isolates were ciprofloxacin, ofloxacin and norofloxacin.
Keywords: *Urinary tract, Bacteria, Pregnant Women, Sana'a, Yamen.*

المستخلص: تعتبر عدوى المسالك البولية (UTI) العدوى الأكثر شيوعاً أثناء فترة الحمل. هذه الدراسة صممت لتحديد انتشار (UTI) بين النساء الحوامل، لتعريف عوامل الخطورة المرتبطة بـ (UTI)، لعزل وتعريف البكتيريا المسئولة عن (UTI)، ولتحديد تأثير بعض المضادات الحيوية ضد البكتيريا المعزولة. تم جمع 400 عينة من وسط مجرى البول، منها 300 عينة من نساء حوامل (PW) و100 عينة من نساء غير حوامل (NPW)، وزرعت هذه العينات وتم عمل فحص المضادات الحيوية للبكتيريا المعزولة. كان معدل انتشار عدوى المسالك البولية في النساء الحوامل وغير الحوامل 24.3% و 18.0%، على التوالي. الارتباط بين الحمل وعدوى المسالك البولية لم يكن ذو دلالة إحصائية (P=0.19). ووجد اعلى معدل لانتشار العدوى في الفئة العمرية 21-25 سنة، ومع ذلك لم يكن هذا الارتباط ذو دلالة إحصائية. الثلثين الثاني والثالث من الحمل ارتبط بمعدل انتشار عالي للعدوى 38.3% و37.0%، على التوالي، لكنه لم يكن ذو دلالة إحصائية. النساء اللواتي كان عندهن عدوى متكررة بالمسالك البولية كن أكثر عرضة للإصابة مرة أخرى، وكان هذا الارتباط ذو دلالة إحصائية عالية (P=0.0006). تكرار التبول والإلم أسفل البطن كانا الاعراض الأكثر شيوعاً. كما أظهرت النتائج أنه لم تكن هناك علاقة بين عدوى المسالك البولية و استخدم موانع الحمل. كانت البكتيريا المعزولة الأكثر شيوعاً هي استافيلوكوكس ايريس و ايشريشيا كولاي، بينما كانت السبروفلوكساسين، الاوفلوكساسين، والنورو فلوكساسين المضادات الحيوية الاكثر فاعلية لاكثر العزلات.
كلمات مدخلية: *المسالك البولية، بكتيريا، النساء الحوامل، صنعاء، اليمن.*

INTRODUCTION

Urinary tract infection (UTI) is one of the most common medical problems. It has been estimated that 150 million patients are diagnosed with UTI yearly in USA (Stamm and Norrby, 2001). UTI refers to the presence of microbial pathogens within the urinary tract (Foxman, 2002), which is second only to the respiratory tract in acquiring microbial infection, especially in females (Mittendorf *et al.*, 1992). UTIs are still one of the most common bacterial infections in pregnant women as well as the non pregnant women. In Germany, it is estimated that about 10-20% of all women suffer from a UTI at some point in life (Weissenbacher and Reisenberger, 1993). Many studies in Yemen have shown that women are more susceptible to UTI than men (Nasher *et al.*, 2001; Al-Moyed and Al-Medhagi, 2004). UTI occurs more frequently in females than in males because of specific anatomical and functional features of female urinary system, sequel of pregnancy, delivery and gynecological diseases (Shabad *et al.*, 1995).

The urinary tract undergoes significant changes during pregnancy that impact the development of urinary tract infection (Thomas *et al.*, 2003). This change includes dilation of the ureter, decrease in ureteral peristalsis, and decrease in bladder tone. Additionally, the physiologic increase in plasma volume during pregnancy decrease urine concentration and increase urinary progestines and estrogens, which may lead to a decrease ability of the lower urinary tract to resist invading bacteria (Sescon *et al.*, 2003). UTIs are of great importance during pregnancy owing to undesirable complications such as fetal and maternal morbidity (Santos *et al.*, 2002).

The prevalence of bacteriuria increases with age and with sexual activity. Other contributing factors include socioeconomic status, history of recurrent UTIs, diabetes, and anatomic or functional urinary tract abnormalities (Thomas *et al.*, 2003).

The etiologic agents associated with bacteriuria are similar in pregnant and non pregnant women. Most of the organisms recovered by routine culture techniques continue to be the coliforms, with *E. coli*, followed by *K. pneumoniae*, *Enterobacter*, *Proteus mirabilis*, and others in smaller numbers (Thomas *et al.*, 2003).

Therapeutic management of UTIs in pregnancy requires proper diagnostic workup and thorough understanding of antimicrobial agents to optimize pregnancy outcome, ensure safety to the fetus, and prevent complications that lead to significant morbidity and mortality in both the fetus and the mother. All pregnant women should be screened for bacteriuria and subsequently treated with antibiotics such as nitrofurantoin, sulfisoxazole or cephalexin (Delzell and Lefevre, 2000; Le *et al.*, 2004). The aims of this study were to determine the prevalence of UTI among pregnant women, to identify risk factors associated with UTI, to isolate and identify bacteria that are responsible for UTI and to determine the antibiotics sensitivity of the isolated bacteria.

SUBJECTS AND METHODS

Subjects

A cross sectional descriptive study was conducted during the period from March 2005 to February 2006. A total of 400 subjects were selected randomly, 300 pregnant women and 100 non-pregnant women seen at "Al-Sabeen" and "Al-Umm" hospitals and "Childhood and Maternal Center" (Al-Olofy Center) located in Sana'a city. The age of the studied subjects ranged from 13 to 45 years old for pregnant women and from 17 to 60 years old for non-pregnant women. All subjects were interviewed using a standardized questionnaire, which included sociodemographic information, and the clinical symptoms of UTI.

Methods

Clean catch mid stream urine (MSU) specimens were collected in the morning in a sterile container and subjected to routine and microscopic examination. Each MSU specimen was inoculated on both Blood agar media and MacConkey agar media (Oxioid, U.K and HIMEDIA, India) plates and incubated aerobically for 24 hours at 37 °C. Each significant bacterial growth was identified by biochemical reactions and all identified isolates were examined for antibiotic sensitivity test using the Kirby-Bauer disk diffusion method (Cheesbrough, 1984) by using nutrient agar media and Mueller Hinton agar media.

Statistical analysis

Data were analyzed using Epi-Info version 6.

RESULTS

Prevalence of UTI and non-UTI among pregnant women and non-pregnant women.

Out of 400 women, 91 (22.8%) had UTI. Of 300 PW 73 (24.3%) had UTI while of 100 NPW 18 (18.0%) had UTI. There was no statistical significant association between pregnancy and UTI, χ^2= 1.7, P = 0.19 (Table 1).

Distribution of UTI according to the age groups.

The distribution of UTI according to the age groups is shown in Table 2. It was found that the highest prevalence of UTI in PW and NPW was found in the age group 21 to 25 years 35.6% and 44.4%, respectively. The lowest prevalence of UTI among PW was in the age group >40 years (1.4%) while the lowest prevalence of UTI among NPW was in the age group 36 - >40 years (5.5%). There was no statistical significant association between the age groups and UTI.

Distribution of UTI in relation to the stage of pregnancy

As shown in Table 3, the prevalence of UTI in the first, the second and the third trimester were 24.7%, 38.3%, and 37.0%, respectively. It was found that the prevalence of UTI in the second trimester (38.3%) and the third trimester (37.0%) were higher than that of the first trimester (24.7%). However, no statistical significant association between the stage of pregnancy and UTI was found.

Prevalence of UTI in relation to the history of recurrent UTI

The Prevalence of UTI in relation to the history of recurrent UTI is shown in Table 4. It was found that 53.4% (39 out of 73 PW) had recurrent UTI, while among NPW 77.8% (14 out of 18 NPW) had recurrent UTI and the relationship between the history of recurrent UTI and UTI was statistically highly significant, χ^2=11.5 and P=0.0006.

Prevalence of UTI in relation to the use of contraceptive in non-pregnant women

Table 5 shows that the higher prevalence of UTI was found among non-pregnant women who had not used contraceptive 55.6% compared to those who had used contraceptive 44.4%. There was no statistical significant association between contraceptive use and UTI, χ^2= 2.8 and P=0.09.

Table 1. Distribution of UTI and non- UTI among pregnant women and non-pregnant women.

Type	pregnant women		Non-pregnant women		Total		χ^2	p
	No.	%	No.	%	No.	%		
UTI	73	24.3	18	18.0	91	22.8	1.7	0.19
Non-UTI	227	75.7	82	82.0	309	77.2	-	-
Total	300	100	100	100	400	100	-	-

Table 2. Distribution of UTI and non- UTI among pregnant women (PW) and non-pregnant women (NPW) according to their age groups.

Age (Years)	UTI				Non-UTI				χ^2	P
	PW		NPW		PW		NPW			
	No.	%	No.	%	No.	%	No.	%		
13 - 20	23	31.5	3	16.7	72	31.7	10	12.2	0.14	0.9
21 - 25	26	35.6	8	44.4	84	37.0	35	42.7	1.54	0.2
26 - 30	17	23.3	3	16.7	46	20.3	19	23.2	0.04	0.8
31 - 35	6	8.2	2	11.1	21	9.2	4	4.9	0.05	0.8
36 - 40	0	0	1	5.5	4	1.8	6	7.3	1.2	0.2
> 40	1	1.4	1	5.5	0	0	8	9.7	0.04	0.8
Total	73	100	18	100	227	100	82	100	-	-

Table 3. Distribution of UTI in relation to the stage of pregnancy.

Stage of pregnancy	UTI		Non-UTI		χ^2	P
	No.	%	No.	%		
1 st Trimester	18	24.7	39	17.2	2.01	0.15
2 nd Trimester	28	38.3	89	39.2	0.02	0.89
3 rd Trimester	27	37.0	99	43.6	0.9	0.3
Total	73	100	227	100	-	-

Table 4. Prevalence of UTI in relation to the history of recurrent UTI among pregnant women (PW) and non-pregnant women (NPW).

History of recurrent UTI	UTI				Non-UTI				χ^2	P
	PW		NPW		PW		NPW			
	No.	%	No.	%	No.	%	No.	%		
Yes	39	53.4	14	77.8	165	72.7	71	86.6	11.5	0.0006
No	34	46.6	4	22.2	62	27.3	11	13.4	-	-
Total	73	100	18	100	227	100	82	100	-	-

Table 5. The relationship between the use of contraceptive and prevalence of UTI in non-pregnant women (NPW).

Contraceptive use	UTI		Non-UTI		χ^2	P
	No.	%	No.	%		
Yes	8	44.4	54	65.9	2.8	0.09
No	10	55.6	28	34.1	-	-
Total	18	100	82	100	-	-

Distribution of UTI and non-UTI with respect to the symptoms

Distribution of UTI with respect to symptoms among pregnant women (PW) and non-pregnant women (NPW) is shown in Figure 1. In pregnant women (PW) with UTI, high frequency of urination and lower abdominal pain were the most common symptoms (85.0%), followed by ureteric pain (72.6%), dysuria (53.4%), fever (48.0%), urgency (46.5%), and nocturia (45.2%).

In non-pregnant women (NPW), lower abdominal pain was the most common symptom (50.0%), followed by urgency (44.4%), dysuria (38.8%), high frequency of urination (38.8%), uretric pain (33.3%), fever (27.7%) and nocturia (16.6%). It was found that there was no statistical significant association between the symptoms and UTI except for high frequency of urination and lower abdominal pain where χ^2= 4.3 and *P*= 0. 03, χ^2= 4.9 and *P*= 0.02, respectively.

Distribution of isolated bacteria

Distribution of bacterial isolates from pregnant women (PW) and non-pregnant women (NPW) with UTI is shown in Table 6. In PW, *Staphylococcus aureus* was the most commonly isolated organism (39.7%), followed by *Escherichia coli* (23.3%) and *Staphylococcus saprophyticus* (22.0%). In NPW, *Escherichia coli* (44.4%) was the most commonly isolate, followed by *Staphylococcus aureus* (17.0%), *Klebsiella pneumoniae* (11.1%).

Effect of some common antibacterial drugs against isolated bacteria

As shown in Figure 2, the antibiotic sensitivity test of the isolated bacteria from PW revealed that ciprofloxacin (76.7%), ofloxacin (63.0%) and norofloxacin (60.3%) were the most effective antibiotics for most isolates. The least effective antibiotics were cefotaxime, nalidixic acid and co-trimoxazole (20.5% for each).

The sensitivity test of antibiotics against bacterial isolates from NPW revealed that norfloxacin (94.4%), ciprofloxacin, and ofloxacin (83.3%) were the most effective antibiotics for most isolates. The least effective antibiotics were co-trimoxazole, amoxicillin (27.8%) and gentamicin (33.3%).

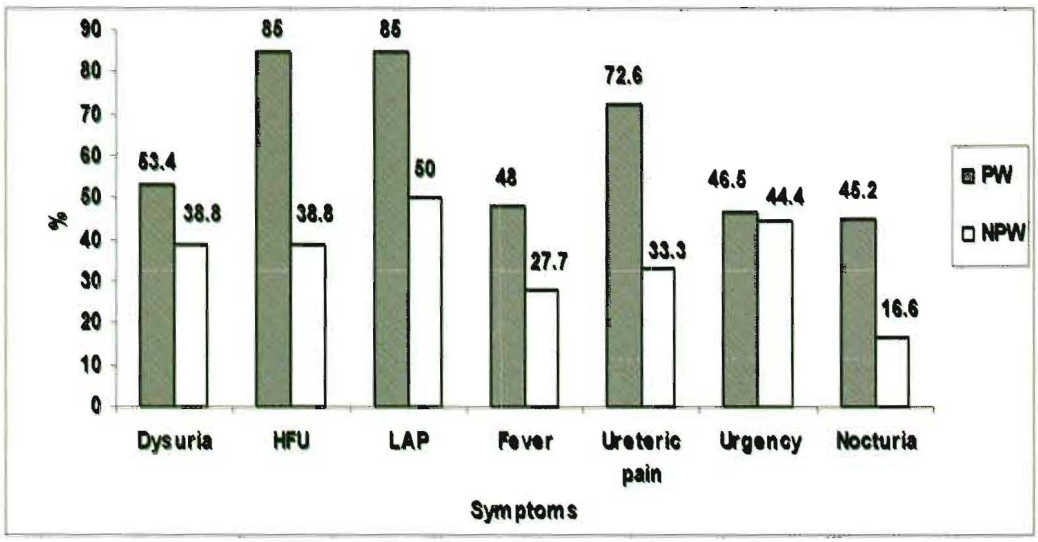

Fig. 1. Distribution of UTI with respect to symptoms among PW and NPW
HFU: High frequency of urination, LAP: Lower abdominal pain.

Table 6. Distribution of isolated bacteria from pregnant women (PW) and non-pregnant women (NPW) with UTI.

Isolated bacteria	pregnant women		non-pregnant women	
	No.	%	No.	%
Staphylococcus aureus	29	39.7	3	17.0
Escherichia coli	17	23.3	8	44.4
Staphylococcus saprophyticus	16	22.0	1	5.5
Klebsiella pneumoniae	4	5.5	2	11.1
Enterococcus faecalis	4	5.5	0	0
Enterobacter spp.	2	2.7	1	5.5
Pseudomonas aeruginosa	1	1.3	1	5.5
β - Hemolytic streptococci	0	0	1	5.5
Citrobacter freundii	0	0	1	5.5
Total	73	100	18	100

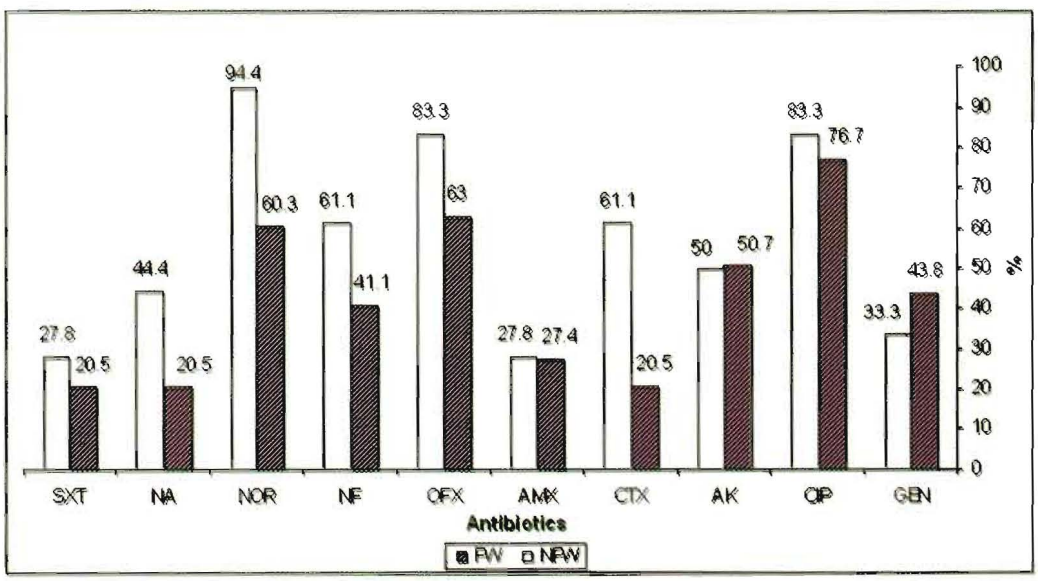

Fig. 2. The effect of some common antibacterial drugs against isolated bacteria
GEN. gentamicin, CIP. ciprofloxacin, AK. amikacin, CTX. cefotaxime, AMX. amoxicillin, OFX. ofloxacin, NF. nitrofurantoin , NOR. norofloxacin, NA. nalidixic acid, SXT. co-trimoxazole.

DISCUSSION

Pregnant women are more susceptible to infectious diseases (Hart, 1988), and the most frequent site of infection during pregnancy is the urinary tract (Andriole and Patterson, 1991). UTI elevated the risk of pyelonephritis, premature delivery, and fetal mortality among pregnant women (Foxman, 2003).

Our study showed that the prevalence of UTI in PW was higher (24.3%) than that of NPW (18.0%). However, the relation between pregnancy and UTI was not statistically significant ($p = 0.19$). Similar observation to our study was reported by Ahmed *et al.* (2003) who found that the prevalence of UTI in PW and NPW was 29.5% and 23.3%, respectively, and there was no statistical significant association between pregnancy and UTI. On the other hand, a study from Nigeria showed that 23.9% of PW and 12.2% of NPW had significant bacteriuria. The difference was statistically significant (Olusanya *et al.*, 1993).

The reasons for these differences could be attributable to anatomic, physiologic and hormonal changes, which contribute to significant changes in the urinary tract that favor development of UTI during pregnancy (Patterson and Andriole, 1997). These changes include dilatation of the ureter and decrease in ureteral peristalsis which are attributed to the ureteral smooth muscle-relaxation due to high levels of progesterone and the mechanical compression of the ureters by the uterus (Waltzer, 1981).

In this study, it was found that the highest prevalence of UTI was in the age group 21-25 years for both PW (35.6%) and NPW (44.4%). The association between age and UTI was not however statistically significant. This result is in agreement with those reported by Al-Haddad (2005) in Yemen who found that bacteriuria was commonest in the age group 15-24. This observation may be due to that women in this age (21-25 years) have more sexual activity so the susceptibility to UTI may be increased.

In contrast to our finding, AL-Sibai *et al.* (1989) in Saudi Arabia found that the prevalence of bacteriuria was more common in women below 20 years of age. On the other hand, Ahmed *et al.* (2003) reported that with increasing age the prevalence of UTI increased significantly both in PW and NPW.

The second trimester was associated with the highest prevalence of UTI (38.3%), followed by the third trimester (37.0%). The association between the stage of pregnancy and UTI was not statistically significant. This result is in agreement with the findings by Maciolek *et al.* (1994) and Sheikh *et al.* (2000) who also found that the incidence of UTI was higher in the second trimester. Other results reported by Nath *et al.* (1996) showed that the third trimester was associated with the highest number of UTI cases. It seems that UTI occurs most frequently at the end of the second trimester or early third trimester, when the hormonal changes of pregnancy are maximal, leading to autonomic muscular atony in the genitourinary tract (Patterson and Andriole, 1997).

Our results also showed that the prevalence of UTI was higher in both PW (53.4%) and NPW (77.8%) who had a history of recurrent UTI. This association between the history of recurrent UTI and current UTI was highly significant ($p = 0.0006$). Previously AL- Sibai *et al.* (1989), Maranchie *et al.* (1997) and Sescon *et al.* (2003) had all found that the history of recurrent UTI was a risk factor for UTI. This could be a reflection of a biological or behavioral predisposition of the host for persistent or recurrent colonization with an uropathogenic strain (Anjum *et al.*, 2004). Risk factors for recurrent UTI also include sexual intercourse, use of spermicidal products, having a first UTI at an early age, and having maternal history of UTIs. Inherited factors may play a role in some women with recurrent UTI. Other factors thought to predispose to recurrent UTI in women are pre and post-coital voiding patterns, and wiping patterns (Hooton, 2001).

The present study showed that although there was a higher prevalence of UTI among non-pregnant women who had not used contraceptive (55.6%), there was no statistical significant association between UTI and contraceptive use (P=0.09). This finding is in agreement with that reported by Sheikh *et al.* (2000). The reasons for this may be attributed to the duration of application, type of contraceptive used, and to the good personal hygiene practiced by these women. In contrast to our results Fihn *et al.* (1985), Hooton and Stamm (1996) and Scholes *et al.* (2005) found that diaphragm and spermicide use are risk factors for UTI.

High frequency of urination and lower abdominal pain were the most frequent symptoms in PW (85.0%), followed by ureteric pain (72.6%), and dysuria (53.4%), while lower abdominal pain was found to be the most common symptom in NPW (50.0%), followed by urgency (44.4%), dysuria, and high frequency of urination (38.8% for each). There was no statistically significant association between symptoms and UTI except for high frequency of urination (P= 0.03) and lower abdominal pain (P=0.02). This result is in agreement with the findings reported by Abdullah *et al.* (2000), and Ahmed *et al.* (2003), indicating that these symptoms are the most common in women with UTI.

The most commonly isolated bacteria among PW were *S. aureus* (39.7%) followed by *E. coli* (23.3%). This result is similar to that reported by Olusanya *et al.* (1993) in Nigeria. However, another study from Pakistan showed that *S. saprophyticus* was the most common bacteria isolated from UTI in PW (Sheikh *et al.*, 2000). Similar result was also reported recently by Shirazi *et al.* (2005) in Iran who found that the most common isolated bacterial strains in renal transplant recipients were coagulase negative staphylococci.

S. aureus are common pathogens that infect the urinary tract by hematogenous spread which can occur in immunocompromised patients (Nguyen, 2004). In contrast to our results Nath *et al.* (1996) in India, Alfredo and Marco (2001) in USA, and Ezechi *et al.* (2003) in Nigeria found that *E. coli* was the most common bacteria associated with UTI in PW.

Bacteria with minimal virulence characteristics are able to infect patients who are significantly compromised (Walsh, 2002). Among NPW it was found that *E. coli* was the most commonly isolated bacteria (44.4%). Our results are in agreement with those reported by Nasher *et al.* (2001) in Yemen, Lavanya and Jogalakshmi (2002) in India, Kahlmeter (2003) in Sweden and Scholes *et al.* (2005) in USA.

Most UTIs are caused by gut microorganisms, which reach the bladder via the urethra. Bacteria can reach the bladder more easily in female because the urethra is short and lies in close proximity to the anus. *E. coli* posses pili that aid its attachment to the epithelial cells of urinary tract, and its motility appears to contribute to its effectiveness as a uropathogen (Plorde, 1994). The ability of *E. coli* to adhere to epithelial cells is mediated by ligands located on the tips of the bacterial fimbriae (pili). The ligands bind to glycolipids or glycoprotein receptors on the surface membrane of uroepithelial cells (Nguyen, 2004).

Our study showed that the most effective antibiotics against most bacterial isolates in PW and NPW were ciprofloxacin, norofloxacin and ofloxacin, while the least effective antibiotics were nalidixic acid and co-trimoxazole. Our results are in agreement with those reported by Sheikh *et al.* (2000) in Pakistan, Abdul and Onile (2001) in Nigeria, Al-Moyed and Al-Medhagi (2004) in Yemen, and Onifade *et al.* (2005) in Nigeria. Difference in susceptibility to antibiotics of isolated bacteria may depend on the type of microorganisms, or due to emergence of resistant bacteria.

In conclusion, there was no a significant association between the prevalence of UTI and pregnancy, age, stage of pregnancy, and contraceptive use. Women who had recurrent UTI were more susceptible to UTI. The most commonly isolated bacteria were *S. aureus* and *E. coli*. Pregnant women should be screened for UTI as part of antenatal care, especially those with a history of recurrent UTI. Any abnormalities of urinary tract should be treated to avoid the complications of UTI. Women should practice a good personal hygiene, wipe from front to back to avoid contaminating the urethra with bacteria.

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