Epidemiology of Bacterial Urinary Tract Infection and Antibiotics Sensitivity among Pregnant Women at Taiz City, Yemen

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Abstract

Background: Bacterial Urinary Tract Infections (UTIs) is an infection caused by the presence and growth of bacteria anywhere in the urinary tract. **Objective:** The present study was done to evaluate epidemiology of UTI (prevalence, risk factors, bacterial isolates and antibiotic sensitivity) among pregnant women in Taiz, City, Yemen. **Methods:** A cross-sectional study design was used for this research from March 2022 to July 2022, including 200 outpatient cases of pregnant women, obtained from hospitals in Taiz-city, Yemen. Urine specimens of pregnant women using midstream urine. Bacteria were identified by standard microbiological methods. **Results:** *Escherichia coli* was the most prevalent isolate, it was recovered 36 (42.86%) of total bacterial UTIs samples, followed by *Staphylococcus aureus* as the second most common representing in 24 (28.57%), and *Klebsiella sp* was appeared in 15 (17.86%), the *Proteus sp* was representing in 5 (5.95%), and *Staphylococcus saprophyticus* appeared in 4 (4.76%). The remaining urine sample isolates were non-bacterial growth (negative cases), representing 116 (58%). Bacterial UTIs were highly present in the age group between 25-34 years, secondary education patients, housewife patients, third pregnancy or above, and during the third trimester. *Escherichia coli* isolates were (100%) sensitive to Tobramycin, Ceftazidime, Ceftriaxone and Aztreonam. *Klebsiella sp* isolates were (100%) sensitive to Tobramycin only. *Proteus sp* isolates were (100%) sensitive to Tobramycin, Ceftazidime, and Ceftriaxone. *Staphylococcus saprophyticus* isolates were (100%) sensitive to all antibacterial drugs except Methiciliin. *Staphylococcus aureus* isolates were (100%) sensitive to Tobramycin and Aztreon. **Conclusions:** *Escherichia coli* washwhfhj the most prevalent isolate from urine of pregnant women. The most important risk factors are third pregnancy, third trimester, and symptomatic bacteruria. Most of the tested antibiotics showed sensitivity to the bacterial isolates. Urine culture for screening and diagnosis purpose for all pregnant is recommended.
Keywords: Urinary Tract Infections, Pregnant women.

وبائيات الإصابات البكتيرية للمسالك البولية وحساسية المضادات الحيوية بين النساء الحوامل في مدينة تعز، اليمن

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الملخص

الخلفية العلمية: التهابات المسالك البولية البكتيرية هي عدوى ناتجة عن وجود ونمو البكتيريا في أي مكان في المسالك البولية. **الهدف من الدراسة:** أجريت الدراسة الحالية لتقييم وبائية إصابات المسالك البولية البكتيرية وحساسية المضادات الحيوية بين النساء الحوامل في مدينة تعز، اليمن. **المنهجية:** دراسة مقطعية خلال الفترة من مارس 2022 إلى يوليو 2022، جمعت 200 عينة من النساء الحوامل، تم الحصول عليها من مستشفيات مدينة تعز، اليمن. كانت العينات هي عينة منتصف التبول. تم التعرف على البكتيريا بالطرق المكروبيولوجية القياسية. **النتائج:** كانت الاشريشية القولونية هي الأكثر انتشارا، حيث كانت بنسبة 36 (42.86٪) من مجموع عينات عدوى المسالك البولية، تليها المكورات العنقودية الذهبية في المرتبة الثانية بنسبة 24 (28.57٪)، وأنواع الكليبسلا ظهرت في 15 (17.86٪)، كانت انواع بكتيريا المتقلبات بنسبة 5 (5.95٪)، وظهرت الاستافلوكوكس سبروفيتكس بنسبة 4 (4.76٪). أما عزلات عينة البول المتبقية فكانت غير بكتيرية (حالات سلبية) تمثل 116 (58٪). كانت عدوى المسالك البولية البكتيرية موجودة بشكل كبير في الفئة العمرية ما بين 25–34 سنة، والمرضى ذوي التعليم الثانوي، وربات البيوت، وفي الحمل الثالث أو أكثر، وخلال الثلث الثالث من الحمل. كانت عزلات الاشريشية القولونية حساسة (100٪) لتوبراميسين وسيفتازيديم وسفترياكسون وأزترونام. كانت عزلات الكليبسلا حساسة (100٪) لتوبراميسين فقط. كانت عزلات المتقلبات حساسة بنسبة (100٪) لتوبراميسين وسيفتازيديم وسفترياكسون. كانت عزلات الاستافلوكوكس سبروفيتكس حساسة بنسبة (100٪) لجميع الأدوية المضادة للبكتيريا ماعدا الميثيسيلين. كانت عزلات المكورات العنقودية الذهبية حساسة بنسبة (100٪) لتوبراميسين وأزترون. **الاستنتاجات:** الاشريشية القولونية كانت أكثر العزلات انتشارًا في بول النساء الحوامل. أهم عوامل الخطر هي الحمل الثالث، والثلث الثالث من الحمل، والمرضي ذوي الأعراض. أظهرت معظم المضادات الحيوية المختبرة حساسية تجاه العزلات البكتيرية. يوصى بزراعة البول لغرض الفحص والتشخيص لجميع الحوامل.

الكلمات المفتاحية: التهابات المسالك البولية، النساء الحوامل.

INTRODUCTION

Urinary Tract Infections (UTIs) is an infection caused by the presence and growth of microorganisms anywhere in the urinary tract. Urinary tract includes the organs that collect and store urine and release it from the body which include kidneys, ureters, bladder and urethra. (UTIs) are among the most common bacterial infections in humans, both in the community and hospital settings and have been reported in all age groups in both sexes (Hooton *et al.*, 1995).

Women tend to have UTIs more often than men do because bacteria can reach the bladder more easily in women. This is partially due to the short and wider female urethra and its proximity to anus. Bacteria from the rectum can easily travel up the urethra and cause infections (Ebie *et al.*, 2001; Kolawole *et al.*, 2009).). For this reason, this research focuses on female infections with urinary tract infections. Moreover, the main factors predisposing married women to bacteriuria are pregnancy and sexual intercourse (Zarate *et al.*, 2006). Sexual activity increases the chances of bacterial contamination of female urethra. Sexual intercourse may also cause UTIs in women because bacteria can be pushed into the urethra. This anatomical relationship of the female urethra to the vagina makes it liable to trauma during sexual intercourse as well as bacteria being massaged up the urethra into the bladder during pregnancy/child birth (Ebie *et al.*, 2001; Kolawole *et al.*, 2009). Studying the Risk factors to urinary tract infections among women in Yemeni society is important, and the researcher has found only one study (Al Haddad, 2005) in Al-Mukalla district that deals with some of these factors, but not all of them.

The main microorganisms that cause UTIs are Enterobacteriaceae, especially *Escherichia coli* and *Klebsiella pneumonia*; *Escherichia coli* is the cause of 80% of urinary tract infections in the community (Bérard *et al.,* 2011). In pregnant women, the presence of urinary infection increases the risk of spontaneous abortion and preterm birth, which makes this type of infections a public health problem that requires strict vigilance due to its high prevalence (Menegotto, 2012; Szweda, & Jóźwik, 2016). The presence of urinary tract infections in pregnant women is a problem when not microbiologically diagnosed early and leads to complications.

The resistance to antimicrobial agents is generally due to the selection of resistant strains in the environment, or due to the exchange of genetic material among different species. Why these organisms become resistant is attributed to the exchange of DNA. Gram-negative species are the most frequently involved in urinary tract infection, such as *E. coli*, can become resistant through conjugation, with DNA transfer from one member to another (Tenover. 2006). Basically, antibiotics are used by humans for therapeutic purposes. The correlate between intensive use of these agents and development of resistant bacteria is not well known; however it can be attributed to many difficulties in developing countries. The available data are not useful to clinicians, especially where the culture is not done and an empirical treatment can be initiated timely which lead to the increase in the magnitude of antibiotic resistance (Smith *et al*., 2003). Previous research reports indicate an increase in the phenomenon of resistance of some bacterial species isolated from urinary tract infections to antibiotics, and this requires more research to find out the effective antibiotics.

The limited number of studies that deal with bacterial UTI among pregnant women in Yemen in general and the Taiz city in particular, was the first reason for carrying out the present study. Predisposing factors and risk factors for urinary tract infections such as pregnancy period, parity, gestation age, and continuous use of antibiotics are of great importance and need a lot of research, especially in Yemen, which is one of the poor countries where the level of health education among women is low, specifically among pregnant women. Though UTI leads to complications such as abortion, the researcher has found only one study that dealt with this in Yemen, (Al Haddad, 2005), in the city of Mukalla (south of Yemen).

The aim of the study: The present study was done to evaluate the epidemiology of UTI (prevalence, risk factors, bacterial isolates and antibiotic sensitivity) among pregnant women in Taiz, city, Yemen.

MATERIALS & METHODS
Clinical diagnosis and sampling of Bacterial UTIs
A cross-sectional study design was used for this research. This study was carried out in a five-month period starting from March 2022 to July 2022, including 200 outpatient cases of pregnant women, obtained from

Gynecology and obstetrics clinics of hospitals in Taiz-city, Yemen, with age ranged from 15 to 45 years. Total (200) urine specimens of pregnant women using morning clean-catch midstream urine were collected from each pregnant woman, about 20 ml of urine specimen were collected in a sterile screw-capped. The samples were immediately transported to the microbiology laboratory, placed in the refrigerator (4–6 °C) until they were ready for processing, which were obviously done within 1-2 hours of collection, (Cheesbrough, 2006).

Culturing of Bacteria:

A loopful of each urine sample was streaked on Cysteine Lactose Electrolyte Deficient (CLED) agar using sterile loop measuring 0.01μl, plates were incubated for 24 hr at 37°C. After incubation, plates with growth were selected, the colonies were isolated using an inoculating loop and subsequently subcultured on agar slants for use in further tests. A diagnosis of UTI was made when there were at least 10^5 colony forming unit (CFU)/ml of urine. For contaminated specimens repeat culture was performed, (Murray *et al*., 1995). The colonial morphology was studied after 24 hours and gram staining technique was done for colonies which were examined by compound microscope at a magnification power of 100x, (Gupte, 1999 & Cheesbrough, 2004).

Identification of Isolates

Bacteria were identified by standard microbiological methods culture characters of pure colonies, staining, fermentation on culture media, and biochemical tests. The following references were used for identification of bacterial genera and species: (Berge's 1984; Sneath *et al*., 1986; MacFaddin 1989; Staley *et al*., 1989; Collins *et al*., 1995; & Singleton, 1997).

Antibiotic Sensitivity Test:

Five antibacterial drugs (Tobramycin, Ceftazidime, Methiciliin, Ceftriaxone and Aztreonam) commonly used in bacterial UTIs were tested against five genera of bacterial isolates, five isolates for each genera in *vitro* by the Modified Kirby- Bauer technic (Cheesbrough 2006).

Data Analysis:

The information collected from questionnaire was documented and tabulated. The data in this study was statistically analyzed using chi-square

test. The statistical analysis was done using SPSS software version 21, p value < 0.05 was considered significant.

RESULTS & DISCUSSION

Microbiological Analysis of Bacterial UTIs Infection

Total 200 specimens were identified from urine of pregnant women from March 2022 to July 2022, contingent on the morphological features on culture medium Cysteine Lactose Electrolyte Deficient (CLED) agar (Table 1). *Escherichia coli* were the most prevalent isolate, it was recovered 36 (42.86%) of total bacterial UTIs sample isolates, followed by *Staphylococcus aureus* that was the second most common representing in 24 (28.57%), and *Klebsiella sp* that appeared in 15 (17.86%), the *Proteus sp* that was represented in 5 (5.95%), and *Staphylococcus saprophyticus* that appeared in 4 (4.76%). The remaining urine sample isolates were non-bacterial growth (negative cases), representing 116(58%). See Table1. So, the results of the study showed prevalence of *Escherichia coli, Staphylococcus aureus*, *Klebsiella sp, Proteus sp*, and *Staphylococcus saprophyticus* in the pregnant women samples.

These results were similar to those obtained by Al Haddad (2005) who studied urinary tract infection among pregnant women in Al-Mukalla district, Yemen. Urine samples that were examined for UTI microscopically, biochemical tests and by culture showed that out of 137 pregnant women tested, 41 (30%) were positive for UTI, while 96 (70%) were negative. The distribution of the different isolates, *E. coli* (41.5%) was the most frequently isolated strain, followed by *Staphylococcus aureus* (19.5%). Matalingana (2015) studied the spectrum of bacteria causing urinary tract infection among pregnant women attending Sabasaba clinic. Out of 196 collected urine samples, 27 showed significant growths. The frequency of Gram negative bacteria causing UTI was higher than the case was with Gram positive bacteria. The causative bacteria isolated were 17 Gram negative rods and 10 Gram positive cocci. *Escherichia coli* were the most prevalent bacteria. Ordaz-Lopez *et al*., (2016) studied Urinary Tract Infection in Pregnancy: in Mexico, and noted that a total of 395 pregnant patients had urinary tract infection. Standard biochemical technique for the identification of microorganisms was used, and 101 patients had a positive urine culture;

as etiological agent was found *Escherichia coli* 82 (81.2%), *Klebsiella* 13 (12.8%), *Proteus* 5 (4.9%), *Staphylococcus* coagulase negative 1 (0.9%).

(Table 1): Microbiological analysis of 200 urine sample investigated during the period from March 2022 to July 2022.

| NO. of Isolate	Gram stain		Growth on CLED	Biochemical Tests											
				Catalase		Coagulase		Indole		Citrate utilization		urease		Oxidase	
	+	-		+	-	+	-	+	-	+	-	+	-	+	-
E. coli	0	36	36	*	*	*	*	36	0	0	36	*	*	*	*
Staph. aureus	24	0	24	24	0	24	0	*	*	*	*	*	*	*	*
Klebsiella sp	0	15	15	*	*	*	*	0	15	15	0	*	*	*	*
Proteus sp	0	5	5	*	*	*	*	*	*	*	*	5	0	0	5
Staph. saprophyticus	4	0	4	4	0	0	4	*	*	*	*	*	*	*	*
No- bacterial growth	0	0	0	*	*	*	*	*	*	*	*	*	*	*	*
Total	28	56	84	28	0	24	4	36	15	15	36	5	0	0	5

*No analysis test

## General Analysis of Bacterial UTIs Infection
Prevalence of Bacterial infections in Samples Population

Total 200 pregnant women cases were collected from March 2022 to July 2022. Among the examined specimens 84 urine samples (42% of total specimens), had bacterial infections genera. The most infected by gram negative genera appeared in 56 (28%) of the total specimens, followed by gram positive genera appeared in 28 (14%). The remaining urine sample isolates were non-bacterial growth (negative specimens), representing 116 (58%). The pregnant women were the most infected by gram negative genera than the gram positive genera (Fig. 1).

Among the total specimens, the gram negative isolates, 36 (18%) infected by *Escherichia coli*, *Klebsiella sp* appeared in 15 (7.5%), and *Proteus sp* was representing in 5 (2.5%). The gram positive isolates, 24 (12%), of the *S.aureus*, and *Staphylococcus saprophyticus* appeared in 4 (2%). The remaining urine sample isolates were non-bacterial growth (negative specimens), representing 116 (58%). See (Figure 2 below).
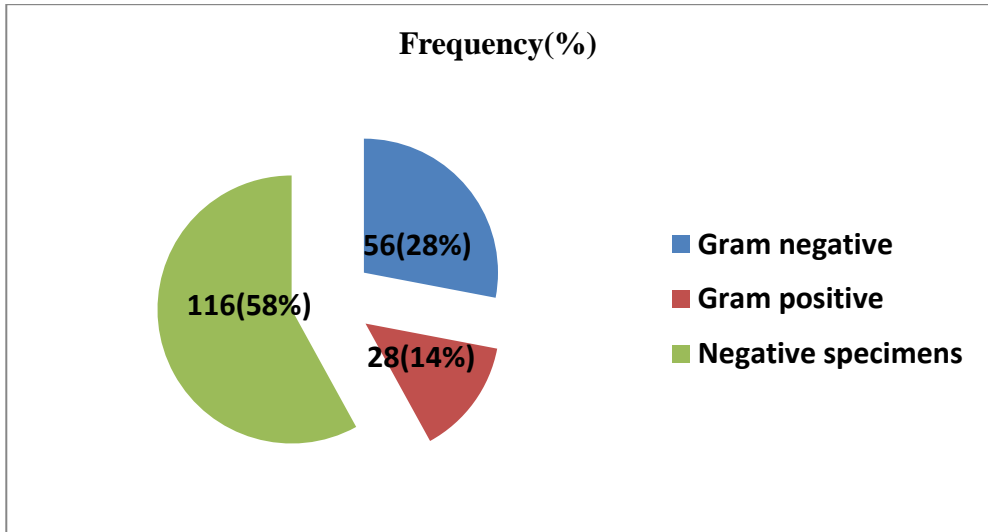
(Fig. 1): Prevalence of gram negative and gram positive bacterial genera among women patients.
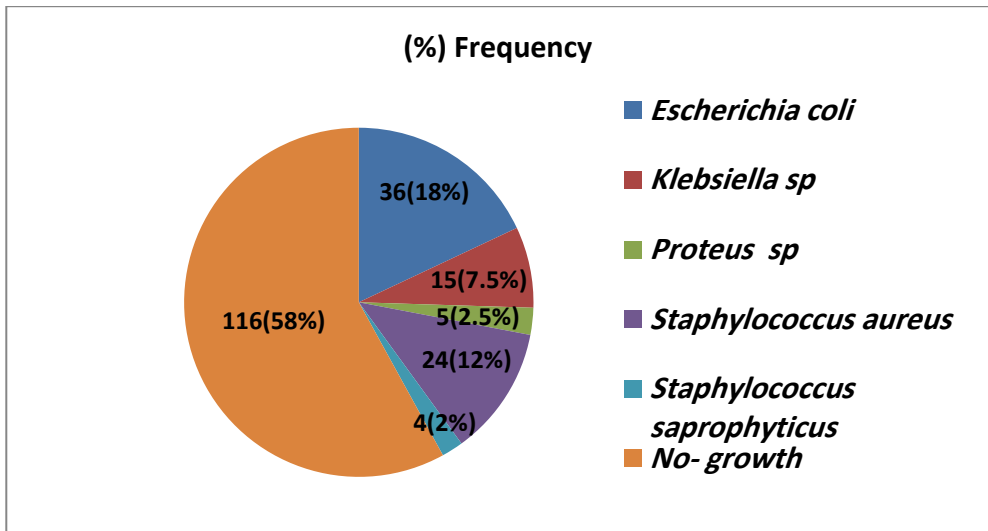
(Fig. 2): Prevalence of bacterial genera among women patients.

Similar observation about the prevalence of bacterial infections among pregnant women was reported by Ezeigbo *et al*., (2016), who studied incidence of urinary tract infections (UTIs) among pregnant women in Nigeria. The study showed that out of 400 urine samples of pregnant women the most common pathogens isolated were *Escherichia coli* (37.0%), *Klebsiella spp* (20.4%), *Proteus mirabilis* (16.6%), *Pseudomonas* spp. (13.0%), *Staphylococcus aureus* (7.4%) and *Staphylococcus epidermidis* (5.6%).

Onyango *et al*., (2018) studied urinary tract infection among pregnant women at Pumwani Maternity Hospital, Nairobi, Kenya. The study showed that among 210 pregnant women, material of undergarment and frequency of changing the undergarments were found to contribute significantly to the acquisition of UTI (P <0.05). *E. coli* was the most predominant UTI organism at (44.5%) followed by *K. pneumoniae* (21.2%) and *S. aureus* (15.1%).

Kaduma *et al*., (2019) studied urinary tract infections among pregnant women in Mwanza City, Tanzania, and showed that out of 393 pregnant women enrolled, 110 (28.0%), 95% had significant bacteriuria [cases: 50.4% (66/131) and control: 16.8% (44/262)]. *Escherichia coli,* 50 (45.5%), and *Klebsiella spp*., 25 (23.6%), predominated.

The present results are different from those obtained by Ibraheem & Diwan (2017) in their study "The Prevalence of Bacteriuria among Pregnant Women in Baghdad, Iraq". The result showed that *Staphylococcus Saprophyticus* is a common cause in these infections appearing in (19%) of the studied group, while *klebsiella* was (17.2%), and *proteus mirabilis* bacteria was (14.7%).

Incidence of Bacterial UTIs in Relation to Age of Patients

Regarding to the bacterial UTIs in relation to age group of pregnant women were represented in Table 2. The results indicated that the age group between 25-34 years were more susceptible, occurred in 60 (49.2%) of positive specimens, followed by age group of 35-45 years appeared in 10 (33.3%). On the other hands, the age group between 15-24 years were less susceptible appeared in 14 (29.2%); there was a statistically significant association between different age groups of pregnant women and bacterial UTIs (P<0.001), as shown in (Table 2).

(Table 2): Incidence of Bacterial UTIs in relation to age distributions of pregnant women

| Age group (years)	No. tested (%)	No. positive (%)	No. negative (%)	p-value
15-24	48 (24)	14 (29.2)	34 (70.8)	
25-34	122 (61)	60 (49.2)	62 (50.8)	<0.001
35-45	30 (15)	10 (33.3)	20 (66.6)	
Total	200	84 (42)	116 (58)	

p-value <0.05 significant

The present results are different from that obtained by Al Haddad (2005) who noted that of the variables examined, 53.7% of the infected women were in the age group 15–24 years. Okonko *et al*. (2009) reported that a higher percentage of pregnant women (77.8%) with UTIs were found within the age brackets of 36-40 years while age groups 26-30 years had the least percentage (37.1%). The highest number of bacterial isolates was obtained from pregnant women within the age brackets of 21-25 years followed by 26-30 years. Comparatively, lower number of bacterial isolates was obtained from age groups 31-35 and 36-40 years.

However, the present result agree with Ezeigbo et al., (2016) who reported that the results obtained showed that 261 (61.5%) pregnant women were infected and age bracket 26-30 years had the highest incidence of UTIs with infection rate of 89.8%. The least infected was in the age bracket 15-20 years with 36.7% rate of infection. There is no significant difference between the age groups of pregnant women and prevalence of UTI ($P > 0.05$).

Incidence of Bacterial UTIs in Relation to Occupational Groups

The bacterial UTIs in relation to occupational groups of pregnant women were represented in (Figure 6). The results revealed that the house wife patients were high susceptible, represented in 54 (55.1%) of total No. tested, the UTIs of the students patients 14 (43.75%) of total No. tested pregnant women, followed by the employee patients in 16 (22.9%). Results of chi-square test from figure 6 showed that there was a statistically significant association between occupational groups of pregnant women and bacterial UTIs (P<0.001)

The present results agree with Younis *et al*., (2019) who showed that the housewives patient were highly susceptible, represented in 78 (55.7%), followed by the employee patients in 62 (44.3%). However, our results are different from those obtained by Onyango *et al*., (2018) noted that the employed patients were highly susceptible, represented in 15 (45.5%), followed by the unemployed patients in 18 (64.5%). There is no significant association between UTI and occupation.
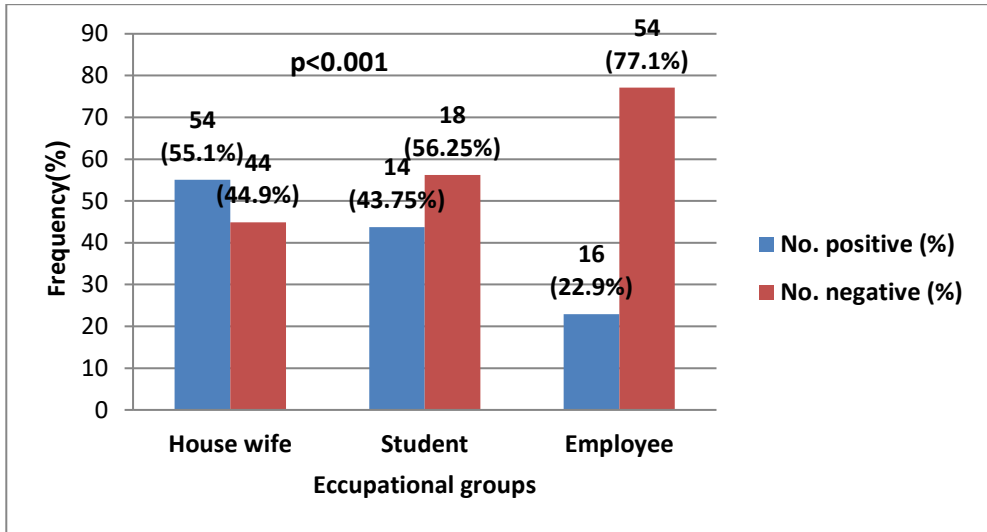
(Figure 6): Incidence of Bacterial UTIs in Relation to Occupational Groups

Incidence of Bacterial UTIs in Relation to Educational Levels:

The bacterial infection in relation to educational levels of pregnant women were represented in (Table 3). The results revealed that the secondary education patients were highly susceptible, representing 50 (61%) of total No. tested, the bacterial infection of the university education patients represented 25 (31.2%), followed by primary education patients with 5 (23.8%), whereas the illiterate patients represented 4 (23.5%) of total No. tested patients. Results of chi-square test showed that there was a statistically significant association between educational levels of pregnant women and bacterial UTIs ($p<0.001$).

(Table 3): Incidence of Bacterial UTIs to in Relation Educational Levels

Education groups	No. tested (%)	No. positive (%)	No. negative (%)	p-value
Illiterate	17(8.5)	4 (23.5)	13 (76.5)	
Primary	21(10.5)	5 (23.8)	16 (76.2)	
Secondary	82(41)	50 (61)	32 (39)	<0.001
University	80(40)	25 (31.2)	55(68.8)	
Total	200(100)	84 (42)	116 (58)	

p-value <0.05 significant

The present results agree with those obtained by Onyango *et al*., (2018) who prove that the majority of pregnant women have secondary degree 15(45.5%). However, the present results are different from those obtained by Haider *et al*., (2010) who noted that the illiterate pregnant women with positive UTIs constitue (90%), while literate pregnant women with positive UTIs constitute (10%). This corresponds with Parveen *et al*. (2011) who report increased urinary tract infection association between pregnancy and education level where 10% were literate and 90% were illiterate. Younis *et al*., (2019) Showed that the majority of pregnant women in this study have university level 92 (65.7%), followed by the secondary level 40(28.6%), primary level 8 (5.7%). Kaduma *et al*., (2019) reported that most of the pregnant women with UTIs have primary education representing 74 (56.5%).

Effect of Risk Factors Among Pregnant Women
The parity (No. of Pregnancy)

Among 84 (42% of total specimens) infected by bacterial UTIs, 30 (60% of No. of tested) were infected in the third pregnancy or more, then 33 (39.3% of No. of tested) infected by bacterial UTIs in the first pregnancy, whereas 21 (31.8%) were infected in the second pregnancy. So, the results of the study showed that the most prevalence of bacterial UTIs was in the third pregnancy or more among pregnant women. See Table 4 below. Results of chi-square test showed that there was a statistically significant association between parity of pregnant women and bacterial UTIs p<0.001.

The present results agree with those obtained Haider *et al*., (2010) assert that parity is a significant variable as 6 (60%) patients were multiparous, while 4(40%) were primigravida. Parveen *et al*. (2011) show that there is a high frequency of infection occurring in those having >4 children (49.23%), followed by those having 2-3 children (32.30/%), while the lowest frequency of infection occurred in those with 0-1 children (18.46%). The current results are different from those obtained Younis et al., (2019) who show that there is a higher frequency of infection in those having 0-1 children and 55.1% among primary gravid, with significant relationship (X^2=14, *P*=0.00).

(Table 4) Incidence of Bacterial UTIs in relation to parity (No. of Pregnancy)

Parity	No. Tested	No. Positive (%)	No. negative (%)	p-value
First pregnancy	84(42)	33 (39.3)	51(60.7)	
2nd pregnancy	66(33)	21 (31.8)	45(68.2)	<0.001
3rd pregnancy or more	50(25)	30 (60)	20(40)	
Total	200(100)	84 (42)	116(58)	

p-value <0.05 significant

The Gestational Age (Age of Pregnancy)

Among 84 (42% of total specimens) infected by bacterial UTIs, 40 (47.6% of No. positive) were infected by bacterial UTIs during the third trimester, 27 (32.2% of No. positive) were infected in the second trimester, and 17 pregnant women (20.2%) were infected in the first trimester. See Table 5 below. The results of the study showed the prevalence of bacterial UTIs was in third trimester among No. positive pregnancy women, (Table 5). Results of chi-square test showed that there was a statistically significant association between gestational age of pregnant women and bacterial UTIs p<0.001.

The current results are basically similar to those obtained by Okonko *et al*., (2009) who report that the incidence of UTI by trimester (a period of three months, especially one of the three month periods into which human pregnancy is divided for medical purposes) as at the time of this study. This revealed that women in their third trimester of their pregnancy had the highest incidence of UTI [27(55.1%)], followed by women in their second trimester [12(41.4%)], while women in their first trimester of their pregnancy, though fewer in number, had no specific bacteria growth and show no sign. of UTIs. Parveen *et al*., (2011) note that there is higher rate of infection in the third trimester (78.46/%) compared to the second trimester (12.30 %) and the first trimester (9.23%). Bahati *et al*. (2020) report that the most prevalence of bacterial UTIs during the third trimester was 66 (47.14%), followed by the second trimester 55(39.29%), and finally the first trimester appeared in 19(13.57%) among No. positive pregnancy women.

However, the current results are different from those obtained by Matalingana (2015) who concluded that the mean and standard deviation of gestation age in weeks of pregnant women enrolled were 20.4 and 7.8 respectively. 36 (18.4%) of pregnant women examined were in the first trimester while 96 (50%) were in the second trimester and 64 (32.6%) in the third trimester. 4 (11.1%), 13 (13.5%) and 10 (15.6%) were detected with bacterial UTI in the first, second and third trimesters respectively. There is

no statistically significant difference between the gestation ages of pregnant women and bacterial UTI ($p = 0.5216$).
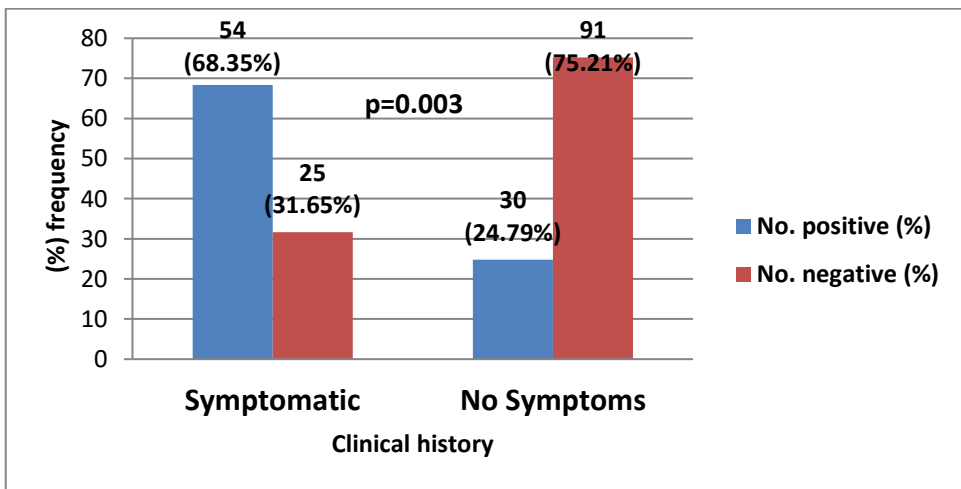
(Table 5) Incidence of Bacterial UTIs in relation to gestational age (age of pregnancy)

Trimester	Age of pregnancy (months)	No. tested (%)	No. positive (%)	Total	%	p-value
First trimester (1st 3 months)	1	10(5)	6 (60)	17	20.2%	
	2	19(9.5)	4 (21.05)			
	3	14(7)	7(50)			
Second trimester (2nd 3 months)	4	19(9.5)	7 (36.84)	27	32.2%	
	5	27(13.5)	13 (48.14)			<0.001
	6	21(10.5)	7 (33.3)			
Third trimester (3rd 3 months)	7	28(14)	15 (53.57)	40	47.6%	
	8	24(12)	9 (37.5)			
	9	38(19)	16 (42.1)			
Total		200(100)	84 (42)	84	100%	

p-value <0.05 significant

Incidence of Bacterial UTIs in Relation to Clinical History

In the current samples, 54 (68.35% of No. tested) were positive to bacterial UTIs and complicated symptomatic history. Whereas 30 (24.79 % No. tested) were positive to UTIs and no- complicated symptomatic history. See (Figure 7). The study showed that 68.35% with complicated symptomatic history tested positive for bacterial UTIs compared to 24.79% of no- complicated symptomatic history. Results of chi-square test showed that there was a statistically significant association between clinical history of pregnant women and bacterial UTIs (P<0.05).

(Figure 7) Incidence of Bacterial UTIs in relation to clinical history.

The present results are basically similar to these obtained by Ali *et al*., (2007) who note that a total of 100 urine samples from pregnant women included in this study, symptomatic and asymptomatic UTIs scored, clearly, 72.4% and 27.6% respectively. Okonko *et al*., (2009) report that only 35 (72.9%) of the 48 pregnant women who showed symptoms of UTIs have specific growth in the urine culture while 3 (60.0%) of the 5 pregnant women who show no symptom also give a positive urine culture. Onyango *et al*., (2018) report that a total of 210 pregnant women are recruited in the study and the overall prevalence of UTI is 15.7%. prevalence of asymptomatic and symptomatic bacteriuria is 4.3% and 11.4% respectively. Younis *et al*., (2019) show that the prevalence of UTIs symptomatic is 50 (72.5%), whereas asymptomatic UTIs is 19 (27.5%). However, the current results are different from those obtained by Hamdan *et al*., (2011) who show that the prevalence of bacteriuria among asymptomatic and symptomatic pregnant women are (14.7%), and (12.1%), respectively, with no significant difference between the two groups.

Incidence of Bacterial UTIs in relation to antibiotics use

In the current samples, 54 (44.26% of No. tested) were positive to Bacterial UTIs and antibiotics use. Whereas 30 (38.46 % No. tested) were positive to UTIs and no- antibiotics use. See (Figure 8). The study showed that 44.26% were antibiotics use tested positive for Bacterial UTIs compared to 38.46% of no- antibiotics use tested positive for Bacterial UTIs among specimens. Results of chi-square test showed that there was a statistically significant association between antibiotics use among pregnant women and bacterial UTIs ($P < 0.05$).
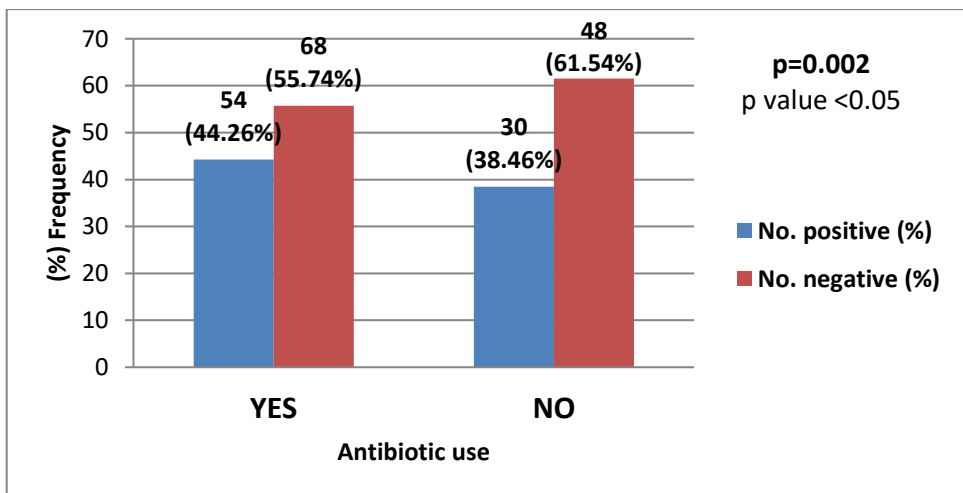

Figure 8: Incidence of Bacterial UTIs in relation to antibiotics use

Many studies refer to the phenomena of antibiotic resistant among pregnant women especially during infection with UTIs. However, we have not get valuable research carried out in Yemen comparing antibiotics use with no- antibiotics use during pregnancy. This can be attributed to the fact that most pregnant women are treated by antibiotics to prevent complication of UTIs. Ordaz-Lopez *et al*., (2016) have carried out a study to determine the most frequent pathogen and its antibiotic resistance in pregnant patients with urinary tract infection in Chihuahua, Mexico. The results show that the most widely used drug is Ampicillin (79%) as well as the one with the highest rate resistance (100%). They conclude that nitrofurantoin and amoxicillin should be the antibiotics chosen in the UTI during pregnancy as prescribed in the Mexican clinical practice guide. The resistance rates to other antibiotics are high. Bookstaver *et al*., (2015). Refer that to the use of antibiotics in pregnancy requires careful assessment and a discussion of risk versus benefit to mother and fetus, many antibiotics are considered safe in pregnancy, especially beta-lactams, macrolides, clindamycin, and fosfomycin; however, additional data are needed for the majority of antibiotic classes.
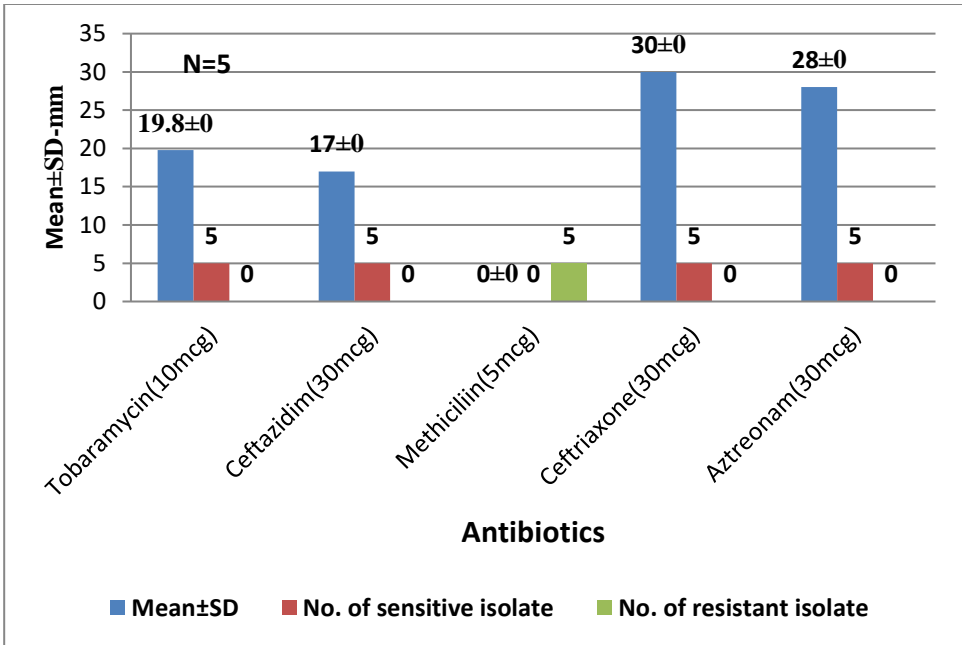
Antibacterial Activity

The results of antibiotics sensitivity tests showed against different bacterial isolates: *E. coli* were sensitive (100%) for Tobramycin with Mean of inhibition zone ±SD(19.8±0), Ceftazidime (17±0), Aztreonam (28±0) and Ceftriaxone (30±0), but Methicillin was reported as the most resistant antibiotics for *E. coli* (100%), as shown in (Figures 9A-10). While *Klebsiella sp* showed the highest sensitivity to Tobramycin (100%) (29.6±0.7), and the highest resistance to Methicillin, Ceftazidime, Aztreonam and Ceftriaxone with the same percentage (100%) as shown in (Figures 9B-11). *Proteus sp* had the highest sensitivity to Tobramycin (16.6±1.4), Ceftazidime (23±0), Ceftriaxone (25.8±0.7) (100%), and the highest resistance to Methicillin and Aztreonam with the same percentage (100%) as shown in (Figure 12). *Staphylococcus aureus* had the highest sensitivity to Tobramycin (18±0) and Aztreonam (24.8±0.7), and the highest resistance to Methicillin, Ceftriaxone and Ceftazidime with the same percentage (100%). See (Figure 14 below). However, *S. saprophyticus* bacteria were sensitive to Tobramycin (24.3±0), Ceftazidime(15.25±0),
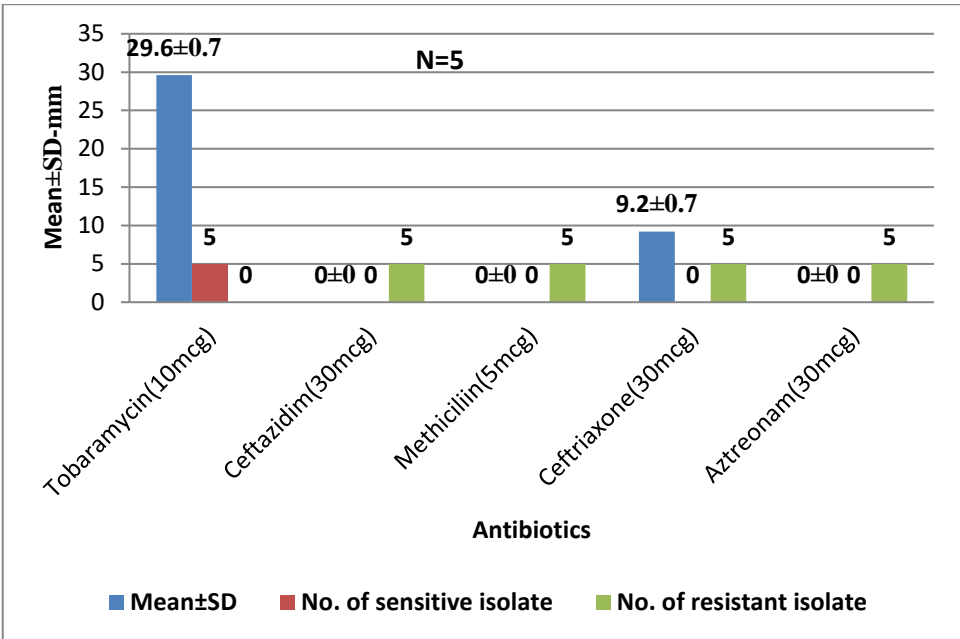
Aztreonam (25±0.7) and Ceftriaxone (21.75±0) with the same percentage (100%). Moreover there was resistant to Methicillin (100%), as showing in (Figure 13).
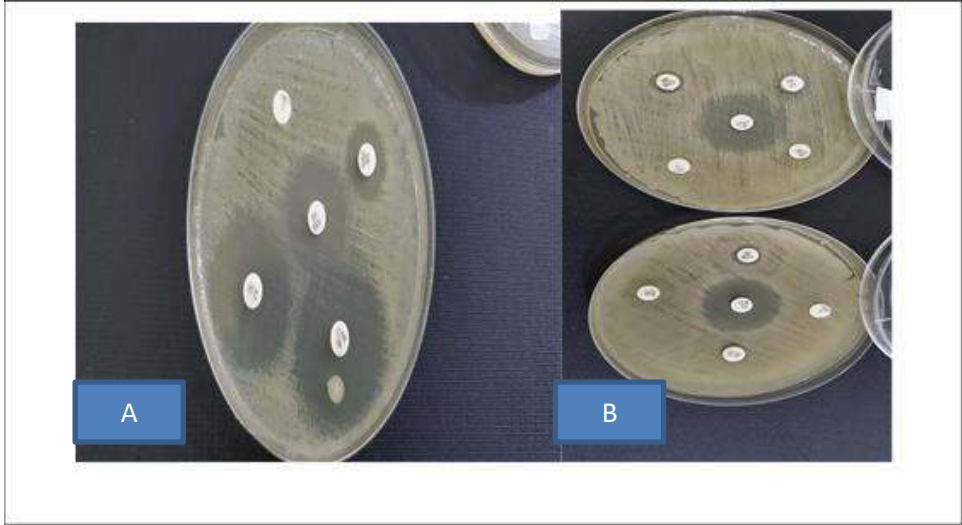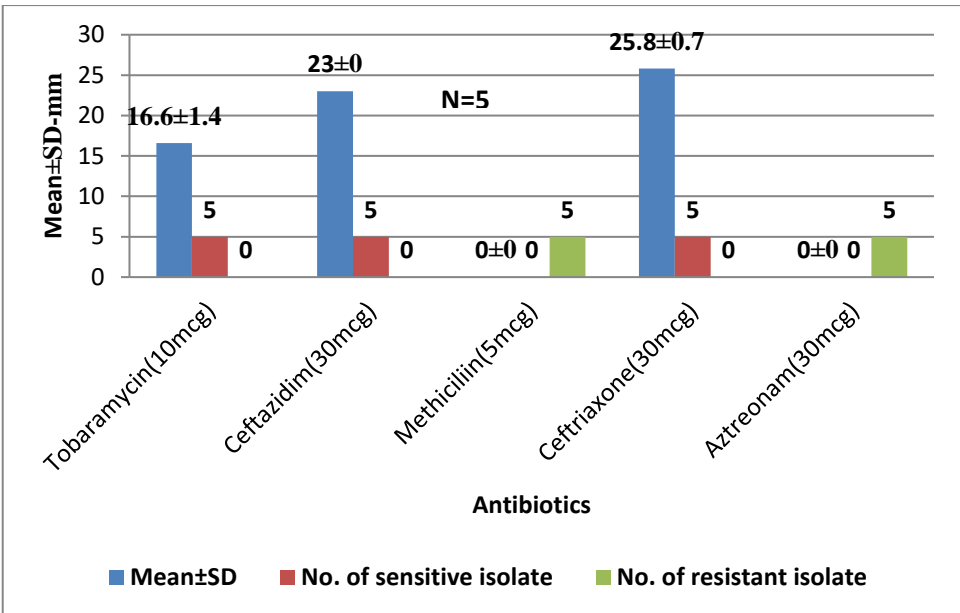

(Figure 9) Effect of antibacterial activity on *E. coli* and *Klebsiella sp*.
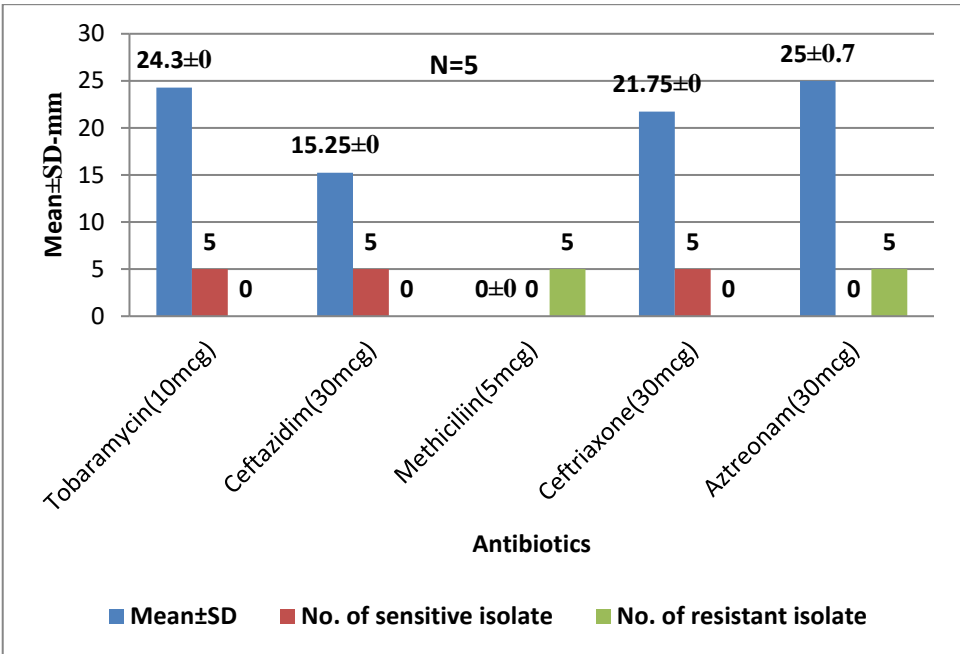

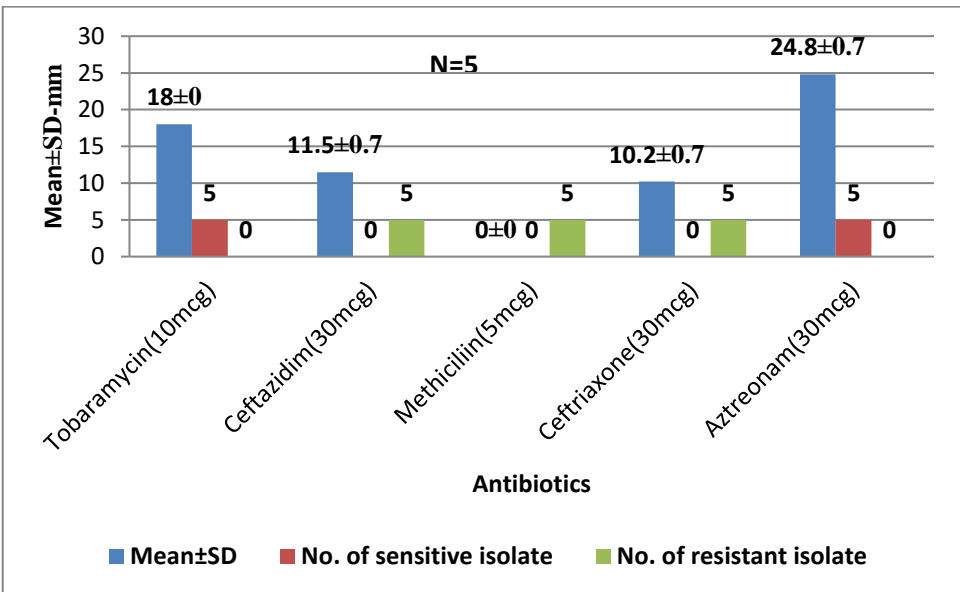**(Figure 10) Effect of antibacterial activity on *E. coli***

(Figure 11) Effect of antibacterial activity on *Klebsiella sp*

(Figure 12) Effect of antibacterial activity on *Proteus sp*

(Figure 13) Effect of antibacterial activity on *S. saprophyticus*

(Figure 14) Effect of antibacterial activity on *Staphylococcus aureus*

The current results are different from those obtained by Hamdan *et al*., (2011) who report that Four, 2, 2, 3, 4, 2 and 0 out of 14 *E. coli* isolates, show resistance to amoxicillin, naladixic acid, nitrofurantoin, ciprofloxacin, co trimoxazole, amoxicillin/clavulanate and norfloxacin, respectively. Thirteen *S. aureus* isoltes show resistant to amoxicillin (1), norfloxacin (3), co-trimoxazole (5), and naladixic acid (5). *K. pneumonia* isolates (3) have resistance to amoxicillin. Younis *et al*., (2019) showed that the isolates show no resistance to most of antibiotics used. The most antibiotics used were Ampicillin, Ciprofloxacin, Gentamicin, Tetracycline and Augmentin.

Al-Jendy & Al-Ofairi (2019) show that the results of antibiotics sensitivity tests show against different bacterial isolates: *E. coli* were sensitive (100%) for Ciprofloxacin, but Erythromycin is reported as the most resistant antibiotics for *E. coli* (77.8%). While *Klebsiella pneumonia* shows the highest sensitivity to Ciprofloxacin and Amikacin with the same percentage (80%) followed by Gentamycin (70%) and the highest resistance to Erythromycin (100%). Rifampicin, Cephalothin, Amoxicillin, Penicillin G with the same percentage of resistance (90%). *Proteus mirabilis* has the highest sensitivity to Ciprofloxacin (100%), followed by Amikacin, Cefotaxime with the same percentage (83.3%) and the highest resistance to Erythromycin, Rifampicin, Cephalothin with the same percentage (100%) and Penicillin G, Amoxicillin, Ampicillin [(83.3%), (66.7%), (66.7%)], respectively. *Pseudomonas aerogenes* showed that they are sensitive to Ciprofloxacin and Gentamycin with the same percentage (80%). It was resistant to the other antibiotic: Rifampicin, Amoxicillin, Penicillin G (100%), Erythromycin, Cephalothin (80%), Ampicillin (60%). But *S. aureus* bacteria are sensitive to Ciprofloxacin (85.7%), Erythromycin, Amikacin with the same percentage (71.4%). they are, as well, resistant to Penicillin G(100%), Ampicillin, Amoxicillin with the same percentage (85.7%), Ceftriaxone, Cefotaxime [(71.4%), (57.1%), respectively].

El-Kashif (2019) notes that amoxicillin and cefoxitin (40.1% & 21.6%, respectively) are the most used antibiotics by infected women for the treatment of UTI, while the lowest used is the fusidic acid (5.6%). In this respect, Faidah *et al*., (2013) reports that amoxicillin, cefoxitin, celtaxidime, norfloxacin, penicillin, and fusidic acid are the most effective antibiotics for

treatment of UTI during pregnancy. The effect of these antibiotics lies in that these highly expensive drugs and had controlled their attaining and indiscriminate use, therefore facilitating the pathogens susceptible to them.

Lee *et al.*, (2020) report that the antimicrobial susceptibility patterns of uro-pathogens in the MIST study. *E. coli* isolates have low rates of susceptibility to ampicillin (34% of isolates) and azithromycin (28%); susceptibility to cefixime, cotrimoxazole, and cephalexin are in the moderate range (69, 63, and 62% respectively). The majority of species are highly susceptible to nitrofurantoin, with the exception of *Klebsiella* species, where 74% of strains are susceptible. Rates of susceptibility to azithromycin are low among the gram negative species.

CONCLUSION

The epidemiology of bacterial urinary tract infection among pregnant women was evaluated in 200 patients. Among 200 of total cases, *Escherichia coli* were the most prevalent isolate, it was recovered 36 (42.86%) of total bacterial UTIs samples, followed by *Staphylococcus aureus* as the second most common representing in 24 (28.57%), and *Klebsiella sp* was appeared in 15 (17.86%), the *Proteus sp* was representing in 5 (5.95%), and *Staphylococcus saprophyticus* appeared in 4 (4.76%). The remaining urine sample isolates were non-bacterial growth (negative cases), representing 116 (58%). Bacterial UTIs were highly present in the age group between 25-34 years, secondary education patients, housewife patients, third pregnancy or above, during the third trimester, symptomatic history, and women with antibiotics use. *Escherichia coli* isolates were (100%) sensitive to Tobramycin, Ceftazidime, Ceftriaxone and Aztreonam. *Klebsiella sp* isolates were (100%) sensitive to Tobramycin only. *Proteus sp* isolates were (100%) sensitive to Tobramycin, Ceftazidime, and Ceftriaxone. *Staphylococcus saprophyticus* isolates were (100%) sensitive to all antibacterial drugs except Methiciliin. *Staphylococcus aureus* isolates were (100%) sensitive Tobramycin and Aztreon. Thus urine culture should be performed as screening and diagnostic tool of UTI in pregnancy in this setting.

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