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Distribution of Bacteria according to Drug Resistance among Adult Women with Bacteriuria in Samara City

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ABSTRACT

Background: Bacteriuria is defined as the presence of bacteria in urine without the accompanying signs and symptoms of a urinary tract infection. The most common bacterium causing bacteriuria is E. coli. About 1-5% of healthy premenopausal women and 1.9-9.5% of pregnant women have bacteriuria. The most effective drugs based on urine culture results were Nitrofurantoin (98.3%), followed by Cefuroxime (89.3%) and Cotrimoxazole (20%).

Aim and objectives: To identify the distribution of bacteria according to drug resistance among adult women with bacteriuria in Samara city, Iraq, and to determine certain influencing factors.

Materials and Methods: This descriptive cross-sectional study was conducted on adult women (18-44 years) attending Samara General Hospital. Demographic information and investigation results were obtained and reported using an appropriate questionnaire. A patient with asymptomatic bacteriuria was identified when one species of bacteria grew in the urine with at least 100,000 colony-forming units (CFUs) per milliliter, regardless of the presence of pyuria, even in the absence of any UTI symptoms. Frequencies (number of cases) and percentages were used to statistically describe the data where appropriate. Comparison between the study groups was performed using the Chi-square ($\chi 2$) test. P values less than 0.05 were considered statistically significant.

Results: The frequency of bacterial growth in the sample was 19%. The highest frequency of cases was among the age group 28-37 years (22.4%). Positive cases were more prevalent among pregnant women (21.4%) than non-pregnant women (13.3%). Staphylococcus was the most frequently identified bacterium (42%), followed by E. coli (39%), Klebsiella (11%), and Streptococcus (8%). The drug with the highest sensitivity to bacterial growth was Amikacin, followed by Meropenem.

Conclusions: The frequency of bacterial growth was 19%. The most frequently isolated bacteria from the culture were Staphylococcus, followed by E. coli. The most sensitive drug was Amikacin, followed by Meropenem.

Keywords: Bacteriuria, drug resistance, Samara.

INTRODUCTION:

Bacteriuria is the presence of bacteria in urine without any accompanying symptoms of a urinary tract infection (UTI) (1-3). Age-related bacteriuria is common in adult women (18 years and older) (4,5). Escherichia coli continues to be the most frequently cultivated organism in both community-dwelling and institutionalized individuals, despite some variances in the incidence of common urinary tract pathogens (6). Almost all research on the bacteriologic criteria used to diagnose UTIs has been conducted in populations that are primarily female(7).

E. coli represents 60-90% of infections in women (1,8,9-11). Other bacteria include Klebsiella pneumoniae, Proteus mirabilis, Pseudomonas aeruginosa, and group B

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Streptococci (3,12,13). Gram-positive organisms like Staphylococcus saprophyticus also cause bacteriuria (14). Certain studies have documented that E. coli is the most common bacterium (65.5%), followed by Klebsiella (20.7%) (15), while another study found E. coli represented 57%, followed by Staphylococcus aureus (22.5%) (16). In another study, the most common bacterium was S. aureus (31.2%), followed by E. coli (25%) (17). Up to 10% of women may have a urinary tract infection in a given year (18). About 1-5% of healthy premenopausal women (19) and 1.9-9.5% of pregnant women (9,20) have bacteriuria.

The reduction in effectiveness of a medication, such as an antimicrobial or an antineoplastic, in treating a disease or condition is called drug resistance (21). Medicines used in the prevention and treatment of infections in humans, animals, and plants are called antimicrobials. These include antibiotics, antivirals, antifungals, and antiparasitics. Antimicrobial resistance (AMR) occurs when bacteria, viruses, fungi, and parasites change over time and no longer respond to medicines (22).

Using drug sensitivity tests to determine the types of bacteria and the most suitable antibiotics to be used, as revealed in urine culture and urine analysis, is essential (23,24). A study conducted in Uganda revealed that the most effective drugs for treating bacteria causing bacteriuria among adult nonpregnant women, based on urine culture results, were Nitrofurantoin (98.3%), followed by Cefuroxime (89.3%) and Cotrimoxazole (20%) (16).

Personal knowledge about antibiotic use and resistance is crucial in the treatment of bacterial infections. A study conducted among Al-Yarmouk University students (both undergraduate and postgraduate) revealed that about 72.7% of the sample had knowledge about antibiotic use and resistance (25). Another study in Jordan revealed that 65% of the sample had heard about the term "antibiotic resistance" from medical staff (26).

MATERIALS AND METHODS:

This study was conducted at Samara General Hospital from July 2022 to March 2023. The hospital is located in Samara city, which is about 120 km north of Baghdad. The study sample consisted of adult women attending outpatient clinics at Samara General Hospital who did not present signs and symptoms of UTIs.

Study design: A cross-sectional study was conducted among adult women (18-44 years) attending Samara General Hospital outpatient clinics. Consent was obtained from all participants.

Study population: The study included all adult women aged 18-44 years attending Samara General Hospital outpatient clinics during the study period who fulfilled the inclusion criteria. The sample size was 500 adult women.

Inclusion criteria: All adult women aged 18-44 years who attended outpatient clinics at Samara General Hospital during the study period, women with asymptomatic bacteriuria, and those willing to participate in the study were included.

Exclusion criteria: Women with a history of antibiotic therapy in the previous 2 weeks and those with serious or chronic diseases were excluded.

Bacterial culture, identification, and antimicrobial susceptibility testing: After obtaining consent, demographic information was collected from the women using a predesigned questionnaire. About 5 mL of freshly voided midstream urine samples were collected using a sterile screw-capped, wide-mouth container. The women cleansed their genitals with clean water and collected the midstream urine into the wide-mouthed container.

After collecting midstream urine samples from the women in sterile bottles, the samples were examined in the laboratory within 3 hours. The urine samples were inoculated on Cystine Lactose Electrolyte Deficient (CLED) agar and incubated at 37°C for 24 hours (27). Blood agar and MacConkey agar media were used for cultures and subcultures. The appearance of 100,000 Colony Forming Units (CFU) per milliliter on blood agar and MacConkey agar was considered positive (6,7,27-30). The identification of bacteria depended on their gram staining, cultural

morphology, and biochemical characteristics (28).

Bacterial isolates were identified using colony features, Gram-staining, and a variety of biochemical assays (such as Kligler Iron Agar (KIA), Sulphur Indole Motility (SIM) media, citrate, oxidase, urease, catalase, and coagulase) in accordance with conventional bacteriological protocol. The antimicrobial susceptibility test was conducted using Muller-Hinton agar medium and the Kirby-Bauer disk diffusion technique. The diameter of the zone of inhibition was evaluated in accordance with the Clinical Laboratory Standard Institute (CLSI) 2017 guidelines (30). For statistical analysis, the Chi-square test was used. A P-value of less than or equal to 0.05 was considered significant.

RESULTS:

According to Table 1, the sample group had a frequency of asymptomatic bacteriuria of 19%. The highest frequency of cases was observed among the age group of 28-37 years (22.4%), followed by the age group younger than 28 years (14.3%), showing a significant difference. The frequency of cases was slightly higher among those with secondary education or less (20%) compared to those with higher than secondary education (18.2%), but without a significant difference. There was a higher prevalence of cases among pregnant women (21.4%) compared to non-pregnant women (13.3%), indicating a significant difference between the two groups.

Figure 1 reveals that Staphylococcus was the most frequently isolated bacteria (42%), followed by E. coli (39%), Klebsiella (11%), and Streptococcus (8%).

Table 2 shows that among pregnant women, the most frequent bacteria isolated from urine cultures were E. coli (45.3%), followed by Staphylococcus (40%), Klebsiella (10.7%), and Streptococcus (4%). Among non-pregnant women, the frequencies were Staphylococcus (50%), Streptococcus (25%), E. coli (15%), and Klebsiella (10%).

Figure 2 shows that Staphylococcus bacteria were sensitive to the following drugs: Amikacin (94%), Ciprofloxacin (82%), Vancomycin (79%), Meropenem (79%), and Ofloxacin (61%). E. coli showed sensitivity to Amikacin (88%), Ciprofloxacin (88%), Vancomycin (87%), Meropenem (63%), and Ofloxacin (50%). Streptococcus bacteria exhibited sensitivity to Amikacin (92%), Ciprofloxacin (77%), Vancomycin (92%), Meropenem (92%), and Ofloxacin (92%). Klebsiella bacteria were sensitive to Amikacin (100%), Ciprofloxacin (50%), Vancomycin (0%), Meropenem (100%), and Ofloxacin (0%). Overall, the most effective drug against bacterial growth was Amikacin, followed by Meropenem.

DISCUSSION:

In the current study, the frequency of bacteriuria among the sample group was 19%. This result was higher than that found in certain studies (6-10%) (31,32), 13% (33), 17% (16), and 12% (8). The current result was lower than that found in other studies (81%) (34) and (60%) (35). This difference may be attributed to variations in vaginal pH among women (36).

Regarding age groups, it was found that the highest frequency of cases was among the age group 28-37 years (22.4%), followed by the age group younger than 28 years (14.3%), and the lowest among the age group older than 37 years (11.5%). Other studies reported that the most frequent cases were among the age group 18-27 years (45.3%), followed by the age group 28-37 years (25.26%), and the lowest among the age group 38 years and older (10.42%) (34). Meanwhile, other studies revealed that the highest frequency was among the age group 25-30 years (62.5%) (17,15), and another found that the highest frequency was among the age group 15-24 years (37); in Cameroon, the highest frequency was among the age group 20-39 years (38). This difference may be attributed to the sexual activity of women in these age groups, which is considered a risk factor (39).

Table (1) Distribution of cases according to certain demographic features.

Personal character \ Bacterial urine culture		Yes	No	Total	Chi square test
Age group (years	Less than 28	5 (14.3%)	30 (85.7%)	35 (100%)	The chi-square statistic is 7.707. The *p*-value is .021206. The result is significant at $p < .05$.
	28-37	75 (22.4%)	260 (77.6%)	335 (100%)	
	more than 37 years	15 (11.5%)	115 (88.5%)	130 (100%)	
	Total	95 (19%)	405 (81%)	500 (100%)	
Education	Secondary and less	45 (20%)	180 (80%)	225 (100%)	The chi-square statistic is 0.2658. The *p*-value is .606152. The result is *not* significant at $p < .05$.
	More than secondary	50 (18.2%)	225 (81.8%)	275 (100%)	
	Total	95 (19%)	405 (81%)	500 (100%)	
Pregnancy	Yes	75 (21.4%)	275 (78.6%)	350 (100%)	The chi-square statistic is 4.4711. The *p*-value is .034474. The result is significant at $p < .05$.
	No	20 (13.3%)	130 (86.7%)	150 (100%)	
	Total	95 (19%)	405 (81%)	500 (100%)	

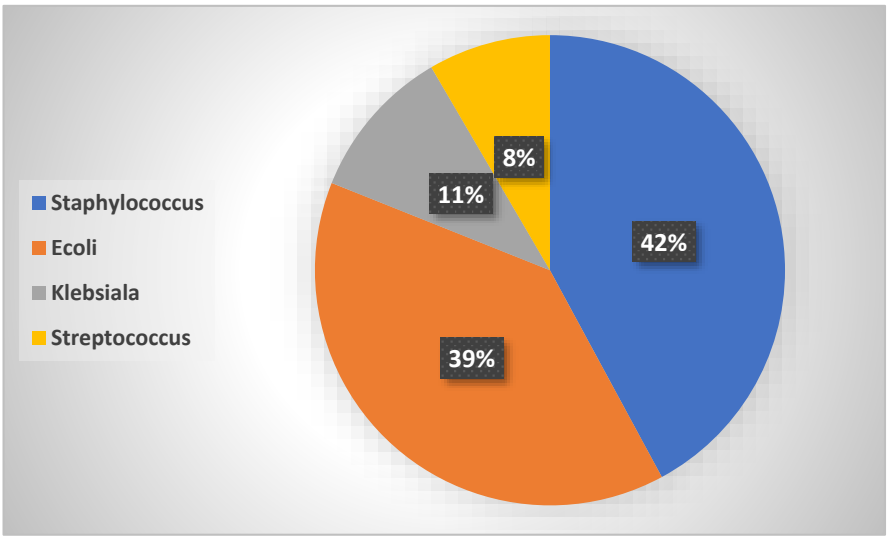

Figure (1) Distribution of cases according to types of bacteria isolation

Table (2) Distribution of cases according to presence of pregnancy and type of bacteria.

Pregnancy presence / Bacteria type	Pregnant		Nonpregnant		Total	
Staphylococcus	30	(40%)	10	(50%)	40	(42.1%)
E. coli	34	(45.3%)	3	(15%)	37	(38.9%)
Klebsiella	8	(10.7%)	2	(10%)	10	(10.5%)
Streptococcus	3	(4%)	5	(25%)	8	(8.4%)
Total	75	(100%)	20	(100%)	95	(100%)

The chi-square statistic is 12.3806. The *p*-value is .006187. The result is significant at $p < .05$.

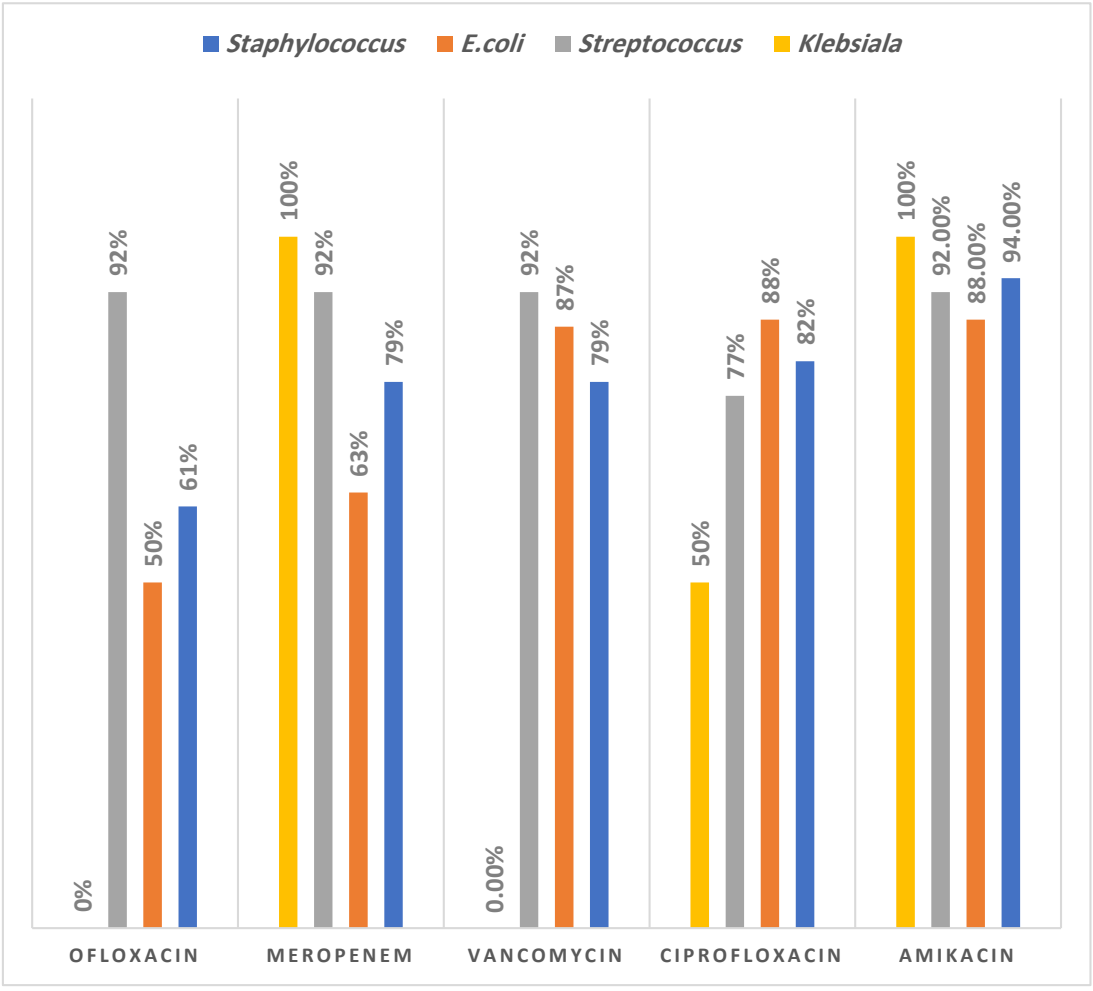

Figure (2) Distribution of bacteria type according to sensitivity to certain antibiotics

Regarding educational level, there were no significant differences similar to those reported by other studies (17,40).

The most frequent bacterial cause of bacteriuria among the sample cases was Staphylococcus (42%), followed by E. coli (39%), Klebsiella (11%), and lastly Streptococcus (8%). Other studies also revealed that the highest frequency of causative bacteria was Staphylococcus followed by E. coli (17,41), while others reported that E. coli had the highest frequency (15,16,34,37,42,43,44).

Among pregnant women, the most frequent bacteria was E. coli (45.3%), and among non-pregnant women, it was Staphylococcus (50%). Other studies found that the highest frequency of causative agents was E. coli among both pregnant women and controls (8).

Regarding pregnancy status, the frequency of bacteriuria cases was more frequent among pregnant women (21.4%) compared to non-pregnant women (13.3%), with a significant difference. These results are consistent with another study reporting that positive cultures were more frequent among pregnant women (14%) than among non-pregnant women (12%) (8).

Staphylococcus showed sensitivity to the following drugs: Amikacin (94%), Ciprofloxacin (82%), Vancomycin and Meropenem (79%), and Ofloxacin (61%). In another study, it was found that Staphylococcus bacteria were sensitive to cefuroxime, cephalexin, Amikacin, and gentamicin (34). E. coli exhibited sensitivity to the following drugs: Amikacin and Ciprofloxacin (88%), Vancomycin (87%), Meropenem (63%), and Ofloxacin (50%). Another study found that E. coli was sensitive to Cefuroxime, Nitrofurantoin, Cephalexin, Amikacin, and Gentamicin (34).

In the current study, Klebsiella bacteria showed sensitivity to the following drugs: Amikacin and Meropenem (100%), Ciprofloxacin (50%), and Vancomycin and Ofloxacin (0%). Another study revealed that this bacterium was sensitive to Cefuroxime, Cephalexin, Amikacin, and Gentamicin. Streptococcus exhibited sensitivity to the following drugs: Amikacin, Meropenem, Ofloxacin, Vancomycin (92%), and Ciprofloxacin (77%) (34).

The most sensitive drug in general for bacterial cultures in the current study was Amikacin, followed by Meropenem, while other studies indicated that the most sensitive drug was Cefuroxime, followed by Amikacin(34).

Conclusions: The frequency of bacterial growth was 19%. The most frequently isolated bacteria from the cultures were Staphylococcus followed by E. coli. The most sensitive drug was Amikacin followed by Meropenem.

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Conflicts of interest: The authors declare no conflict of interest.

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توزيع البكتريا طبقا لمقاومة المضادات الحيوية في تجرثم البول عند النساء البالغات في مدينة سامراء

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ملخص

الخلفية: تعريف البيلة الجرثومية هو وجود البكتيريا في البول مع عدم وجود مجموعة من علامات وأعراض التهاب المسالك البولية. البكتيريا الأكثر شيوعًا التي قد تسبب البيلة الجرثومية هي الإشريكية القولونية. حوالي 1−5% من النساء الأصحاء في فترة ما قبل انقطاع الطمث و(1.9−9.5%) من النساء الحوامل يعانين من البيلة الجرثومية. أكثر الأدوية الفعالة على البكتيريا نتيجة زراعة البول هي النيتروفورانتوين (98.3%) يليه السيفوروكسيم (89.3%) والكوتريموكسازول (20%).

الهدف والغايات: التعرف على توزيع البكتيريا حسب مقاومة الأدوية بين النساء البالغات المصابات بالبول الجرثومي في مدينة سامراء/ العراق، وتحديد بعض العوامل المؤثرة.

المواد والطرق: كانت الدراسة عبارة عن دراسة وصفية مقطعية أجريت على النساء البالغات (18−44) سنة اللاتي يترددن على مستشفى سامراء العام. تم الحصول على المعلومات الديموغرافية مع نتائج الفحوصات المختبرية وفقًا للاستبيان المعد لذلك. عندما ينمو نوع واحد من البكتيريا في البول مع ما لا يقل عن 100000 وحدة تشكيل مستعمرة لكل ملليلتر، سواء كانت البيلة البولية موجودة أم لا، يتم تحديد مريض يعاني من البيلة الجرثومية بدون أعراض، حتى في حالة عدم وجود أي أعراض لالتهاب المسالك البولية. عندما يكون ذلك مناسبا، تم استخدام التكرارات (عدد الحالات) والنسب المئوية لوصف البيانات إحصائيا. تمت المقارنة بين مجموعات الدراسة باستخدام اختبار مربع كاي. واعتبرت قيم (p) اقل من 0.05 ذات دلالة إحصائية.

النتائج: بلغ معدل نمو البكتيريا في العينة (19%). أعلى تكرار للحالات كان بين الفئة العمرية (28−37) سنة (22.4%). وكانت الحالات الإيجابية أكثر انتشارا بين النساء الحوامل (21.4%) مقارنة بغير الحوامل (13.3%). تمثل المكورات العنقودية أكثر أنواع البكتيريا شيوعا (42%)، يليها الإشريكية القولونية (39%)، الكليبسيلا (11%)، وأخيرا المكورات العقدية (8%). وكان الدواء الأكثر حساسية بشكل عام لنمو البكتيريا هو أميكاسين يليه أدوية الميروبينيم.

الاستنتاجات: كان معدل نمو البكتيريا 19٪. وكانت البكتيريا الأكثر شيوعا المعزولة من المزرعة هي المكورات العنقودية تليها الإشريكية القولونية. وكان الدواء الأكثر حساسية هو الأميكاسين يليه الميروبينيم.

الكلمات الدالة: البيلة الجرثومية، مقاومة الأدوية، سامراء.

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