IJBPAS, January, 2021, 10(1): 263-275

ISSN: 2277–4998

International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

RISK FACTORS ASSOCIATED WITH URINARY TRACT INFECTIONS AMONG PATIENTS IN OMAN: AN ETIOLOGY AND ANTIBACTERIAL SUSCEPTIBILITY STUDY

MUGHAIRI RA[1], AL LAMKI RNA[2] AND MABRUK M[1]

1: College of Medicine and Health Sciences, Department of Allied Health Sciences, Sultan Qaboos University, Oman

2: College of Medicine and Health Sciences, Department of Microbiology, Sultan Qaboos University, Oman

***Corresponding Author: Professor Mohamed Mabruk: E Mail: mabruk@squ.edu.om;**

Received 31st March 2020; Revised 21st April 2020; Accepted 13thJuly 2020; Available online 1st Jan. 2021

https://doi.org/10.31032/IJBPAS/2021/10.1.5336

ABSTRACT

Urinary tract infection (UTI) is a very common infection affecting many people every year. In Oman, no studies have been conducted in order to identify the risk factors associated with UTI.

A total of 300 urine samples were collected from patients attending Sultan Qaboos University Hospital (SQUH) clinics**.** Pathogens were isolated and identified. In addition, antimicrobial sensitivity tests of isolated pathogenic bacteria were conducted. Risk factors for each patient were recorded and analysed.

Pathogens were identified in 60 patients (20%) out of the 300 urine samples analysed. The most commonly detected pathogenic microorganisms in urine samples was *E.coli* (61.6%) followed by *K.pneumonia* (16.7%) and yeast with a percentage of (6.6%). Pregnancy ranked as the most common risk factor (36.7%), followed by diabetes (25%) and cancers (11.7%). The isolated bacterial uropathogens showed high resistance to ampicillin (67.57%), and amoxicillin (46%).

In the present study, the determination of risk factors associated with UTI and antibiotic resistance patterns of isolated uropathogens may provide useful information for the future management and treatment of Urinary tract infections in Oman.

Keywords: Urinary tract infection, Risk factors, antibiotic resistance, Omani patients

INTRODUCTION

Urinary tract infection (UTI) is a common infection and presented as both Community-acquired and Hospital-acquired infections [**1**]. Around 150 million urinary tract infection cases are estimated annually worldwide, costing the global economy about 6 Billion US dollars **[2, 3]**.

A prospective study of UTIs was carried out in the U.S.A, showed that the incidence of female UTI positive cases was 0.5–0.7 per year **[3]**. While UTI incidence among male was 5–8 infections per 10,000. Based on Hospital survey data, at least 250,000 cases of pyelonephritis annually occur in the USA [**3]**. A previous study carried out in Bangladesh demonstrated that among 462 patients suspected to have UTI, bacteriuria was presented in 9% of the samples **[4]**, around 16.8% of UTI cases in this Bangladesh study was noted among women aged above 19 years. *Escherichia coli* was the most pathogen detected with a percentage of (69%), *Streptococcus spp.* (15%) and *Pseudomonas aeruginosa* (7%), *Enterococcus faecalis* (3%). *Staphylococcus aureus, Klebsiella pneumoniae* (2%) and *Hafnia alvei* (2%) **[4]**.

In Saudi Arabia, a study on the incidence of UTI was carried in King Abdulaziz University Hospital in Jeddah. This study showed that among 200 urine samples collected, 11 (5.8%) showed significant bacteriuria **[5].** UTI cases were higher in female than male, with a percentage of (66%). Moreover, around 50% of patients with UTI were in the age group of 21-50 years **[5]**.

In Oman, a retrospective study was carried out to identify the most common uropathogens, in children presented with documented UTI. This study showed that out of 438 urine sample, 208 were positive urine culture with a percentage of 47.5% **[6]**. According to this study, UTI was found to be more prevalent in female (73%) than male (27%) **[6**].

UTI can be associated with many risk factors, the presence of such factors does not ensure that individuals will develop UTI, rather than increasing the risk of getting UTI. Age is considered as a risk factor in old individuals and young children **[7]**. Pregnant women are more at risk of getting UTI **[8**]. Menopause also is considered as another UTI risk factor among woman **[9, 10]**, because during the time of menopause the estrogen level will decrease, and this may rise the ability to develop UTI **[12]**.

The present study aims to determine the most common risk factors associated with urinary tract infection (UTI) in Omani outpatients attending SQUH clinics and to

identify the newly emerging antibiotic-resistant patterns in isolated uropathogens.

METHODS

Study design

This study was carried out at Sultan Qaboos University Hospital (SQUH), Microbiology Department.

A total of 300 urine samples were collected from patients attending SQUH and suspected with urinary tract infection (UTI), at the period from 20st of September until 23th of November 2017. The ethical approval for this research was obtained from the Research Ethics Committee, College of Medicine and Health Science, Sultan Qaboos University, Muscat, Sultanate of Oman (MERC#1496).

Patients information were collected including age, gender and clinical manifestations. Also, the history of patients diagnosed with UTI was obtained from the Hospital Information System (HIS).

Samples

Three hundred fresh urine samples were collected in sterile containers from patients attending SQUH clinics. Each sample was labeled with the necessary data (patient MRN, date, time of collection, type of test). The appearance of urine samples was checked, for their color (turbid, hemolysed and clear), and the volume of urine in each container was determined. All data were recorded.

The wet mount of urine samples was checked using an inverted microscope. The microscopical examination allowed the determination of the presence of any white or red blood cells, casts, crystals and epithelial cells.

Microbiological analysis

Detection of pathogenic bacteria in the urine samples

To detect the causative bacteria of UTI cases in the present study, samples were inoculated aseptically using a plastic sterile loop on Cysteine lactose electrolyte deficient (CLED) agar. Then plates were incubated at 37˚C for 24 hrs. The bacterial growth was determined in all cultured plates after 24 hrs., from the inoculation of urine samples on CLED agar. The standard for determining the degree of significance of bacterial growth in each urine sample was conducted in accordance with the loop size (µl) used in the Microbiology Department at SQUH. CLED agar plates with less than eleven colonies were reported as non-significant growth, while plates with more than eleven colonies were reported as significant pathogenic growth.

Identification of bacterial pathogens in urine samples using "BD Phoenix" system

The positive bacterial growth on CLED agars was used to prepare the 0.5 McFarland suspension. The suspension

was then transferred into two panels, one panel for identification and the other panel for antibiotic sensitivity testing. After the addition of the suspension to the panel, the panel was inserted in the BD Phoenix™ automated system (Becton and Dickinson Company, USA). The BD Phoenix™ automated system is a pathogen identification and antibiotic susceptibility testing system providing rapid and accurate detection of known and newly emerging antimicrobial resistance. Interpretation of results was done according to the National Committee for Clinical Laboratory Standards (NCCLS) recommendations.

Detection of fungi in urine samples

The process of the detection of fungi in urine samples obtained from Omani outpatients attending SQUH clinics was carried out by observing the presence of yeasts in urine samples using an inverted microscope. Followed by culturing of urine samples on Sabouroud agars (SAB). The isolated fungal colonies were further identified by performing Germ tube test, to identify if the isolate is *Candida albicans*.

Data analysis

All patients' data were collected in Exel programmer (Excel 2013) and tabulated using Statistical Package for Social Science (SPSS) software. The mean, median and proportion for categorized variables were analyzed also by SPSS.

RESULTS

Clinical features

During the data collection period from 20th September until the 23rd November 2017, a total of 300 patients, were recruited randomly for the present study. Patients were aged between (0 – 80) years with a median age of 38 years **(Table 1)**. Urine samples were collected from Sultan Qaboos University Hospital (SQUH) clinics, which is a referral Hospital from all regions in Oman. Of the 300 patients, 255 (85%) were female and 45 (15%) were male. A urine sample was collected from each patient. The majority of the cases (35%) were within the age of more than 47 years' age group. The sociodemographic characteristics of patients are summarized in **Table 1**.

The prevalence of pathogens in urine samples

From the 300 collected urine samples, 60 urine samples were positive for microbial pathogens. The most common bacterial pathogen isolated from the 300 samples obtained from patients attending SQUH clinics, was *E. coli* **(Table 2; Figure 1)**. *Escherichia coli* was identified in 37(61.6%) of patients, followed by *Klebsiella pneumonia* in ten patients (16.7%), Yeast *(Candid species),* in five patients (6.6%) **(Table 2; Figure 1).** *Streptococcus agalactica* and *Acintobacter*

baumanii in 2 patients with a percentage of (3.3 %) **(Table 2)**. *Proteus mirabilus*, *Acromobacter spp, Pseudomonas aeruginosa* and *Enterococcus faecalis* were identified in one patient with a percentage of (1.7%) for each **(Table 2)**.

Identified risk factors

Many risk factors enhance the ability of the individual to develop UTI. In the present study, the risk factors presented in the patients attending SQUH clinics were obtained from the history of each patient diagnosed with UTI. Gender is one of the risk factors associated with UTI in Omani patients, the female patients were more at risk of developing UTI with a percentage of (85%) in comparison to male (15%) as shown in **(Figure 2)**. The most common pathogens detected in female were *E.coli*, *K. pneumonia* and Yeasts *(Candid species)*, wherein male *E.coli* and *K. pneumonia* were the most common pathogens detected in the urine samples. Patients were grouped into five age groups to study how age can be identified as a risk factor of UTI, the majority of positive UTI cases were within the age group of more than 47 years, with a percentage of (35%) **(Figure 3)**. The most common pathogens detected in both age group, were *E.coli* and *K. pneumonia* **(Figure 4)**. For the age groups of 26-36 years and more than 47 years, *E.coli, K. pneumonia* and Yeast *(Candid species)* were the most common pathogens detected **(Figure 4)**. While in the age group of 37-47 years, *E.coli* and *yeast* were mostly detected in the urine samples. Other factors like pregnancy, diabetes and cancer were included during the present study. Pregnancy ranked as the first most common risk factor in female outpatients attending SQUH clinics with a percentage of (36.7%). *E.coli , K. pneumonia* and *Yeasts (Candid species),* were the most detected pathogens in the urine samples obtained from pregnant women. Followed by diabetes (25%) and cancerous patients (11.7%), as shown in **(Table 3)**. *E.coli* and *k.pneumonia* were the most common pathogens detected in urine samples obtained from both diabetic and cancerous patients.

Antimicrobial resistance and sensitivity

The antibiotic sensitivity testing results showed that the resistance rates of *E.coli* to ampicillin was high (67.57%), to amoxicillin (46%), to trimethoprim (21.60%), to ciprofloxacin (21.60%), nitrofurantion (10.81%), imipenem (0%), meropenem (0%), cefuroxime (48.60%) **(Table 4)**. Also, the resistance rate for, ampicillin to amoxicillin, trimethoprim, ciprofloxacin, nitrofurantion, imipenem, meropenem and cefuroxime was (0%) for all isolated *P.*

mirabilus. The antibiotic susceptibility results of all bacterial pathogens isolated from urine samples obtained from Omani outpatients attending SQUH clinics are summarized in **(Table 4)**.

Table 1: Sociodemographic characteristics of patients included in this study

Gender		
Female	**255**	**85%**
Male	**45**	**15%**
Age		
(median – range)	**38 (0 -80)**	
Age group, years		
Less than 15	**15**	**5%**
15-25	**36**	**12%**
26-36	**90**	**30%**
37-47	**54**	**18%**
More than 47	**105**	**35%**

Table 2: Prevalence of organisms in urine samples of outpatients attending SQUG clinics

Organism	Number (%) prevalence
Normal (no organism detected)	**240(80%)**
Total number of infected samples	**60(20%)**
Escheriachia coli	**37 (61.6%)**
Klebsiella pneumoniae	**10 (16.7%)**
Yeast	**5 (6.6%)**
Streptococcus agalactica	**2 (3.3%)**
Proteus mirabilis	**1 (1.7%)**
Achromobacter spp	**1 (1.7%)**
Pseudomonas aeruginosa	**1 (1.7%)**
Enterococcus faecalis	**1 (1.7%)**
Acintobacter baumanii	**2 (3.3%)**

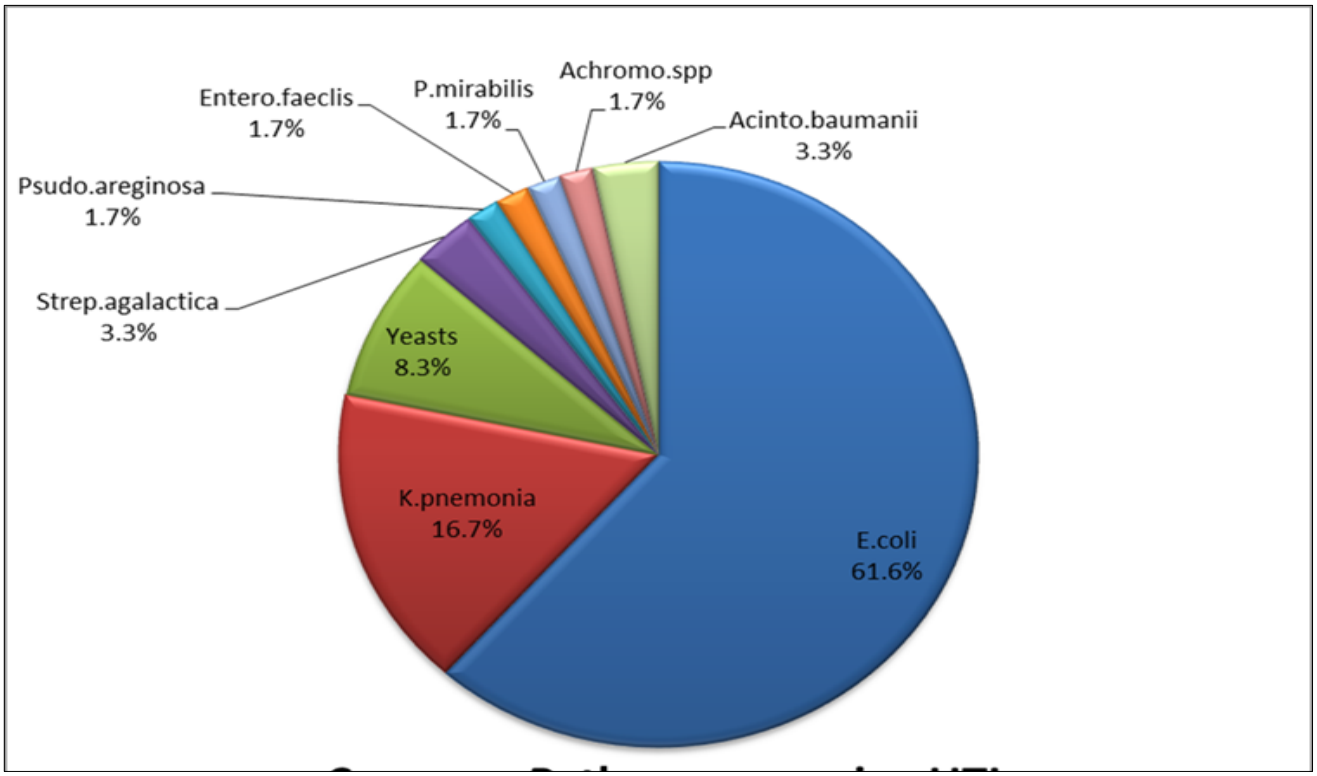

Figure 1: Most common Pathogens detected in patients attending SQUH clinics

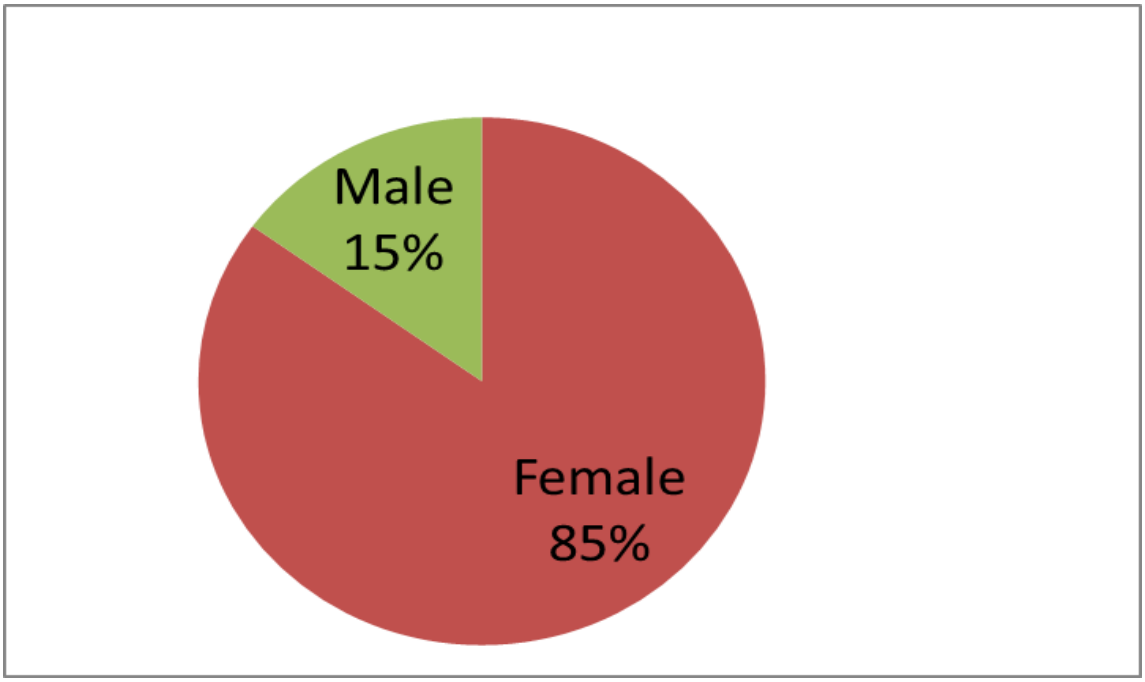

Figure 2: Correlation between positive UTI cases and gender

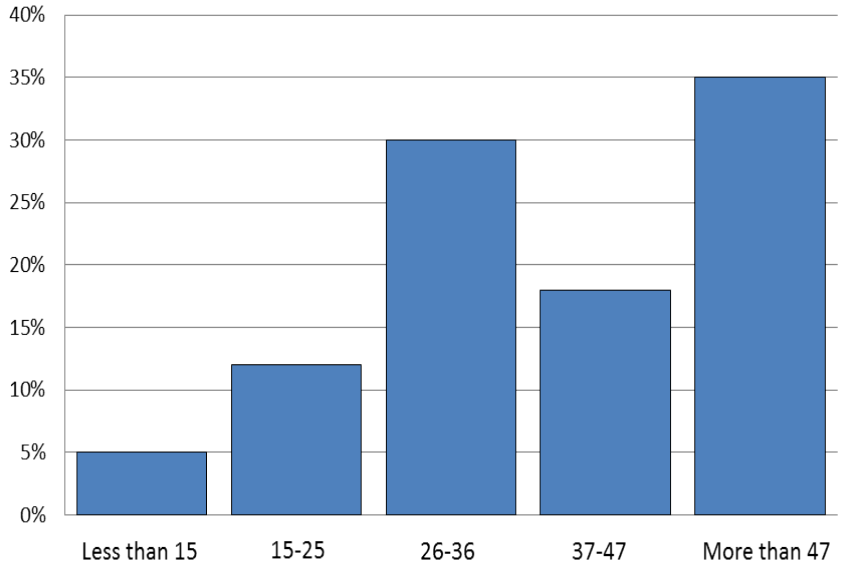

Figure 3: Correlation between positive UTI and age groups

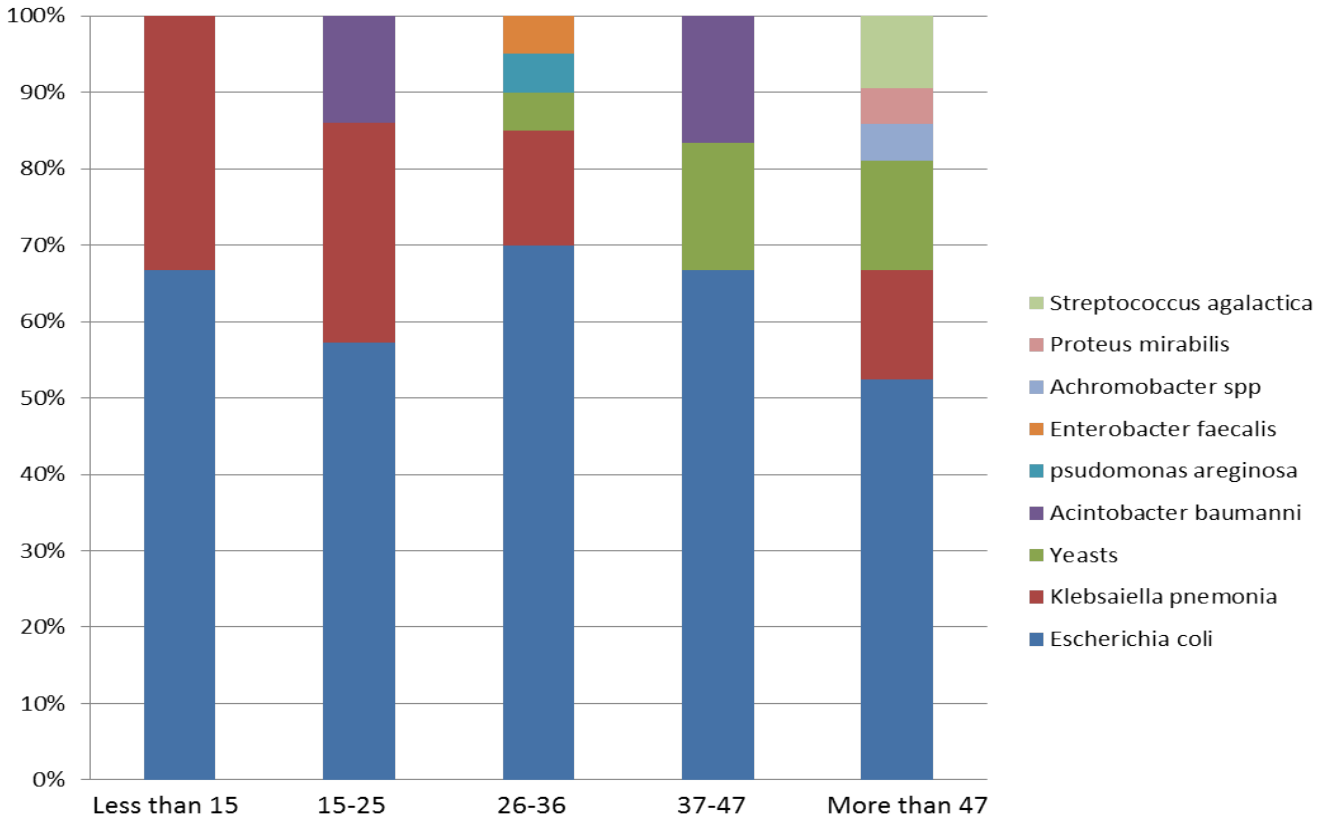

Figure 4: Pathogens detected on urine samples on each age group

Table 3: The association of UTI with risk factors

Risk factors	Percentages
Pregnancy	36.7%
Diabetes	25%
Cancers	11.70%

Table 4: Prevalence and antimicrobial susceptibility (%) of bacterial strains recovered from urine samples obtained from outpatients attending SQUH clinics

Bacterial strains	N(%)	AM	AMX	TRM	CFN	NFN	IPM	MPM	CXM
E. coli	37(61.6%)	67.57%	46%	21.60%	21.60%	10.81%	0%	0%	48.60%
K. pneumonia	10(16.7%)	100%	20%	30%	10%	10%	10%	0%	20%
P.mirabilis	1(1.7%)	0%	0%	0%	0%	0%	0%	0%	0%
P.aeruginosa	1(1.7%)	100%	100%	0 %	0%	100%	0%	0%	100%
A. baumanii	2(3.3%)	100%	100%	50%	50%	100%	100%	50%	100%

N=300

***AM = Ampicillin; AMX = Amoxicillin; TRM = Trimethoprim; CFN = Ciprofloxacin; NFN = Nitrofurantion; IPM = Imipenem; MPM = Meropenem; CXM = Cefuroxime**

DISCUSSION

In the present study, among the 300 urine samples collected from Omani patients attending to Sultan Qaboos University Hospital (SQUH) clinics, only 60 (20%) of cases were positive for UTI. The most common causative agent of UTI in Omani patients recruited for the present study was bacteria (93.4%) followed by yeast (6.6%). Also, the most common bacteria associated with UTI was found to be *E.coli*. (61.6%), followed by *K. pneumoniae* (16.7%), and *S. agalactia* (3.3%). These results were similar to a previous study conducted in SQUH, which showed that the leading cause of UTI was *E.coli* (77%), followed by *K .pneumoniae* (10%)[**6]**. Similar results were shown in a study conducted at King Abdul Aziz University Hospital, showing that *E.coli* (40%) was the most common pathogen detected in urine samples obtained from outpatients, followed by *K.pneumoniae* (26%) [**5**].

In the present study, age was considered to be one of the risk factors of UTI in patients attending SQUH clinics, the ages were grouped into five groups. The results obtained from this study showed that the majority of positive UTI cases were within the age group of more than 47 years old with a percentage of 35%, this can be explained that the immune system in elderly could be suppressed, as a consequence their susceptibility to UTI increases **[13].**

Moreover, in the present study, the correlation between UTI and gender was investigated. The result of the present study showed that female is more at risk to develop UTI with a percentage of (85%) in

comparison to male (15%). This result could be explained by the anatomical difference between male and female, the urethra in male is longer than the urethra in the female, in which the possibility of the pathogen to reach the bladder is much higher in female **[10,11, 14]**. A similar result was also seen in a study conducted on Saudi Arabia and showed a higher percentage of positivity among female (58%) in comparison to male patients (42%) **[5]**.

In our study, pregnancy, diabetes and cancers were included as risk factors. Pregnancy ranked as the most common causative risk factor causing UTI, with a percentage of (36.7%). This high percentage could be simply explained by the fact that pregnant ladies are considered as immunocompromised **[8,14]**, thus they are more at risk to develop UTI since they are more susceptible to pathogens, moreover, the hormonal and anatomical changes which occur in during the pregnancy may also contribute to this increased UTI risk **[8]**. Diabetes was one of the risk factors seen in the present study, with a percentage of 25%. This could be due to the fact that the high level of sugar cause nephrons damage in diabetic patients, and also the anti-diabetic drugs used as a treatment in diabetes can decrease the immunity of individuals, and ultimately, increase the ability of the pathogen to cause urinary tract infections **[15,16].** The present study showed that cancer patients are more at risk to develop UTI because of their immune state due to the use of chemotherapy **[17].**

In the present study, the resistance rate of 67.5% of *E.coli* to Ampicillin is slightly lower in comparison to a previously published a study, which showed a resistance rate of 76% of *E. coli* isolated from Omani children diagnosed with UTI **[6].** In contrast resistance to Ampicillin was much higher in adult UTI Omani patients in comparison to a lower rate of 28.6% seen in adult Russian patients with UTI **[18].** This could be contributed to the over-prescription of Ampicillin in Oman. Ciprofloxacin resistance in our study was documented as 21.60%% in *E. coli*, while it was reported to be much higher (78%) in a previous Italian study [**19]**. There was no resistance to meropenem in *E. coli* in the present study. This is in agreement with previous study conduct in Oman **[6].**

Our study showed that the resistance of *Klebsiella pneumonia* to Ampicillin was 100%, which is in agreement with a previously published study conducted on Omani children with UTI and showed 100% resistance to Ampicillin **[6]**. Also, the present study revealed 100% sensitivity of the isolated *Klebsiella pneumonia* to

imipenem. This finding is in contrast to a previous report from a similar study conducted in Madagascar which showed that 40% of *Klebsiella pneumoniae* strains were resistant to imipenem **[20]**.

CONCLUSIONS

In the present study, we investigated the risk factors associated with UTI in Omani patients and determined the antibacterial resistant patterns in these patients. Identifications of risk factors for UTI may help in implementing prevention plans in order to reduce the risk of UTI. In addition, the determination of antibiotic resistance patterns of isolated uropathogens may help in the implementation of aggressive antimicrobial prophylactic strategies for treating UTI in Oman.

ACKNOWLEDGMENTS

We would like to thank the head and all the clinical and technical staff at the Microbiology Department, Sultan Qaboos University Hospital for allowing us to use all of their departmental and laboratories facilities and for all of their support and encouragement. Also, the authors would like to thank the SQU ethical committee for the approval of this project and for allowing us to obtain patients data.

Declaration of Conflicting Interests

The Authors declare no conflict of interest.

Funding

This project was funded by the College of Medicine and Allied Health Sciences, Sultan Qaboos University.

REFERENCES

[1] Akram, M., Shahid, M., & Khan, A. U. 2007. Etiology and antibiotic resistance patterns of community-acquired urinary tract infections in JNMC Hospital Aligarh, India. *Annals of clinical micro-biology and anti-microbials*; *6*(1): 4.

[2] De Cueto M, Aliaga L, Alós JI, Canut A, Los-Arcos I, Martínez JA, Mensa J, Pintado V, Rodriguez-Pardo D, Yuste JR, Pigrau C. 2017. Executive summary of the diagnosis and treatment of urinary tract infection: Guidelines of the Spanish Society of Clinical Microbiology and Infectious Diseases (SEIMC). *Enferm Infecc Microbiol Clin*.; 35(5): 314-320.

[3] McLellan LK, Hunstad DA. 2016. Urinary Tract Infection: Pathogenesis and Outlook. *Trends Mol Med.*; 22(11):946-957.

[4] Rahman, S. R., Ahmed, M. F., & Begum, A. 2014. Occurrence of urinary tract infection in adolescent and adult women of shanty town in Dhaka City, Bangladesh. *Ethiopian*

journal of health sciences. 24(2):145-52.

[5] Elthawy, A. and Khalaf, R. 1988. Urinary Tract Infection at a University Hospital In Saudi Arabia: Incidence, Microbiology, And Antimicrobial Susceptibility. *Annals of Saudi Medicine*. 8, (4): 261-66.

[6] Sharefa SW; El-Naggaria M; Al-Nabhania D; Al Sawaia A; Al Muharrmib Z ; Elnoura I. 2015. Incidence of antibiotics resistance among uropathogens in Omani children presenting with a single episode of urinary tract infection. *Journal of Infection and Public Health*. 8(5): 458-465.

[7] Hooton, T. M., Bradley, S. F., Cardenas, D. D., Colgan, R., Geerlings, S. E., Rice, J. C., Nicolle, L. E. 2010. Diagnosis, prevention, and treatment of catheter-associated urinary tract infection in adults: 2009 International Clinical Practice Guidelines from the Infectious Diseases Society of America. Clinical infectious diseases 50(5)**:** 625-63.

[8] Glaser AP, Schaeffer AJ. 2015. Urinary Tract Infection and Bacteriuria in Pregnancy. *Urol Clin North Am*. 42(4): 547-60.

[9] Foxman B. 2008. Epidemiology of urinary tract infections: incidence, morbidity, and economic costs. *The American journal of medicine*. 113 (1): 5-13.

[10] Foxman B. 2014. Urinary tract infection syndromes: occurrence, recurrence, bacteriology, risk factors, and disease burden. . *Infect Dis Clin North Am*. 28 (1): 1-13.

[11] Hooton, T. M., Scholes, D., Hughes, J. P., Winter, C., Roberts, P. L., Stapleton, A. E., & Stamm, W. E . 1996. A prospective study of risk factors for symptomatic urinary tract infection in young women. *New England journal of medicine. 335*(7)**:** 468-74.

[12] Kakde P, Redkar NN, Tract Infection in Elderly: Clinical Profile and Outcome Yelale A 2018. *Assoc Physicians India***.;** 66(6):14-17.

[13] Pescatore R, Niforatos JD, Rezaie S, Swaminathan A. 2019. Evidence-Informed Practice: Diagnostic Questions in Urinary Tract Infections in the Elderly. *West J Emerg Med*. 20(4):573-77.

[14] Cohen R, Gutvirtz G, Wainstock T, Sheiner E. 2019. Maternal urinary tract infection during pregnancy and long-term infectious morbidity of the off spring. *Early Hum Dev*. 136:54-59.

[15] Nitzan O, Elias M, Chazan B, and Saliba W. Urinary tract infections in patients with type 2 diabetes mellitus: review of prevalence, diagnosis, and management. Diabetes Metab Syndr Obes. 2015; 8: 129–136.

[16] Yeshitela B, Gebre-Selassie S, Feleke Y. 2012. .Asymptomatic Bacteriuria and Symptomatic Urinary Tract Infections (UTI) in Patients With Diabetes Mellitus in Tikur Anbessa Specialized University Hospital, Addis Ababa, Ethiopia. *Ethiop Med J* ; 50(3): 239-49.

[17] Charshafian S, Liang SY. 2018. Infectious Disease Emergencies in the Cancer Patient: Rapid Fire. *Emerg Med Clin North Am*. 36(3): 493–516.

[18] Rafalsk V.V 2006. Antimicrobial susceptibility of pathogens isolated from adult patients with uncomplicated community-acquired urinary tract infections in the Russian Federation: two multicentre studies, UTIAP-1 and UTIAP-2). *Int J Antimicrob Agents* 28 Suppl 1: 4-9.

[19] De Francesco MA, Ravizzola G, Peroni L, Negrini R, Manca N 2007. Urinary tract infections in Brescia, Italy: etiology of uropathogens and antimicrobial resistance of common uropathogens. *Med Sci Monit.* 13 (6): 136-44.

[20] Rasamiravaka T, Shaista Sheila HS, Rakotomavojaona T, Rakoto-Alson AO, Rasamindrakotroka A. 2015. Changing profile and increasing antimicrobial resistance of uropathogenic bacteria in Madagascar. *Med Mal Infect*. 45(5):173-6.