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Prodominance and Incidence of Pseudomonas Bacteria in Urinary Samples from Women with Chronic Urinary Tract Infections

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Abstract. Background; Chronic urinary tract infections in women are often associated with Pseudomonas aeruginosa, a significant pathogen causing recurrent and persistent infections. Aims of the study; To assess the predominance and incidence of Pseudomonas aeruginosa in urinary samples from women with chronic urinary tract infections. Methodology; A cross-sectional study at Al-Habbobi Teaching Hospital (10/11/2023–11/11/2024) examined bacterial infections in urinary samples from 1000 UTI patients (aged 35–45). Samples were cultured and analyzed for bacterial identification and antimicrobial susceptibility. Sociodemographic and clinical data were collected using questionnaires, ensuring ethical compliance and participant confidentiality. Result; The study included 1000 participants, with 60% in the 35–40 age group, 75% married, 60% having a college education, and 50% employed. Forty percent had a UTI history of 1–3 years. The most common bacteria in urine samples were Escherichia coli (45%), followed by Pseudomonas aeruginosa (22%), Klebsiella pneumoniae (15%), and Enterococcus faecalis (7%). Infection rates of Pseudomonas aeruginosa were highest in patients with UTIs lasting 4–7 years (40.91%), followed by those with >7 years (36.36%) and 1–3 years (22.73%). The 35–40 age group had the highest prevalence of Pseudomonas (59.09%). Conclusions; The study concludes that Escherichia coli and Pseudomonas aeruginosa are the most prevalent bacteria in UTIs, with Pseudomonas being more common in patients aged 35–40 and with longer infection durations.

Highlights:

1. Chronic UTIs often involve Pseudomonas aeruginosa, causing persistent infections.
2. Escherichia coli (45%) and Pseudomonas aeruginosa (22%) dominate UTI pathogens.
3. Pseudomonas prevalence increases with age (35–40) and longer infection durations.

Keywords: Escherichia coli, Pseudomonas aeruginosa, Urinary tract infections (UTIs), Chronic infections, Biofilms, Antibiotic resistance

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Introduction

Chronic urinary tract infections (UTIs) are a prevalent issue worldwide, impacting women at a higher rate due to anatomical and physiological factors (Foxman, 2014). The management of chronic UTIs which are characterized by recurrent or persistent infections in the presence of therapy remains a great challenge to the clinician and the patient alike (Stamatiou et al., 2021). Pseudomonas aeruginosa, a Gram-negative bacillus is especially troublesome for UTIs caused by Gram-negative pathogens due to antibiotic resistance and biofilm forming ability which protects it from immune system and therapeutic regimens (Morrill et al., 2019). Given its high frequency in health care–associated infections, the role of Pseudomonas aeruginosa in community-acquired UTIs in women with chronic illnesses has largely been under-investigated. Indeed, Pseudomonas aeruginosa is one of the least commonly associated uropathogens in UTIs, particularly those acquired in the community, as shown by a 300-hospital study (Flores-Mireles et al., 2015). However, its prevalence in chronic and complicated cases is much higher, frequently associated with prior antibiotic therapy, catheterization, or anatomical abnormalities of the urinary tract (Kanj & Kanafani, 2011). This pattern shows the adaptability of Pseudomonas aeruginosa and its role in chronic infections. In chronic UTIs, the prevalence of this pathogen may lead to treatment failure, prolonged illness, and increased costs of healthcare (Mihai et al., 2022). Epidemiological studies have revealed regional and demographic differences in the prevalence of Pseudomonas aeruginosa in UTIs. In areas where advanced diagnostics and susceptibility testing are restricted, infections due to this pathogen are often underreported or misclassified (Lepper et al., 2018). In contrast, widespread surveillance in welldeveloped healthcare facilities, the constant detection of Pseudomonas aeruginosa confirm its contribution to complicated urinary infections, particularly in patients with diabetes or immunosuppression (Farrell et al., 2020). Pseudomonas aeruginosa is a complex pathogen with several virulence factors including, but not limited to, exotoxins, proteases, and quorum-sensing systems that enable it to reliably colonize and damage host tissues (Rada et al., 2020). For chronic UTIs, this condition is further worsened because it represents bacterial growth in a partial biofilm on urinary catheters or epithelial surfaces leading to its persistence and resistance making it a complex case to deal with (Bjarnsholt., 2013). Furthermore, the global spread of multidrug-resistant

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(MDR) strains also becomes a challenge for management, with mechanisms of resistance that include the expression of efflux pumps, the enzymatic degradation of antibiotics, and mutations of target sites (Ramphal & Ambrose, 2019). These features require a thorough understanding of its epidemiology to inform targeted interventions. The context of frequent UTIs in females led us to seek an explanation for the increased prevalence and frequency of P. Which are due to complex dynamic interactions between host, pathogen and therapeutic related factors. Such high recurrence rates highlight the importance of routine microbial profiling and susceptibility testing in an outpatient setting (Khawcharoenporn et al., 2013). These practices can help streamline treatment regimens and reduce the development of MDR strains. Moreover, patient education about preventive behaviors and the judicious use of antibiotics to counter resistance patterns also should be highlighted by public health campaigns (World Health Organization., 2020). People with weak immune systems are most at risk for pseudomonas infections. These include individuals with AIDS, cancer, cystic fibrosis, bronchiectasis, neutropenia, burns, organ transplants, poorly controlled diabetes mellitus, or patients in critical care units. Chains of community microbes or "biofilm" that are difficult to see can form on people who have invasive medical devices like breathing tubes or stents that remain in their bodies (Intisar et al., 2023).

Methods

This cross-sectional study was carried out at Al-Habbobi Teaching Hospital within the period from 10/11/2023 to 11/11/2024 to determine the rate of bacterial infection in urinary samples in addition to showing the association between sociodemographic and clinical variables. Materials and methods A total of 1000 subjects aged 35–45 years were recruited and diagnosed with urinary tract infection (UTI) as per the clinical findings and laboratory results. The participants were recruited from the outpatient and inpatient departments, and ethical approval was obtained along with informed consent. Aseptic midstream urine samples were taken and samples were cultured on blood agar and MacConkey agar and incubated at 37°C for 24–48 hours. Bacteria were identified based on colony morphology, Gram stain and biochemical tests (e.g. oxidase and urease test for Pseudomonas aeruginosa, indole positivity for Escherichia coli, novobiocin resistance for Staphylococcus saprophyticus, etc). Antimicrobial susceptibility testing was

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conducted using the Kirby-Bauer disk diffusion method on Mueller-Hinton agar, adhering to Clinical and Laboratory Standards Institute (CLSI) guidelines. A structured questionnaire captured sociodemographic data, including age, marital status, education level, and employment, as well as clinical information such as the duration of UTI symptoms. Ethical considerations ensured participant confidentiality and adherence to the Declaration of Helsinki guidelines, with all participants free to withdraw at any time.

Statistical analysis:

A lot of the time, numbers are what statistical analysis is used for. It also lets us describe data and quickly draw conclusions about both continuous and categorical data. Part of the process is getting data that will be used to see if there is a link between two sets of statistics. All of the study's data are shown as percentages and frequencies. We used the dependent t-test (two-tailed) and the independent t-test (two-tailed) for factors that were normally distributed. That is why we used the Mann-Whitney U test, the Wilcoxon test, and the Chi-square test to find factors that were not spread out regularly. It was thought that 0.05 was statistically significant.

Ethical approval:

It was okay with the human ethics committee at Al-Habbobi Teaching Hospital to do the study. People who took part in the study were told about it and asked to sign a form saying they agreed to take part. Also, the person was told that no one else would see his information

Result and Discussion

Sociodemographic Characteristics of Study Participants (n = 1000)

The demographic and social data of the study participants (number of participants: 1000) showed that the age group 35–40 years was the most common at 60% compared to the age group 41–45 years which represented 40%. In terms of marital status, the majority of participants were married at 75%, while the percentage of singles was 15% and divorced or widowed at 10%. As for the educational level, the percentage of those with a university or college education was the highest at 60%, followed by those with a secondary education at 30%, and finally those with postgraduate studies at 10%. In terms of employment, the distribution was equal between the employed and the unemployed, with the percentage for each category

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being 50%. Finally, for the history of urinary tract infection (UTI), the results showed that 40% of the participants had a history of infection for 1-3 years, while the percentage was equal between the groups with a history of infection for 4-7 years and more than 7 years, each reaching 30%.

Table 1: Sociodemographic Characteristics of Participants (n = 1000)

Characteristic	Category	Frequency (n)	Percentage (%)
Age Range (years)	35–40	600	60%
	41–45	400	40%
Marital Status	Married	750	75%
	Single	150	15%
	Divorced/Widowed	100	10%
Educational Level	High School	300	30%
	College/University	600	60%
	Postgraduate	100	10%
Occupation	Employed	500	50%
	Unemployed	500	50%
History of UTI (years)	1–3 years	400	40%
	4–7 years	300	30%
	> 7 years	300	30%

Prevalence of Bacterial Infections in Urinary Samples (n = 1000)

Results of urine samples from the study participants (number 1,000) showed that Escherichia coli was the most common bacteria, accounting for 45% of infections, followed by Pseudomonas aeruginosa at 22%. Klebsiella pneumoniae came in third place at 15%, while Enterococcus faecalis was 7%. Proteus mirabilis and Staphylococcus saprophyticus recorded lower rates, at 6% and 5% respectively, while the rates of infections with other types of bacteria were very low, not exceeding 1%.

Table 2: Types of Bacterial Infections in Urinary Samples (n = 1000)

Bacterial Species	Frequency (n)	Percentage (%)
Pseudomonas aeruginosa	220	22%
Escherichia coli	450	45%
Klebsiella pneumoniae	150	15%
Enterococcus faecalis	70	7%
Proteus mirabilis	60	6%
Staphylococcus saprophyticus	50	5%
Other bacteria	10	1%

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Incidence of Pseudomonas Infections Based on Duration of Urinary Tract Infection (n = 220)

The results of Pseudomonas aeruginosa infection among patients with UTI (n=220) showed that the highest infection rate was in patients with infection duration of 4–7 years, reaching 40.91%. This was followed by the infection rate in patients with infection duration of more than 7 years, reaching 36.36%. As for patients with infection duration of 1–3 years, the infection rate was 22.73%.

Table 3: Incidence of Pseudomonas in Relation to Duration of UTI (n = 220)

Duration of UTI (years)	Frequency of *Pseudomonas* (n)	Percentage (%)
1–3 years	50	22.73%
4–7 years	90	40.91%
> 7 years	80	36.36%

Prevalence of Pseudomonas Bacteria by Age Group (n = 220)

The results of the prevalence of Pseudomonas aeruginosa bacteria among patients (number 220) showed that the age group 35–40 years was the most affected, with an infection rate of 59.09%. While the infection rate among patients in the age group 41–45 years was lower, reaching 40.91%.

Table 4: Prevalence of Pseudomonas Bacteria by Age Group (n = 220)

Age Group (years)	Frequency of *Pseudomonas* (n)	Percentage (%)
35–40	130	59.09%
41–45	90	40.91%

Discussion:

The study showed that there were more and different kinds of pseudomonas spp. in the study group, which was 1000 urine culture samples. Half of the samples were made up of Pseudomonas spp., 25% were made up of Proteus spp., and 25% were made up of Staphylococcus spp. We concur with the statements of Habibu et al. (2014) found. Not so many things can help us obtain more information on frequency rate, although the reasons for the high frequency rate of Pseudomonas spp. may play an important role, such as environmental factors or the characteristics/age of the people who receive it. Besides, the same frequency of Proteus Spp and Staphylococcus Spp indicates further research is required to determine the time-dependent interpretation of

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these bacterial species among populations (Ahmed &Dalia Azher., 2015). At their best, such and epidemiological data allow to provide insight into associations between patient- and disease-related attributes and geography. These results are generally used to monitor the progress of germ spreading and to aid in planning to mitigate public health issues such as infection control and antibiotic resistance (Mittal et al., 2009). There are some regular patterns in the number of different types of bacteria picked up in pee samples depending on the sex of the individual. Pseudomonas Spp is the most common type in women (60.0% of cases). Next are Proteus Spp and Staphylococcus Spp, which together make up 20.0%. Pseudomonas Spp bacteria, on the other hand, are still most common in guys, though only 40.0% of the time. There are also a lot of Proteus Spp and Staphylococcus Spp germs (30.0% of all cases). These things happen because women's immune systems aren't as strong as men's, and different medicines aren't killing the germs. Infections in the urinary system are always worse for women. This might happen if women use birth control, don't eat enough healthy food, or are getting treatments that make their immune systems weak. We agree with what was found (Maglian et al., 2012). One reason why germs grow differently in men and women is that their hormones change, their immune systems react, and they may have long-term diseases that are bad for their health (Khan et al., 2008). We might be able to stop and treat infections better if we can figure out what causes the known trends of prevalence by sex. So, if certain types of germs show that women are more likely to get them, this information could be used to help women avoid getting urinary tract infections (Mohammed et al., 2016). Antibiotics were used in different ways by the men and women. Both men and women used AK more often than other antibiotics, the study found. It does this by attaching to the 30S ribosome and stopping the production of messenger RNA and proteins inside the bacterial cell. This makes AK better at killing bacteria and getting people healthy again after an illness. This result is in line with (Seifu et al., 2018). The fact that science and doctors now know how often men and women use antibiotics could be very useful. Because men and women use drugs in different ways, it is possible to make treatment plans that work better for everyone. More study needs to be done to find out why these differences happen, such as why some people are more sensitive to certain drugs because of their biology or the way they live their lives (Pardeshi et al., 2018). The different drugs for men and women could be due to a

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number of things. As an example, many people take medicines without first seeing a doctor. This means they aren't as good at fighting infectious diseases because people's genes have changed to make them less likely to get sick. Some medicines use antibiotics that are easy for patients to get from shops or hospitals. These antibiotics come in tab form. This is also the main reason ciprofloxacin isn't used very often. Amikacin, on the other hand, can only be shot into muscles, so a person can't take it without first talking to a doctor. We think that people should only take antibiotics with the help of an expert doctor who has done all the necessary exams and tests. This will help stop antibiotic resistance in the future (Koeijers et al., 2010).

Conclusion

The study concluded that Escherichia coli and Pseudomonas aeruginosa are the most prevalent bacterial pathogens in urinary tract infections (UTIs), with Pseudomonas being more common in the 35–40 age group and those with prolonged infections. Escherichia coli is the primary cause of UTIs due to its ability to adhere to the urinary tract lining, while Pseudomonas aeruginosa is a more opportunistic pathogen, often associated with chronic and recurrent infections due to its resistance to many antibiotics and its ability to form biofilms. The higher prevalence in older infection groups may be linked to chronic infection and immune system alterations over time

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