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Bacterial Urinary Tract Infections Among Pregnant Women in Al-Diwaniyah City

Layth Hussein Hadi Alshaibah., laith.hussein@qu.edu.iq,(1)
College of Dentistry, University of Al-Qadisiyah, Diwaniya, Iraq

(1) Corresponding author

Abstract

General Background: Urinary tract infections (UTIs) are the most prevalent infectious complication during pregnancy, ranging from asymptomatic bacteriuria to severe pyelonephritis. **Specific Background:** These infections cause significant maternal and fetal morbidity, yet bacterial etiology and severity patterns across gestational periods remain incompletely characterized regionally. **Knowledge Gap:** Limited data exist regarding trimester-specific bacterial profiles and inflammatory marker correlations with UTI severity in Al-Diwaniyah province. **Aims:** This cross-sectional study identified bacterial pathogens causing UTIs in 140 pregnant women and examined associations between inflammatory markers and infection severity across trimesters. **Results:** *Escherichia coli* (55%) and *Klebsiella* (18%) predominated, with severity increasing from mild first-trimester to severe third-trimester infections. Inflammatory markers (WBC, CRP, procalcitonin, proteinuria) correlated significantly with disease severity. **Novelty:** This study establishes trimester-specific bacterial distributions and severity-biomarker relationships in this population. **Implications:** Findings support targeted screening protocols and trimester-appropriate antimicrobial strategies for improved maternal-fetal outcomes.

Keywords : Urinary Tract Infections, Pregnant Women, Escherichia coli, Bacterial Pathogens, Pregnancy Complications

Highlight :

- E. coli caused 55% of infections, primarily in severe third-trimester cases.
- Infection severity increased significantly with gestational age across all three trimesters.
- Inflammatory markers were highest in very severe cases, especially white blood cells.

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Introduction

Preterm birth and low birth weight are among the issues that can result from bacterial (UTIs), which are common during pregnancy. Fever, hazy urine, and painful or frequent urination are some of the symptoms [1]. Since pregnant go through many physiological changes, early evaluation and treatment are critical using antibiotics which are necessary specially for kidney infection (pyelonephritis) [2].

10.7% of maternal fatalities globally during pregnancy which was the estimation of the (WHO) are caused by different illnesses. Recent studies shows that over 28% of these occur in the urinary tract [3]. Asymptomatic bacteriuria considered the predominant factor putting expecting women at risk for cystitis & pyelonephritis. More than 100,000 organisms/mL were taken on a clean catch urinalysis from a patient who is asymptomatic is known as asymptomatic bacteriuria [4]. Pregnancy-related UTI rates have been estimated to be over 25% if asymptomatic bacteriuria is left untreated. the prevalence of bacteriuria without symptoms. is 5% to 6% in women who are not pregnant, which is comparable to the 2% to 10% estimated rates among pregnant women. Parous women and women from lower socioeconomic backgrounds are more likely to have asymptomatic bacteriuria. Asymptomatic bacteriuria is also more common in women who carry sickle cell trait [5,6].

Most prenatal guidelines advise screening for asymptomatic bacteriuria, either in the first or second trimester, due to the high incidence and probable severity of pyelonephritis [7]. The most common method for doing this is a clean catch urine culture. In the past, it was believed that treating UTIs would reduce the clinical infection rate to 3% to 4%. It is interesting to note that more current research shows little proof that treating UTIs lowers the risk of low birth weight and preterm birth. More research is required in this field [1,7].

One to two percent of pregnant women develop cystitis [8]. Additionally, 1% to 2% of pregnant women get pyelonephritis, usually in the second trimester. Serious infections, such as septic shock, are frequently caused by pyelonephritis in pregnant individuals. The majority of prenatal medical hospitalizations are due to it [9]. Pregnancy-related pyelonephritis risk factors include, low socioeconomic position ,obesity, smoking, nulliparity, young age, diabetes and a history of recurrent UTIs [8]. In one study, UTIs accounted for 3.5% of antepartum admissions. Similar to bacteriuria, certain patients may have a history of pyelonephritis, cystitis, or bacteriuria and may be at risk for infection. Up to 25% of instances of pyelonephritis may be bilateral, although it usually affects the right side. Uropathogens which causes UTIs in pregnant patients are also responsible for UTIs in expecting women [9].

The most frequently isolated organism is *Escherichia coli* (*E. coli*)[10]. According to an 18-year retrospective investigation, *E. coli* was the cause of pyelonephritis in pregnant individuals in 60% to 82.5% of cases. Additional bacteria that could be observed include *Proteus* (5%), *Staphylococcus*, *Streptococcus*, *Enterococcus* species, and *Klebsiella pneumonia* (11%). *Gardnerella vaginalis* and Ureaplasma can be isolated, specifically in women who have underlying kidney disease. Group B *Streptococcus* in the 3rd trimester of pregnancy is considered more prevalent than *E.coli* & identified from urine cultures.[11,12].

The current study aims to identify the bacterial isolates causing urinary tract infections in pregnant women in the city of Diwaniyah and to identify some of the factors associated with the infection that increase the severity of the infection. Perhaps this study will contribute to finding appropriate treatments for this problem that is currently worsening among pregnant women.

Methods

Patients and Specimens: Data and samples were collected from pregnant women diagnosed with (UTIs) infections by a physician and laboratory at the Maternity and Child Teaching Hospital in Diwaniyah between October 2024 and February 2025. Data collected included patient age, month of pregnancy, presence or absence of symptoms, and whether or not the patient had a history of UTIs before pregnancy. Official consent was obtained from both the hospital and the patients before data collection. Samples included blood and urine, which were immediately transported to the laboratory for testing.

Isolation of pathogenic bacteria: Midstream urine samples were taken using a calibrated loop (0.01 ml) and sterile containers in order to make the final diagnosis of a urinary tract infection. The midstream urine sample was cultivated in sterile circumstances at 37 °C on MacConkey agar, Eosin-methylene blue, and blood agar medium. After 18 to 24 hours, samples were deemed positive for urine infection if the number of colonies that had developed was 100,000 CUF/ml or greater. Biochemical assays and differential culture media, including urease, Voges–Proskauer, methyl red (methyl red), triple sugar iron agar, lysine decarboxylase and indole synthesis and motility (sulfide indole motility), were employed to identify the bacterium [13].

Complete blood count: complete blood count carried out by RUBY automatic system (USA) to determine Red blood cells (RBCs) and white blood cells (WBCs).

C-reactive protein (CRP) and Procalcitonin test: C-REACTIVE PROTEIN TEST kit (USA) and Procalcitonin Kit (pioneer) are a rapid immunochromatographic device for the semi-quantitative detection of CRP and Procalcitonin in whole blood samples.

Proteinuria test: Proteinuria is tested by urine dipstick test, which uses a reagent strip impregnated with a pH indicator (tetrabromophenol) and a buffer to keep the pH at 3.0. The pH indicator dye changes color as proteins attach to it. The pH of the urine has no bearing on this shift.

General urine test: General urine examination preformed by direct test urine on sterile slide under light microscope. Mucous, pus, red blood cells and bacteria used in determine severity of UTIs.

Severity of UTIs: Determined by uropathologist doctor who was depended on UTI location and the presence of symptoms in addition to results of general urine examination.

Statistical analysis: The data was explained using descriptive analysis. Standard and mean deviation was used to characterize Continuous variables. The categorical variables were described using frequency and percentage. To evaluate the relationship between the variables under study, the chi-square test (X^2) was employed. If an estimate's computed P value was less than 5%, it was deemed statistically significant. SPSS was used for all statistical analyses (v.22).

Results

The current study is a quarterly cross-sectional study that included collecting 170 urine and blood samples from pregnant women suffering

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from urinary tract infections. The ages of the patients varied between 17 and 46 years, with an average age of 24.88 years. Most of the pregnant women with urinary tract infections were in the age group from 17 to 26 (47%), followed by the age group from 27 to 37 (36%). The fewest infections were among older pregnant women, where the X^2 (P value) was equal to 9.15 (0.033), as shown in Table (1).

According to clinical and laboratory examinations, specialist doctors classified the severity of urinary tract infections as shown in Table 2. Most patients suffered from mild and moderate infections at a rate of 42% and 28% respectively, while very severe infections constituted the lowest percentage (10%).

Our study results showed that urinary tract infections clearly increase (P value = 0.037) as pregnancy progresses, with the percentage being 21% in the first trimester, 33% in the second, and 46% in the third, as shown in Figure (1). Furthermore, Figure 2 described that the majority of infections (69%) were recent bacterial infections not present before pregnancy (P value = 0.027).

Table (1): Age distribution for patients

Charateria	Patients data
Age range (years)	**17 - 46**
Age Mean	**24.88**
Standard deviation	**± 3.57**
Standard error	**0.30**
Total number	**140**
Age groups (years)	**N (%)**
17-26	**66 (47%)**
27-37	**50 (36%)**
38-46	**24 (17%)**
***X*² (P value)**	**9. 15 (0.033)**

Difference at P<0.05

Table (2): Severity of UTIs distribution for patients

Severity of infection		.No	%
+	Mild	45	**42%**
++	Moderate	38	**28%**
+++	Severe	33	**20%**
++++	Very severe	24	**10%**
P value	**0.042**		
Total		**140**	**100**

Difference at P<0.05

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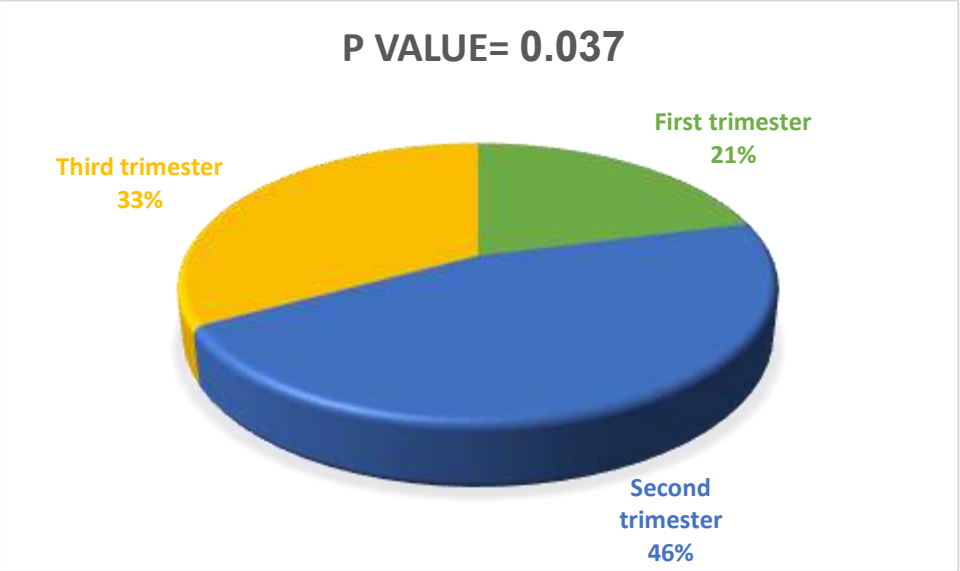

Figure (1): Frequency of UTIs according to pregnancy trimester

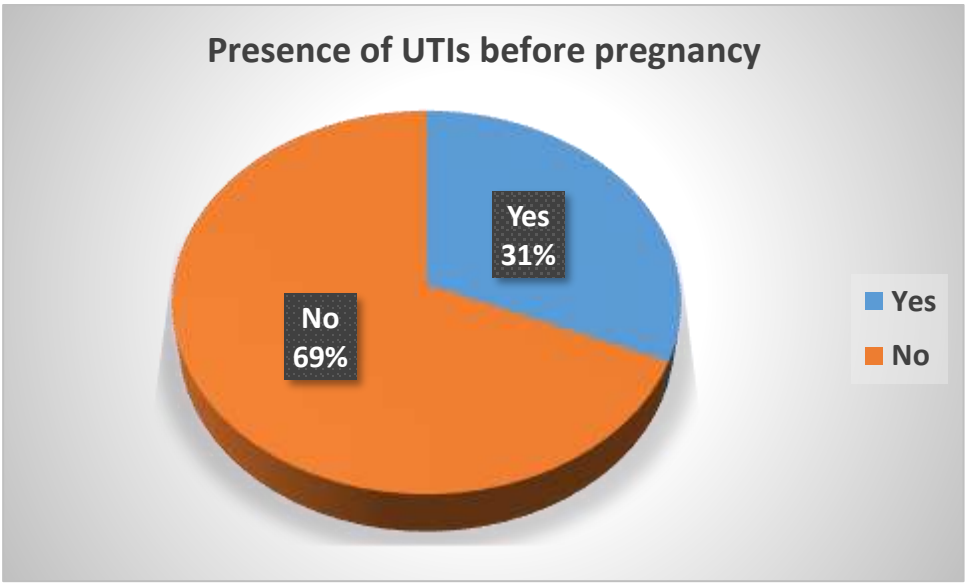

Figure (2): Time of urinary tract infections during pregnancy

This study included an assessment of the role of some inflammatory markers that may have a role in the development of disease severity. It was found that the level of these factors had increased in patients compared to the normal level known, where the concentration of WBC (16113 ± 381cells/mm³), Proteinuria (49.8 ± 8.4 mg/mM), C- reactive protein (15.45 ± 3 mg/L), RBC (4.73 ± 2.8 cell/ HPF) and Procalcitonin (1.53 ± 0.65 ng/mL) as shown in Table (3).

In table (4), we found the highest concentration of inflammatory markers in very severe UTIs cases (17444 ± 195cells/mm³, 57.5 ± 9.9mg/mM, 18.62 ± 1mg/L, 5.1 ± 3 cell/ HPF, 1.59 ± 0.69ng/mL for WBC, Proteinuria, C- reactive protein, RBC and Procalcitonin respectively).

Table (3): Evaluation some inflammatory markers of UTIs patients

Inflammatory markers	Concentrations	
	Range	Mean ± Standard deviation
WBC (cells/mm³)	10005 – 17995	16113 ± 381
Proteinuria (mg/mM)	13.5 - 59.8	49.8 ± 8.4
C- reactive protein (mg/L)	9.33 – 24.8	15.45 ± 3

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RBC (cell/ HPF)	1-11	4.73 ± 2.8
Procalcitonin (ng/mL)	0.1-2.41	1.53 ± 0.65

Table (4): Distribution of inflammatory markers according to UTIs severity

Inflammatory markers	Mild	Moderate	Severe	Very severe	P value
WBC (cells/mm³)	11113 ± 902	13861 ± 500	13692 ± 205	17444 ± 195	0.038
Proteinuria (mg/mM)	13.6 ± 7.3	33.3 ± 5.8	48.2 ± 10.1	57.5 ± 9.9	0.012
C- reactive protein (mg/L)	18.5 ± 2.1	3.2 ± 13.7	13.5 ± 1.1	18.62 ± 1	0.216
RBC/HPF	3.63 ± 0.5	4.75 ± 1.2	5.0 ± 2.8	5.1 ± 3	0.573
Procalcitonin (ng/mL)	1.21 ± 0.63	1.5 ± 0.7	1.52 ± 0.46	1.59 ± 0.69	0.601

In table 5, we determined significant differences in distribution of patients age groups according to severity of UTIs (P value = 0.032). The patients over 34 years mainly have very severe UTIs while the lower ages have mild UTIs . In the same table we didn't find statistical differences in UTIs severity when the woman infected before or after pregnancy (P value = 0.111). On the other hand, we found that the severity of UTIs varied significantly (P value = 0.029) according to the gestational age, with most pregnant women experiencing mild cases during the 1st. trimester. In the 2nd. trimester, 30% of pregnant women experienced mild cases, while another 30% experienced very severe cases. In the third trimester, the severity ranged from moderate (37%) to severe (34%).

Table (5): Distribution of age groups, time of infection and pregnancy trimester according to UTIs severity

Age groups				Total number	Mild (%)	Moderate (%)	Severe (%)	Very severe (%)	*df*	X^2	*P value*
17-25				58	25 (43)	16 (28)	12 (21)	5 (9)	9	6.96	0.032
26-34				42	15 (36)	13 (31)	10 (24)	4 (10)			
35-44				15	0 (0)	3 (20)	6 (40)	6 (40)			
45-53				25	5 (20)	6 (24)	5 (20)	9 (36)			
present of infection before pregnancy											
Yes				43	14 (33)	10 (23)	9 (21)	10 (23)	3	2.01	0.111
No	97	31 (32)	28 (29)	24 (25)	14 (14)						
Pregnant trimester											
First	30	16 (53)	10 (33)	4 (13)	0 (0)		6	7.88		0.029	

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Second	64	19(30)	11 (17)	15 (23)	19 (30)			
Third	46	10 (22)	17 (37)	14 (34)	5 (11)			
***df*: degree of freedom, X^2 : chi square**								

By culture media (Figure 3) we determined E. coli, Klebsiella, Proteus, Pseudomonas, Enterobacter and Citrobacter in 55%, 18%, 7%, 6%,9% and 3% respectively as described in Figure 5. *Klebsiella* & *E. coli* isolates the most common causes of bacterial infections in UTI present in all age groups (*E. coli* mainly detected in age group 26-34 years, Klebsiella mainly isolated from patients in age group 35-44 years) while Citrobacter, the less common bacteria isolated mainly from patients at age between 17 to 25 years.

The presence of the type of bacterial infection is unclear, whether before or after pregnancy (P value = 0.051). The presence of the type of bacterial infection is unclear, whether before or after pregnancy (P value = 0.051). However, specific types of bacteria appeared during each part of the pregnancy. We found E. coli and Proteus bacteria to be the most common causes of infection during the 1st. trimester of pregnancy. We also found E. coli and Klebsiella to be the most isolated from pregnant women with UTIs during the second and third trimesters of pregnancy, as shown in Table (6).

Figure (4-A): *Escherichia coli*

Figure (4-B): *Klebsiella sp*

Figure (4): Colonies of *E. coli* and *Klebsiella* on mackonky agar

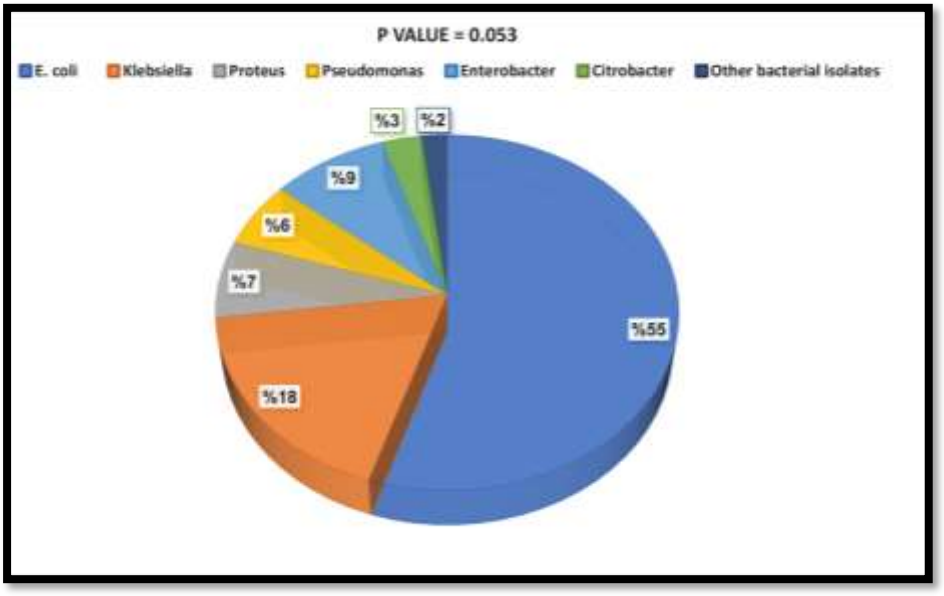

Figure (5): Percentage of bacterial isolated from UTI

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Table (6): Distribution of age groups, time of infection and pregnancy trimester according to types of uropathogenic bacteria

Age groups	Total number	*E. coli*	*Klebsiella*	*Proteus*	*Pseudomonas*	*Enterobacter*	*Citrobacter*	Other bacterial isolates
17-25	58	25 (43)	15 (26)	4 (7)	5 (9)	4 (7)	3 (5)	2 (3)
26-34	42	31 (74)	5 (12)	0 (0)	2 (5)	4 (10)	0 (0)	0 (0)
35-44	15	6 (40)	4 (27)	2 (13)	1 (7)	1(7)	0 (0)	1 (7)
45-53	25	15 (60)	3 (12)	3(12)	1(4)	2 (8)	1(4)	0 (0)
Statistical analysis	*df* = 18 X^2 = 5.42 P value = 0.048							
Present of infection before pregnancy								
Yes	43	20 (46)	10 (23)	5 (12)	3 (7)	2 (5)	1 (2)	2 (5)
No	97	57 (59)	16 (16)	5 (5)	4 (4)	9 (9)	4 (4)	2 (2)
Statistical analysis	*df* = 6 X^2 = 3.42 P value = 0.051							
Pregnant trimester								
First	30	13 (43)	5 (17)	6 (20)	1 (3)	3 (10)	1 (3)	1 (3)
Second	64	37 (58)	14 (22)	2 (3)	5 (8)	3 (5)	2 (3)	1(2)
Third	46	28 (61)	6 (13)	2 (4)	3 (7)	5 (11)	1 (2)	1 (2)
Statistical analysis	*df*: 12 X^2: 3.61 P value:0.049							

df: degree of freedom, X^2 : chi square

Discussion

Our study results showed that urinary tract infections (UTIs) are common among pregnant women, especially those aged 17 to 26 years. Most cases were mild while very severe infections occurring in a smaller percentage of pregnant women. This may be due to the lack of regular prenatal care, which generally prevents the worsening of bacterial infections [14]. Furthermore, our findings are consistent with previous research regarding the relationship between maternal age and bacterial infection; younger pregnant women are more susceptible to UTIs. The reasons for this are numerous, including a lack of awareness about the importance of sexual hygiene and insufficient medical follow-up during pregnancy [15,16]. Mentioning Eltahawy study which clarify that more than 50% of bacteriuria patients were ranging in age 21-50 years while this study has found that more than 50% of uropathogens bacteriuria found in 50 plus years patients [17-19]. Other Iraqi study in Al Samawa city, Considering the high reproductive activity & women tendency to sexual activity in age range from 25-34 (52.4%) which increased the likelihood of UTIs most UTIs (49.1%) occurring in the 3rd. trimester, while (50.2%) accounting for frequent pregnancies & parity [20].

In current research, including uropathogenic bacteria, can cause damage or inflammation in the urinary tract, leading to increased permeability of the kidneys and the leakage of protein into the urine .Previous studies have shown that women experiencing UTIs tend to have higher levels of protein in their urine compared to those without a UTI. Interestingly, some research also indicates that treating a UTI may not

always lead to a meaningful decrease in proteinuria [21].

The presence of leukocytes and red blood cells in a pregnant urine is a strong indicator of UTI, often caused by uropathogenic bacteria [22]. The leukocytes are the body's immune cells fighting the infection, while the red blood cells may be present due to damage caused by the infection. This combination is suggestive of a UTI, which is more common in pregnancy due to anatomical and hormonal changes that can lead to urinary stasis[23]

We determined *E. coli*, Klebsiella, Proteus, Pseudomonas, Enterobacter and Citrobacter in 55%, 18%, 7%, 6%,9% and 3% respectively. *Klebsiella & E. coli* isolates the most common causes of bacterial infections in UTI present in all age groups (E. coli mainly detected in age group 26-34 years, Klebsiella mainly isolated from patients in age group 35-44 years) while Citrobacter, the less common bacteria isolated mainly from patients at age between 17 to 25 years .In addition, the presence of the type of bacterial infection is unclear, whether before or after pregnancy (P value = 0.051). However, specific types of bacteria appeared during each part of the pregnancy. We found E. coli and Proteus bacteria to be the most common causes of infection during the 1st. trimester of pregnancy. We also found E. coli and Klebsiella to be the most isolated from pregnant women with UTIs during the second and third trimesters of pregnancy. E. coli is often the most frequently identified organism in different regions around the world, especially when it comes to UTIs [24,25]. the likelihood of bacteriuria increase occur as pregnancy unfolds specially during the 3rd trimester, E. coli was responsible for pyelonephritis cases among expecting women roughly between 60% and 82.5%. Which give its prominence in these situations [25]. Also many other uropathogenic bacteria like Streptococcus, Proteus, Staphylococcus, Enterococcus, Group B Streptococcus, Klebsiella pneumonia and many others can also play a role[26] .

There are many virulence factor genes (VFGs) which can cause infections found in uropathogenic *E. coli*. There had been studies in which the *E. coli* infect the bladder of mice, creating intracellular bacterial communities (IBCs) which resemble biofilms and become dormant reservoirs leading to recurrent urinary tract infections (RUTIs) [27]. No antibiotics have been able to eliminating these IBCs reservoirs. Furthermore, recent studies showed exfoliated IBCs and filamentous *E. coli* in the urine of women experiencing acute uncomplicated cystitis. This suggests that women suffering from UTIs may, indeed, be encountering this particular pathogenic pathway. [28]. It is still unclear whether these specific VFGs actually correlate with the presence of E. coli. In the end this type of infections occur in percentage considered somewhat high and need to be addressed especially in early ages [29].

Conclusions

According to patients age distribution & severity of infection which is clear in this study. *E. coli*, Enterobacter, *Pseudomonas aeruginosa*, *Proteus, Klebsiella* and Citrobacter were present in 55%, 9%, 6%, 7%, 18%, and 3% of cases, respectively. *Klebsiella & E. coli* and are the most common bacterial causes of UTIs, occurring across all age groups (*E. coli* is primarily detected in the 26-34 age group, and Klebsiella is mainly isolated from patients aged 35-44), while Citrobacter is the least common, being primarily isolated from patients aged 17-25. The presence of the specific bacterial infection before or after pregnancy is unclear ($p < 0.051$). However, specific types of bacteria emerged during each trimester of pregnancy. We found that *E coli* and Proteus were the most common causes of infection during the first trimester. We also found that *E. coli* and Klebsiella were the most frequently isolated bacteria in pregnant women with urinary tract infections during the 2nd. & 3rd. trimesters. Therefore, preventive and therapeutic solutions should be found to avoid the bacterial causes of urinary tract infections during pregnancy to protect the health of both mother and child

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