



Prevalence of Urinary Tract Infection and Its Association with Inflammatory Markers and Blood Pressure among Pregnant Women Attending Selected Healthcare Facilities in Basrah, Iraq

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Abstract:

Urinary tract infections (UTIs) are among the most common bacterial infections during pregnancy and may be associated with systemic inflammatory responses and cardiovascular changes. To determine the prevalence of culture-confirmed bacterial UTIs among pregnant women in Basrah, Iraq, identify the causative bacterial species, and investigate their association with inflammatory markers and blood pressure. A cross-sectional study was conducted from February 2025 to January 2026 in four healthcare facilities in Basrah, Iraq. A total of 200 pregnant women aged 15-44 years were enrolled. Mid-stream urine samples were cultured for bacterial isolation and identification using the VITEK® 2 automated system. For comparative analysis, 50 women with culture-confirmed UTI and 50 culture-negative pregnant women were included for comparative analysis. C-reactive protein (CRP), erythrocyte sedimentation rate (ESR), and blood pressure (BP) were assessed. Statistical analyses were performed using the chi-square test and independent-samples t-test, with a P-value > 0.05 considered statistically significant. The prevalence of culture-confirmed bacterial UTI was 25% (50/200). Gram-negative bacteria predominated (68%), mainly *Escherichia coli* (42%) and *Klebsiella pneumoniae* (22%), whereas Gram-positive isolates accounted for 32%, with *Enterococcus faecalis* and *Staphylococcus haemolyticus* (12% each) being the most frequent. CRP positivity did not differ between groups (36%; P = 1.000). ESR was significantly higher in women with UTI (45.62 ± 20.36 vs. 35.44 ± 16.39 mm/1 hour; P = 0.008). Diastolic blood pressure (DBP) was significantly elevated in the UTI group (81.88 ± 11.00 vs. 76.50 ± 9.47 mmHg; P = 0.010), whereas systolic BP did not differ significantly. Culture-confirmed UTI affected one-quarter of the pregnant women studied. *E. coli* and *K. pneumoniae* were the predominant pathogens. ESR, but not CRP, was associated with UTI during pregnancy, and UTI was significantly associated with elevated diastolic blood pressure.

Key words: urinary tract infection; pregnancy; blood pressure; inflammatory markers



Introduction

Urinary tract infections (UTIs) are defined as inflammatory responses elicited by pathogenic microorganisms colonizing any segment of the urinary system [1]. They are broadly classified into lower-tract infections encompassing asymptomatic bacteriuria (ASB) and symptomatic cystitis and upper-tract infections, most notably pyelonephritis, which is considered the most severe form [2]. UTIs rank among the most prevalent infections worldwide, affecting approximately 150 million individuals annually. Women are disproportionately affected owing to the relative shortness of the female urethra and the anatomical proximity of the urinary, genital, and gastrointestinal tracts, which facilitates ascent and colonization by commensal Enterobacteriaceae [3].

Susceptibility increases markedly during pregnancy as a consequence of interrelated anatomical, physiological, and hormonal adaptations. Elevated progesterone concentrations induce smooth-muscle relaxation of the ureters and bladder, promoting urinary stasis and bacterial proliferation. Mechanical urethral compression by the enlarging ureters impairs urine flow and predisposes to vesicoureteral reflux. The rise in glomerular filtration rate dilutes urinary antibacterial factors, while glycosuria present in approximately 70% of pregnant women provides a nutrient source for bacteria [4,5]. Pregnancy-associated immunosuppression, necessary to prevent fetal rejection, further lowers the threshold for bacterial infection [6,7].

If left untreated, UTI and ASB during pregnancy may progress to pyelonephritis in

approximately 20% of cases and are associated with preterm birth, low birth weight, intrauterine growth restriction, sepsis, and preeclampsia [4,8]. The global prevalence of UTI during pregnancy has been estimated at 23.9% (95% CI 16.2-33.8%), with considerable geographic variation [5]. Inflammatory biomarkers – particularly C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR) – are widely used to assess systemic inflammatory responses [9,10]. However, pregnancy itself modulates both markers, and their behavior in the context of UTI during pregnancy warrants investigation [11]. Additionally, UTI has been reported to influence blood pressure, with potential implications for hypertensive disorder of pregnancy [12].

Despite the clinical importance of UTI in pregnancy, data from Basrah Governorate remain limited. This study aimed to: (i) determine the prevalence of bacterial UTI among pregnant women attending healthcare facilities in Basrah; (ii) characterize the causative bacterial species using VITEK® 2; and (iii) assess the associations of UTI with CRP, ESR, and blood pressure.

Materials and Methods

Study design and setting

A hospital-based cross-sectional screening study followed by a case-control comparison was conducted between February 2025 and January 2026 at four healthcare facilities in Basrah Governorate, Iraq: Al-Basrah Hospital for Maternity and Children, Al-Zubair General Hospital, Khor Al-Zubair Health Center, and a specialist obstetric private clinic.

Study Population

A total of 200 consecutive pregnant women aged 15-44 years, representing all gestational trimesters, were enrolled after providing written informed consent. Women who had received antibiotics within 48 hours prior to sample collection or who had active vaginal bleeding were excluded. Urine culture was performed for all participants to determine the prevalence of bacterial urinary tract infection (UTI). Of the 200 screened women, 50 had culture-confirmed bacterial UTI and constituted the case group. For comparative analyses, 50 culture-negative pregnant women were selected consecutively from the same study population and served as the control group. Thus, the case-control component of the study included two equal groups (50 UTI-positive and 50 UTI-negative pregnant women).

Ethical approval

The study protocol was approved by the Ethics Committee of Basrsh Health Directorate. Written informed consent was obtained from all participants prior to enrolment.

Specimen Collection

Each participant provided a mid-stream clean-catch urine specimen in a sterile wide-mouth container following standardized periurethral hygiene instructions. Specimens were transported to the laboratory within one hour of collection and processed within two hours to minimize bacterial overgrowth.

Urine Culture and Bacterial Identification

Urine specimens were inoculated onto Blood Agar, MacConkey Agar, and Mannitol Salt

Agar using a calibrated loop (0.001 mL). Plates were incubated aerobically at 37°C for 24-48 hours. Clinically significant bacteriuria was defined as growth of a uropathogen at a concentration of $\geq 10^5$ CFU/mL. Cultures showing low colony counts, mixed growth patterns, or organisms considered probable contaminants were classified as non-significant and excluded from further analysis. Gram staining was performed on pure isolates, and bacterial identification was carried out using the VITEK® 2 automated system (bioMérieux, France). Bacterial suspensions were standardized to 0.5-0.6 McFarland using the DensiCHEK instrument.

Inflammatory markers

C-reactive protein (CRP) was determined by latex agglutination (CRP-Latex assay). The result was considered positive when CRP concentration was ≥ 6 mg/L, consistent with manufacturer instructions. ESR was measured by the Westergren method: venous blood was collected into sodium citrate tubes, the Westergren tube was filled to the zero mark and placed vertically at room temperature, and readings were recorded at 1 hour (mm/1 hour).

Blood pressure measurement

Blood pressure was measured with a validated Rossmax electronic sphygmomanometer with the participant seated and at rest. Systolic (SBP) and diastolic (DBP) readings were recorded in mmHg.

Statistical analysis

Data were analyzed using IBM SPSS Statistics (v.26). Categorical variables were compared with Pearson's chi-square test; continuous variables were compared with the independent-samples t-test. A two-tailed P-value < 0.05 was considered statistically significant. Data are expressed as frequency and percentage for categorical variables, and as mean $\pm$ standard deviation (SD) for continuous variables.

Results

Of 200 urine specimens analyzed, 76 (38%) showed bacterial growth. However, only 50 (25%) fulfilled the criteria for clinically significant bacteriuria ($\geq 10^5$ CFU/mL) and were classified as confirmed UTI cases. The

remaining 26 cultures were considered non-significant because they represented normal flora, contamination, or low-count growth and were therefore excluded from further analysis. The remaining specimens showed no bacterial growth.

Gram-negative bacteria predominated, accounting for 68% (34/50) of all pathogenic isolates. *Escherichia coli* was the most frequently isolated organism, 42% (21/50), followed by *Klebsiella pneumoniae*, 22% (11/50). Gram-positive bacteria represented 32% (16/50) of isolates, with *Enterococcus faecalis* and *Staphylococcus haemolyticus* each accounting for 12% (6/50). The distribution of bacterial species is shown in Table 1.

Table 1. Distribution of bacterial pathogens among pregnant women with UTI (No. = 50).

Gram Stain	Bacterial Species	No.	%
Gram-negative	<i>Escherichia coli</i>	21	42
	<i>Klebsiella pneumoniae</i>	11	22
	<i>Acinetobacter baumannii complex</i>	1	2
	<i>Pseudomonas aeruginosa</i>	1	2
	Sub-total	34	68
Gram-positive	<i>Enterococcus faecalis</i>	6	12
	<i>Staphylococcus haemolyticus</i>	6	12
	<i>Staphylococcus aureus</i>	2	4
	<i>Enterococcus faecium</i>	1	2
	<i>Staphylococcus simulans</i>	1	2
	Sub-total	16	32
	Total	50	100

CRP positivity was observed in 36% (18/50) of both the UTI and control groups. No statistically significant association was found

between CRP status and UTI occurrence (Table 2)

Table 2. Distribution of CRP results between pregnant women with and without UTI.

CRP Result	Control No. (%)	UTI Group No. (%)	Total No. (%)	P-value
Negative	32 (64%)	32 (64%)	64 (64%)	1.000
Positive	18 (36%)	18 (36%)	36 (36%)	
Total	50 (100%)	50 (100%)	100 (100%)	

Mean ESR was significantly higher in the UTI group (45.62 ± 20.36 mm/1 hour) compared with controls (35.44 ± 16.39 mm/1

hour; $P = 0.008$), indicating a significant association between UTI and elevated ESR during pregnancy (Table 3).

Table 3. Comparison of mean ESR between pregnant women with and without UTI.

Group	No.	Mean $\pm$ SD	P-value
Control	50	35.44 ± 16.39 mm/1 hour	0.008*
UTI Group	50	45.62 ± 20.36 mm/1 hour	

Data expressed as mean $\pm$ SD. $P < 0.05$ considered statistically significant.

Mean SBP was slightly higher in the UTI group than in controls; however, the difference was not statistically significant (121.08 ± 13.60 vs. 117.30 ± 11.90 mmHg, $P = 0.142$). In contrast, mean DBP was

significantly higher among women with UTI (81.88 ± 11.00 mmHg) compared with controls (76.50 ± 9.47 mmHg, $P = 0.010$) (Table 4).

Table 4. Comparison of systolic and diastolic blood pressure between pregnant women with and without UTI.

Blood Pressure	UTI Group (No.=50) Mean $\pm$ SD	Control (No.=50) Mean $\pm$ SD	P-value
Systolic (SBP) mmHg	121.08 ± 13.60	117.30 ± 11.90	0.142
Diastolic (DBP) mmHg	81.88 ± 11.00	76.50 ± 9.47	0.010*

Data expressed as mean $\pm$ SD. * $P < 0.05$ considered statistically significant. SBP = systolic blood pressure; DBP = diastolic blood pressure.

Discussion

The prevalence of culture-confirmed bacterial UTI among pregnant women in the present study was 25%, which is comparable to the global prevalence estimate of 23.9% reported in a recent meta-analysis involving more than 30,000 pregnant women [5].

Similar prevalence rates have been reported in Jordan (21.5%) [13], and in Baghdad, Iraq (31.2%) [14]. The relative agreement among these studies may reflect similarities in study populations and the use of urine culture as the primary diagnostic method for confirming infection. The increased susceptibility of

pregnant women to UTI is well documented; it is largely attributed to physiological and anatomical changes during pregnancy, including progesterone-mediated relaxation of the urinary tract, urinary stasis, urethral dilatation, glycosuria, and alterations in immune function, all of which facilitate bacterial colonization and persistence within the urinary system [4.15]. However, marked variation in UTI prevalence has been reported across Iraqi studies, with rates ranging widely from 5.6% to 86% and an overall pooled prevalence of 48.08% [16]. This variability is most likely attributable to differences in study design, population characteristics, and diagnostic criteria, particularly the use of strict culture-based definitions versus inclusion of symptomatic or non-confirmed cases. In the present study, bacterial growth was detected in 76 urine specimens; however, only 50 cultures fulfilled the criteria for clinically significant bacteriuria ($\geq 10^5$ CFU/mL) and were classified as confirmed UTI cases. The remaining cultures were considered non-significant due to contamination, normal flora, or low bacterial counts and were excluded from further analysis. This strict microbiological interpretation reduces overestimation and ensures that only clinically relevant infections were included in the final prevalence calculation.

Gram-negative bacteria predominated among the isolated uropathogens, accounting for 68% of all confirmed infections. *Escherichia coli* was the most frequently isolated species (42%), followed by *Klebsiella pneumoniae* (22%). These findings are consistent with numerous regional and international studies identifying *E. coli* as the principal causative

agent of UTIs in pregnant women [5.17.18]. The predominance of *E. coli* is generally attributed to its well-recognized virulence factors, particularly fimbrial adhesins that facilitate attachment to uroepithelial cells and promote colonization of the urinary tract [19]. Gram-positive organisms constituted 32% of isolates. This proportion is comparable to that reported in a study conducted in Wasit, where Gram-positive bacteria accounted for 27% of UTI cases among pregnant women [17]. *Enterococcus faecalis* and *Staphylococcus haemolyticus* each represented 12% of the total isolates. The relatively frequent recovery of *E. faecalis* is consistent with recent reports suggesting an increasing contribution of enterococci to UTIs among pregnant women, owing to their ability to adhere to epithelial surfaces and form biofilms [20]. The 12% prevalence of *S. haemolyticus* exceeds values traditionally reported for coagulase-negative staphylococci (CoNS) as a whole; this likely reflects the species-level resolution provided by VITEK® 2, which earlier conventional methods lacked, combined with the immunosuppressive environment of pregnancy that facilitates colonization by this opportunistic skin commensal [21]

No significant association was observed between CRP positivity and UTI status, with identical positivity rates recorded in both infected and control pregnant women (36%; $P = 1.000$). This finding suggests that CRP may have limited value as a standalone marker for detecting localized urinary tract infections during pregnancy. Pregnancy is recognized as a state of physiological inflammation characterized by complex hormonal and immunological adaptations

associated with placental development and maternal-fetal tolerance. These physiological changes may contribute to elevated CRP levels even in the absence of infection [22]. Furthermore, many urinary tract infections during pregnancy remain localized to the lower urinary tract and may not trigger a pronounced systemic inflammatory response. Consequently, CRP levels may remain within the range observed during normal pregnancy despite the presence of bacteriuria [2]. The present findings differ from those reported by Naser and AlSultany (2024), who observed significantly higher CRP levels among women with UTI. However, their study compared pregnant infected women with non-pregnant healthy controls, making it difficult to distinguish the effects of pregnancy from those of infection [23]. In contrast, both groups in the present study consisted exclusively of pregnant women, thereby minimizing the confounding effect of pregnancy status and allowing a more accurate assessment of the relationship between UTI and CRP levels.

ESR was significantly elevated in the UTI group ($P = 0.008$). Although ESR rises physiologically during pregnancy due to increased fibrinogen and globulin concentrations [24], the significant difference between infected and control pregnant women in the present study suggests that UTI imposed an additional inflammatory burden exceeding baseline gestational elevation. Unlike CRP, which responds rapidly to acute inflammatory stimuli, ESR reflects more sustained inflammatory activity and may therefore be more sensitive to the low-grade systemic inflammatory response associated with localized urinary tract infection [25,26].

It is noteworthy that studies directly evaluating ESR among pregnant women with UTI remain limited, particularly those comparing infected and non-infected pregnant women within the same physiological context of pregnancy. Therefore, the present findings contribute additional evidence regarding the potential utility of ESR as an adjunct inflammatory marker in this population.

The present study demonstrated a significant elevation in diastolic blood pressure (DBP) among women with UTI compared with controls ($P = 0.010$), whereas systolic blood pressure (SBP) did not differ significantly between groups ($P = 0.142$). This observation regarding DBP is consistent with the findings of Marlina et al. [27], who showed that the increase in DBP may reflect infection-associated endothelial dysfunction and increased peripheral vascular resistance resulting from inflammatory mediator release during bacterial infection. Because DBP is more sensitive to alterations in peripheral vascular resistance than SBP, inflammatory vascular changes may become evident initially through elevations in diastolic pressure. Similar associations between antenatal UTI and hypertensive disorders have been reported previously [27;28]. Although the clinical implications of this finding require further investigation, the results suggest a possible relationship between maternal urinary tract infection and early vascular changes during pregnancy.

Conclusions and Recommendations

This study concludes that urinary tract infections remain a significant health

challenge among pregnant women. Approximately one-quarter of the Pregnant women included in the study had culture-confirmed UTI, with *Escherichia coli* and *Klebsiella pneumoniae* emerging as the primary uropathogens. The findings highlight a critical physiological link between UTI and systemic inflammatory responses, as evidenced by the significant elevation of erythrocyte sedimentation rate (ESR), whereas C-reactive protein (CRP) appeared less sensitive to localized urinary tract infections in the context of pregnancy. Furthermore, the significant association between UTI and increased diastolic blood pressure underscores the potential hemodynamic impact of these infections, suggesting that untreated UTIs could contribute to broader cardiovascular stress during gestation. Consequently, it is strongly recommended that routine urine culture and sensitivity testing be integrated as a standard component of antenatal care to ensure early detection and targeted antimicrobial therapy, thereby mitigating the risk of antibiotic resistance and maternal-fetal complications. Future clinical strategies should also emphasize the monitoring of inflammatory and hemodynamic markers like ESR and blood pressure as adjunctive tools for assessing the severity of infection and the overall well-being of the mother.

Conflict of Interest

The authors declare no conflict of interest.

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انتشار التهابات المسالك البولية وعلاقتها بالمؤشرات الالتهابية وضغط الدم لدى النساء الحوامل المراجعات لعدد من المؤسسات الصحية المختارة في محافظة البصرة، العراق

حبايب العبادي *: سندس العبدالله : منى المازني: امل المازني
قسم الأحياء، كلية العلوم، جامعة البصرة، البصرة، العراق

الخلاصة

تُعد التهابات المسالك البولية (UTIs) من أكثر أنواع العدوى البكتيرية شيوعاً أثناء الحمل، وقد ترتبط بحدوث استجابات التهابية جهازية وتغيرات في المؤشرات القلبية الوعائية. هدفت الدراسة إلى تحديد معدل انتشار التهابات المسالك البولية البكتيرية المؤكدة بالزرع لدى عينة من النساء الحوامل في محافظة البصرة، العراق، وتشخيص الأنواع البكتيرية المسببة للعدوى، ودراسة علاقتها بالمؤشرات الالتهابية وضغط الدم. أُجريت دراسة مقطعية خلال المدة من شباط 2025 إلى كانون الثاني 2026 في أربع مؤسسات صحية بمحافظة البصرة، العراق. شملت الدراسة 200 امرأة حامل تراوحت أعمارهن بين 15-44 سنة. جُمعت عينات إدرار (Mid-stream urine) وأجري لها الزرع الجرثومي لتحديد معدل انتشار التهابات المسالك البولية وتشخيص الأنواع البكتيرية المسببة لها باستخدام نظام VITEK® 2. ولأغراض المقارنة، شملت الدراسة 50 امرأة مصابة بـUTI المؤكد بالزرع و50 امرأة حامل غير مصابة (سالية الزرع). كما جرى تقييم البروتين المتفاعل C (CRP)، ومعدل ترسيب كريات الدم الحمراء (ESR)، وضغط الدم (BP). وأجري التحليل الإحصائي باستخدام اختبار Chi-square واختبار (t) للعينات المستقلة واعتمد مستوى دلالة إحصائية عند ($P < 0.05$). بلغ معدل انتشار التهابات المسالك البولية البكتيرية المؤكدة بالزرع 25% (50 من أصل 200 عينة). وكانت البكتيريا السالبة لصبغة غرام هي الأكثر شيوعاً (68%)، وتصدرتها *Escherichia coli* بنسبة (42%) تلتها *Klebsiella pneumoniae* بنسبة (22%)، أما البكتيريا الموجبة لصبغة غرام فقد شكلت (32%) من العزلات، وكانت *Enterococcus faecalis* و *Staphylococcus haemolyticus* الأكثر شيوعاً بنسبة (12%) لكل منهما. ولم يسجل اختبار CRP أي فرق معنوي بين المجموعتين ($P = 1.000$; 36%). في المقابل، كان متوسط ESR أعلى معنوياً لدى المصابات بالتهاب المسالك البولية مقارنة بمجموعة السيطرة (20.36 ± 45.62 مقابل 16.39 ± 35.44 ملم/ساعة، $P = 0.008$). كما ارتفع ضغط الدم الانبساطي (DBP) بصورة معنوية لدى المصابات (11.00 ± 81.88 مقابل 9.47 ± 76.50 ملم زئبق، $P = 0.010$)، في حين لم يُظهر ضغط الدم الانقباضي فرقاً معنوياً بين المجموعتين. أصاب التهاب المسالك البولية المؤكد بالزرع 25% من النساء الحوامل المشمولات بالدراسة. وكانت *E. coli* و *K. pneumoniae* أكثر المسببات البكتيرية شيوعاً. وأظهر ESR، بخلاف CRP، ارتباطاً بالتهاب المسالك البولية أثناء الحمل، كما ارتبطت الإصابة بـUTI بارتفاع معنوي في ضغط الدم الانبساطي.

الكلمات المفتاحية: التهاب المسالك البولية، الحمل، ضغط الدم، المؤشرات الالتهابية