International Journal of Reproduction, Contraception, Obstetrics and Gynecology
Arunaa R et al. Int J Reprod Contracept Obstet Gynecol. 2025 Dec;14(12):4254-4258
www.ijrcog.org
pISSN 2320-1770 | eISSN 2320-1789

DOI: https://dx.doi.org/10.18203/2320-1770.ijrcog20253892

Original Research Article

From infection to hypertension: exploring the association between urinary tract infection and development of preeclampsia

Roshini Arunaa[1]*, Padmalatha Dakshinamurthy[2]

[1]Department of Gynaecological Endoscopy, PSRI Hospital, New Delhi, India
[2]Department of Obstetrics & Gynecology, Madras Medical College, Chennai, Tamil Nadu, India

Received: 08 October 2025
Revised: 06 November 2025
Accepted: 15 November 2025

***Correspondence:**
Dr. Roshini Arunaa,
E-mail: e.roshiniarunaa@gmail.com

ABSTRACT

Background: Preeclampsia remains a major cause of maternal and perinatal morbidity, presenting with hypertension and proteinuria after 20 weeks of gestation. Although multifactorial in origin, maternal inflammatory and endothelial dysfunction play crucial roles in its pathogenesis. Urinary tract infection (UTI), a common condition in pregnancy, has been proposed as a potential trigger for systemic inflammation contributing to preeclampsia. This study aimed to evaluate the association between UTI and the subsequent development of preeclampsia among pregnant women attending a tertiary care hospital in Chennai.
Methods: A prospective cohort study was conducted from October 2023 to October 2024 at Madras Medical College, Chennai. A total of 116 pregnant women were enrolled and categorized into UTI (n=58) and non-UTI (n=58) groups based on urine routine and culture findings. Participants were followed throughout pregnancy with serial assessments of blood pressure, urine albumin, and clinical parameters each trimester. Statistical analysis was performed using Chi-square and Fisher's exact tests, and relative risk was calculated to estimate the strength of association.
Results: UTI occurred most frequently in the first trimester, whereas preeclampsia was mainly observed in the third trimester. Among women with UTI, 60% developed preeclampsia compared to 18.7% without UTI, yielding a relative risk of 3.2, signifying a significant association.
Conclusions: UTI in pregnancy was associated with a 3.2-fold increased risk of preeclampsia. Early identification and prompt treatment of UTI may reduce preeclampsia-related complications. Further large-scale studies are needed to confirm this relationship.

Keywords: Asymptomatic bacteriuria, Preeclampsia, Prevention, Screening, Urinary tract infection

INTRODUCTION

Preeclampsia (PE) is a complex multisystem vascular disorder of pregnancy, often described as a "silent storm" that brews after 20 weeks of gestation, presenting with new-onset hypertension and proteinuria, and affecting 0.2-9.2% of pregnancies worldwide.[1,2] Despite decades of research, its precise origins remain partly hidden, though it is increasingly recognized as a consequence of abnormal placentation. Here, defective spiral artery remodeling leaves the placenta in a state of perpetual drought, deprived of oxygen and nutrients, leading to ischemia and oxidative stress.[3,4] This dysfunction sparks the release of antiangiogenic factors such as soluble fms-like tyrosine kinase-1 (sFlt-1), unleashing a cascade of systemic inflammation and endothelial injury-the clinical "fingerprint" of preeclampsia.[5]

Within this storm, urinary tract infections (UTIs) emerge as hidden embers that fan the flames of maternal inflammation. UTIs, which affect up to 20% of pregnant women, may be silent trespassers or symptomatic

intruders, but in either form they amplify systemic immune activation.[6,7] This infectious spark can intensify the inflammatory tempest of PE, raising the risk of intrauterine growth restriction, preterm birth, and cesarean delivery.[8] Addressing such infection-driven inflammation could be akin to quenching the fire before it spreads, offering hope to safeguard both maternal and fetal health.

METHODS

Study setting

This prospective cohort study was conducted over a period of one year from October 2023 to October 2024 at the Institute of Social Obstetrics, Kasturba Gandhi Hospital, Chennai and the Institute of Obstetrics and Gynecology, Egmore, Madras Medical College, Chennai. The objective was to investigate the association between urinary tract infection (UTI) and the risk of developing preeclampsia (PE) in pregnant women.

Study population

Pregnant women attending antenatal clinics were enrolled after obtaining informed consent. Inclusion criteria encompassed both symptomatic women (fever, dysuria, urinary urgency, increased frequency, flank pain, hematuria) and asymptomatic individuals. UTI was diagnosed by urine culture, in line with current clinical guidelines.[6,7] Exclusion criteria included pre-existing hypertension, gestational hypertension in previous pregnancies, chronic hypertension, multiple gestations, morbid obesity, chronic renal or vascular diseases, thromboembolism history, overt diabetes mellitus, systemic infections, and immunosuppression.

Diagnostic criteria

Preeclampsia was defined as new-onset hypertension (≥140/90 mmHg on two occasions, at least 4 hours apart, after 20 weeks of gestation) with proteinuria (≥300 mg in a 24-hour urine collection, or ≥1+ on dipstick), based on the criteria of the American College of Obstetricians and Gynecologists (ACOG) and the World Health Organization.[1,6]

Sample size

Based on prevalence estimates from previous studies and allowing for a 10% non-response rate, a total of 116 participants were recruited, equally divided into UTI-positive and UTI-negative groups.

Data collection

All participants underwent detailed clinical evaluation, including history and physical examination. Midstream urine samples were collected for routine analysis and culture with antibiotic sensitivity testing.[6,7] Blood pressure and proteinuria were monitored at each trimester follow-up visit to identify the onset of PE.

Statistical analysis

Data were entered into Microsoft Excel and analyzed using SPSS software, version 23.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics summarized demographic and clinical characteristics. The association between UTI and the development of PE was assessed using chi-square and Fisher's exact tests. The relative risk (RR) of PE in participants with UTI was calculated. Independent t-tests were employed for continuous variables. Statistical significance was set at $p<0.05$.

RESULTS

A total of 116 pregnant women were enrolled, equally divided into UTI-positive which was 17.24% (n=20) and UTI-negative was 82.75% (n=96) groups. Baseline demographic and clinical characteristics-including age, BMI, gravidity, parity, gestational age at enrolment, educational status, employment, socioeconomic status, menstrual regularity, presence of pallor, and pedal edema-were comparable between groups, with no statistically significant differences.

Baseline characteristics

The majority of participants were in the 25-35-year age group (51.7%, n=60), with nearly equal proportions having normal or overweight BMI (43.1%, n=50 each). Most women were primigravidae (43.1%, n=50) and nulliparous (51.7%, n=60). Almost half of the participants (48.3%, n=56) were enrolled before 20 weeks of gestation. Primary and secondary education levels were the most common, and about two-thirds of the participants were unemployed. Most participants belonged to the middle and low socioeconomic groups, had regular menstrual cycles (72.4%, n=84), no pallor (57.8%, n=67), and no pedal edema (83.6%, n=97) (Table 1).

Trimester wise distribution

UTIs were most frequently diagnosed in the first trimester (N=9), whereas preeclampsia was most commonly observed in the third trimester (n=40), suggesting a temporal relationship between early infection and later onset of disease (Figure 1).

Relative risk of preeclampsia

Among the UTI group, 12 of 20 women (60%) developed preeclampsia compared to 18 of 96 women (18.8%) in the non-UTI group. The calculated relative risk (RR) was 3.2, indicating that women with UTI were over three times more likely to develop preeclampsia than those without UTI (Table 2).

Table 1: Baseline characteristics of study participants.

Characteristi	category	Frequency (N)	%
Age group (years)	<25	45	38.8
	25–35	60	51.7
	>35	11	9.5
Body mass index (BMI)	<25 (Normal)	50	43.1
	25-29.9 (overweight)	50	43.1
	≥30 (Obese)	16	13.8
Gravidity	1 (Primigravida)	50	43.1
	2	40	34.5
	≥3	26	22.4
Parity	0 (Nulliparous)	60	51.7
	1	35	30.2
	≥2	21	18.1
Gestational age at enrollment	<20 weeks	56	48.3
	20–28 weeks	50	43.1
	>28 weeks	10	8.6
Educational status	Illiterate	23	19.8
	Primary education	40	34.5
	Secondary education	33	28.4
	Higher education	20	17.3
Employment status	Employed	43	37.1
	Unemployed	73	62.9
Socioeconomic status	Low	40	34.5
	Middle	46	39.6
	High	30	25.9
Menstrual regularity	Irregular	32	27.6
	Regular	84	72.4
Pallor	Present	49	42.2
	Absent	67	57.8
Pedal edema	Present	19	16.4
	Absent	97	83.6

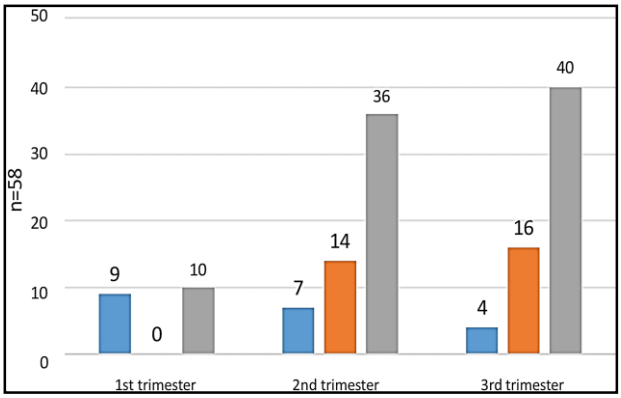

Figure 1: Distribution of urinary tract infections, pre-eclampsia and normal subjects in three trimesters. Blue - Patients with UTI (Urinary tract infections). Orange - Patients with Pre-eclampsia. Grey - Patients without UTI/ Pre-eclampsia

Table 2: Relative risk of pre-eclampsia among pregnant women with UTI.

	Preeclampsia (Yes)	Preeclampsia (No)	Total	RR	P value
UTI (Yes)	12	8	20	3.2	<0.05
UTI (No)	18	78	96		
Total	30	86	116		

RR=Relative risk

Urinary tract infections

The association between UTI and the development of PE was assessed using chi-square and Fisher's exact tests. The relative risk (RR) of PE in participants with UTI was calculated. Independent t-tests were employed for continuous variables. Statistical significance was set at $p<0.05$.

DISCUSSION

The study investigated the association between urinary tract infection (UTI) and preeclampsia (PE) among 116 pregnant women. The findings revealed that participants with UTI were 3.2 times more likely to develop PE compared to those without UTI. This strong association underscores infection as an important and modifiable risk factor in pregnancy. Our findings emphasize that infection control is not merely a maternal health intervention but a key strategy in preventing hypertensive disorders of pregnancy.

Temporal relationship between UTI and PE

Trimester-specific analysis showed that most UTIs were diagnosed in the first trimester, whereas preeclampsia occurred predominantly in the third trimester. This suggests a temporal sequence where infection early in pregnancy may predispose to later hypertensive complications. Similar trends have been reported by Zahedkalaei et al who found that first-trimester UTI nearly doubled the risk of preeclampsia.[9] Our findings therefore support the hypothesis that infection-induced systemic inflammation and placental vascular injury may initiate a cascade that manifests clinically as PE later in gestation.

Biological plausibility

The biological plausibility of this relationship is grounded in shared inflammatory pathways. UTIs trigger maternal systemic inflammation, characterized by release of cytokines and oxidative stress, which parallels the pathophysiology of PE.[5] Moreover, infections upregulate antiangiogenic factors such as soluble fms-like tyrosine kinase-1 (sFlt-1), leading to widespread endothelial dysfunction, the hallmark of preeclampsia. Thus, UTI may act as an early "inflammatory spark" that compounds abnormal placentation and precipitates PE.

Comparison with other studies

Our relative risk of 3.2 is higher than that reported in some meta-analyses but aligns with individual cohort and case-control studies. Yan et al found that UTI increased PE risk by 31% in a meta-analysis of 19 studies.[10] Conde-Agudelo et al reported a twofold increased risk in their systematic review.[11] Regional studies echo our findings: Fatima et al (Pakistan) noted an odds ratio of 2.591.[12] These results collectively reinforce the global significance of UTI as a risk factor for PE, though differences in magnitude may reflect variations in diagnostic criteria, population characteristics, and infection prevalence.

Clinical implications

The public health impact of these findings is notable. UTIs are common in pregnancy, with prevalence rates of 8-20%, and often asymptomatic. If untreated, they not only progress to pyelonephritis but also increase the risk of preeclampsia, preterm birth, and low birth weight.[13] Early detection through urine culture and timely antibiotic therapy can significantly reduce complications. Given that most UTIs in our study were identified in the first trimester, routine screening during early antenatal visits could provide an opportunity for prevention.

Strengths of this study include its prospective design, use of culture-confirmed UTI diagnosis, and balanced baseline characteristics, which reduce confounding. However, limitations include the relatively small sample size (n=116), single-center setting, and lack of adjustment for other inflammatory risk factors such as periodontal disease or anemia. Additionally, while temporal association was observed, causality cannot be established without larger prospective cohorts or interventional trials.

CONCLUSION

Thus, this prospective cohort study demonstrates a significant association between urinary tract infections (UTI) during pregnancy and an increased risk of developing preeclampsia. Pregnant women with UTIs were found to have a 3.2-fold higher risk of preeclampsia compared to those without infection, highlighting UTI as a critical and modifiable risk factor. Early screening, prompt diagnosis through urine culture, and effective management of UTIs during antenatal care are essential strategies to reduce the incidence and adverse outcomes of preeclampsia. Given the temporal relationship observed between first-trimester UTIs and later development of preeclampsia, routine infection control measures should be integrated into prenatal protocols. Further large-scale studies are warranted to confirm causality, elucidate underlying mechanisms, and evaluate the impact of systematic UTI management on preeclampsia prevention. This study underscores the need to consider infection-driven inflammation as a key target in safeguarding maternal and fetal health.

Recommendations

Routine screening for urinary tract infections (UTIs) should be integrated into antenatal care, with urine culture preferred as the gold standard at the first visit. Prompt, culture-guided antibiotic therapy and follow-up testing in high-risk women are essential to ensure eradication and prevent recurrence. Antenatal protocols must explicitly include infection control as a strategy for preeclampsia prevention, with low-cost options like midstream urine testing applicable in resource-limited settings. Equally important is educating expectant mothers on hydration, perineal hygiene, and early reporting of urinary symptoms, while raising awareness of the link between UTIs and pregnancy complications. Finally, large multicenter trials are needed to confirm causality and assess whether systematic UTI management reduces the incidence of preeclampsia, alongside further research into other infectious and inflammatory triggers to inform holistic prevention strategies.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee (No.09092023)

REFERENCES

1. World Health Organization. Pre-eclampsia, 2025. Available at. https://www.who.int/news-room/fact-sheets/detail/preeclampsia. Accessed 29 August 2025.
2. Gemechu KS, Assefa N, Mengistie B. Prevalence of hypertensive disorders of pregnancy and pregnancy outcomes in Sub-Saharan Africa: A systematic review and meta-analysis. Women's Health. 2020;16:1745506520973105.
3. Rana S, Lemoine E, Granger JP, Karumanchi SA. Preeclampsia: pathophysiology, challenges, and perspectives. Circul Res. 2019;124(7):1094-112.
4. Jena MK, Sharma NR, Petitt M, Maulik D, Nayak NR. Pathogenesis of preeclampsia and therapeutic approaches targeting the placenta. Biomolecules. 2020;10(6):953.
5. Murphy SR, LaMarca BB, Parrish M, Cockrell K, Granger JP. Control of soluble fms-like tyrosine-1 (sFlt-1) production response to placental ischemia/hypoxia: role of tumor necrosis factor-α. Am J Physiol-Regulat Integrat Comparat Physiol. 2013;304(2):R130-5.
6. Silverman MD, Turrentine MA. Urinary tract infections in pregnant individuals. Obstet Gynecol. 2023;142(2):435-5.
7. Matuszkiewicz-Rowińska J, Małyszko J, Wieliczko M. State of the art paper Urinary tract infections in pregnancy: old and new unresolved diagnostic and therapeutic problems. Arch Medi Sci. 2015;11(1):67-77.
8. Hill JB, Sheffield JS, McIntire DD, Wendel GD Jr: Acute pyelonephritis in pregnancy. Obstet Gynecol. 2005;105(1):18-23.

9. Taghavi Zahedkalaei A, Kazemi M, Zolfaghari P, Rashidan M, Sohrabi MB. Association between urinary tract infection in the first trimester and risk of preeclampsia: A case–control study. Int J Wom Heal. 2020;10:521-6.
10. Yan L, Jin Y, Hang H, Yan B. The association between urinary tract infection during pregnancy and preeclampsia: A meta-analysis. Medi. 2018;97(36):e12192.
11. Conde-Agudelo A, Villar J, Lindheimer M. Maternal infection and risk of preeclampsia: systematic review and metaanalysis. Am J Obstetr Gynecol. 2008;198(1):7-22.
12. Fatima W, Shabana N, Tabasam S, Malik IK, Hanif A, Nadar A. Association of urinary tract infection with preeclampsia during pregnancy. Indus J Biosci Res. 2025;3(5):755-8.
13. Smaill FM, Vazquez JC. Antibiotics for asymptomatic bacteriuria in pregnancy. Coch Datab System Revi. 2019;11:10.

Cite this article as: Arunaa R, Dakshinamurthy P. From infection to hypertension: exploring the association between urinary tract infection and development of preeclampsia. Int J Reprod Contracept Obstet Gynecol 2025;14:4254-8.