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Original Research Article

Association Between Urinary Tract Infection in the First Trimester and Risk of Preeclampsia in Pregnant Women

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Abstract: *Urinary tract infection during pregnancy is a common clinical problem and has been implicated in adverse maternal and fetal outcomes. Preeclampsia remains a leading cause of maternal and perinatal morbidity and mortality worldwide, particularly in low and middle-income countries. Evidence suggests that infections occurring early in pregnancy may contribute to the pathogenesis of preeclampsia through inflammatory and immunological mechanisms; however, data from Pakistani populations remain limited.* ***Objective:*** *To determine the association between urinary tract infection in the first trimester and the risk of developing preeclampsia among pregnant women.* ***Methods:*** *This case-control study was conducted at the Department of Obstetrics and Gynaecology, Ibn-e-Siena Hospital, Multan, over six months, from November 2023 to May 2024. A total of 176 pregnant women were enrolled using non-probability consecutive sampling, including 88 women with preeclampsia and 88 normotensive controls. A urinary tract infection during the first trimester was identified through medical record review, based on urine examination and culture results. Demographic and obstetric variables were recorded, and data were analyzed using SPSS version 23. The association between first-trimester UTI and preeclampsia was assessed using chi-square testing and odds Ratio estimation, with stratification performed for potential confounders.* ***Results:*** *The mean age of participants was 29.4 ± 5.8 years. First-trimester urinary tract infection was significantly more frequent among women with preeclampsia compared to controls (37.5% vs. 20.5%, p = 0.01). Women with documented UTI had more than twice the odds of developing preeclampsia (OR 2.33; 95% CI: 1.18–4.59; p = 0.01). Stratified analysis demonstrated a persistent significant association across age groups, higher body mass index categories, and urban residence.* ***Conclusion:*** *Urinary tract infection during the first trimester is significantly associated with an increased risk of preeclampsia. Early screening and prompt management of UTIs during pregnancy may reduce the burden of preeclampsia and improve maternal outcomes.*

Keywords: Urinary tract infection, Preeclampsia, Pregnancy, First trimester

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Introduction

Urinary tract infections (UTIs) during pregnancy are a significant clinical concern, particularly in the first trimester when fetal development plays a critical role. UTIs are prevalent and can have considerable implications for maternal and fetal health, including potential associations with the development of preeclampsia. This hypertensive disorder poses risks for both the mother and the fetus. Preeclampsia is characterized by hypertension and proteinuria occurring after 20 weeks of gestation. It affects 2% to 8% of pregnant women, being one of the leading causes of maternal and perinatal morbidity and mortality (1).

Research indicates that infections during pregnancy, particularly UTIs, can increase the likelihood of preeclampsia and other adverse outcomes such as preterm labor and low birth weight (2). Layuk et al. noted that infections, including UTIs, might stimulate systemic inflammatory responses, which can contribute to the pathophysiology of preeclampsia (3). The inflammatory pathways activated during a UTI can disrupt normal placental development and function, potentially fostering an environment conducive to the onset of preeclampsia (4). Furthermore, asymptomatic bacteriuria often goes undetected and untreated, leading to acute UTIs that complicate pregnancy (5). Screening and treating UTIs in pregnant women, especially in the first trimester, is crucial since earlier intervention has been shown to significantly improve maternal and neonatal outcomes (6).

Several pathophysiological mechanisms have been proposed regarding how first-trimester UTIs could influence the risk of preeclampsia. For instance, UTIs result in increased hemodynamic changes and stress responses, which may predispose women to hypertensive disorders later in pregnancy (2). Moreover, maternal nutrient and oxygen transport can be impaired in cases of UTI, leading to fetal distress and inadequate placentation, which can exacerbate the risk of gestational complications (7). Studies have further revealed that women with a history of UTIs are more likely to develop hypertension during pregnancy, underscoring the need for effective screening and management strategies (8).

Moreover, the significance of urinary tract health is magnified in specific populations. In Pakistan, the incidence of UTIs among pregnant women can be notably high due to socio-economic factors, lack of access to healthcare, and varying hygiene practices (7). Given the unique cultural and health variables present in the Pakistani context, there is an urgent need for tailored public health strategies to enhance screening for UTIs early in pregnancy. This screening could include urine cultures and assessments of symptomatology in antenatal clinics, enabling targeted interventions that could mitigate the risk of developing preeclampsia (9). Addressing these issues through awareness and healthcare accessibility can significantly reduce the burden of preeclampsia and improve maternal and fetal health outcomes in Pakistan.

Thus, there is compelling evidence to indicate that UTIs in the first trimester are closely linked with an increased risk of preeclampsia in pregnant women. This association highlights the importance of integrated maternal healthcare services that incorporate routine screening for UTIs and prompt treatment to improve health outcomes in both mothers and their infants.

Methodology

This study was designed as a case-control investigation. It was conducted at the Department of Obstetrics and Gynaecology, Ibn-e-Siena Hospital, Multan, over a period of six months, from November 2023 to May 2024, following formal approval of the research synopsis by the institutional ethics review committee. The study population comprised pregnant women presenting to the hospital's antenatal and obstetric units during the study period. Written informed consent was obtained from all participants before enrollment, and the confidentiality of patient information was strictly maintained throughout the study.

A total sample size of 176 pregnant women was calculated using OpenEpi software for a case-control study design, assuming a urinary tract infection frequency of 31.5 percent among controls, an expected odds Ratio of 2.5, a power of 80 percent, and a significance level of 5 percent. The study sample included 88 cases and 88 controls. A non-probability, consecutive sampling technique was used to recruit eligible participants until the required sample size was reached. Cases were defined as pregnant women diagnosed with preeclampsia, while controls were pregnant women without preeclampsia.

Pregnant women aged between 20 and 45 years with a confirmed singleton pregnancy were included in the study. Gestational age ranged from 25 to 37 weeks and was determined using the last menstrual period method and confirmed by antenatal ultrasound when available. Women with a history of chronic kidney disease or pre-existing chronic hypertension, as documented in medical records, were excluded to minimize confounding factors.

Preeclampsia was operationally defined as blood pressure equal to or greater than 140/90 mmHg measured after 20 weeks of gestation, accompanied by proteinuria of +1 or more on spot urine examination using the dipstick method. Urinary tract infection in the first trimester was identified irrespective of clinical symptoms and was confirmed through medical record review. UTI was considered present if complete urine examination showed positive leukocyte esterase or nitrites, or if urine culture demonstrated growth of pathogenic bacteria at a concentration of at least 10^5 colony-forming units per milliliter after 48 hours of incubation of a midstream urine sample. Assessment of UTI status was performed by the researcher, who was blinded to participants' case-control status to reduce observer bias.

Demographic and obstetric data, including age, parity, gestational age, area of residence, and body mass index, were recorded on a predesigned proforma. Body mass index was calculated using the standard formula of weight in kilograms divided by height in meters squared. Weight was measured using a calibrated weighing scale, and height was measured using a stadiometer, following standard measurement protocols. Women diagnosed with preeclampsia were managed according to the hospital's standard treatment guidelines and clinical protocols, independent of study participation.

Data were entered and analyzed using SPSS version 23. Quantitative variables such as age, gestational age, and body mass index were expressed as mean and standard deviation. Qualitative variables, including parity, area of residence, and presence of urinary tract infection, were presented as frequencies and percentages. The frequency of urinary tract infection in the first trimester was compared between cases and controls using the chi-square test. Stratification was performed for age, gestational age, parity, body mass index categories, and area of residence to assess potential effect modifiers. Post-stratification chi-square testing was applied, and a p-value of 0.05 or less was considered statistically significant for all analyses.

Results

The overall mean age of the study participants was 29.4 ± 5.8 years, with no statistically significant difference between cases and controls. The majority of participants belonged to the 26–35-year age group. Most women were multiparous and presented during the late second or early third trimester of pregnancy. A higher proportion of participants were from urban areas, reflecting the hospital catchment population.The baseline demographic and obstetric characteristics of both groups were comparable, indicating appropriate matching between cases and controls. (Table 1).

Urinary tract infection during the first trimester of pregnancy was documented in 41 women (23.3%) overall. The frequency of UTI was notably higher among women who developed preeclampsia.Women with preeclampsia had a significantly higher frequency of UTI in the first trimester compared to controls ($p = 0.01$). (Table 2).

A statistically significant association was observed between first-trimester UTI and the development of preeclampsia. Pregnant women with documented UTI were more likely to develop preeclampsia compared to those without UTI. (Table 3).

Stratification was performed to assess the effect of potential confounders, including age, BMI, parity, gestational age, and area of residence.A significantly higher frequency of UTI among preeclamptic women was observed, particularly in women aged 26–35 years, those with BMI ≥ 27 kg/m², and among urban residents. (Table 4).

Table 1. Demographic and obstetric characteristics of study participants (n = 176)

Variable	Preeclampsia (n = 88)	Controls (n = 88)	p value
Age (years), mean ± SD	29.8 ± 5.6	29.0 ± 6.0	0.42
Gestational age (weeks), mean ± SD	31.2 ± 3.4	30.8 ± 3.6	0.48
BMI (kg/m²), mean ± SD	28.6 ± 4.1	26.9 ± 3.8	0.01
Primiparous	34 (38.6%)	39 (44.3%)	0.44
Multiparous	54 (61.4%)	49 (55.7%)	
Urban residence	56 (63.6%)	52 (59.1%)	0.53
Rural residence	32 (36.4%)	36 (40.9%)	

Table 2. Frequency of first-trimester UTI among cases and controls

UTI in the first trimester	Preeclampsia (n = 88)	Controls (n = 88)	p value
Yes	33 (37.5%)	18 (20.5%)	0.01
No	55 (62.5%)	70 (79.5%)	

Table 3. Association between first-trimester UTI and preeclampsia

Variable	Odds Ratio	95% CI	p value
UTI in the first trimester	2.33	1.18–4.59	0.01

Table 4. Stratified analysis of the association between first-trimester urinary tract infection and preeclampsia (n = 176)

Stratification variable	Category	UTI present n (%)	UTI absent n (%)	Total	p value
Age (years)	20–25	8 (25.0)	24 (75.0)	32	0.04
	26–35	28 (36.8)	48 (63.2)	76	
	>35	15 (22.1)	53 (77.9)	68	
BMI (kg/m²)	<27	14 (18.4)	62 (81.6)	76	0.02
	≥27	37 (37.0)	63 (63.0)	100	
Parity	Primiparous	20 (27.4)	53 (72.6)	73	0.18
	Multiparous	31 (30.1)	72 (69.9)	103	
Gestational age (weeks)	25–30	17 (26.6)	47 (73.4)	64	0.21
	31–37	34 (30.4)	78 (69.6)	112	
Area of residence	Urban	38 (35.2)	70 (64.8)	108	0.03
	Rural	13 (19.1)	55 (80.9)	68	

Discussion

Our study examined the relationship between urinary tract infections (UTIs) in the first trimester and the subsequent development of preeclampsia among pregnant women. The results demonstrated that the overall incidence of UTI was significantly higher in women who later developed preeclampsia compared to controls (37.5% vs. 20.5%; p = 0.01). This finding aligns with previous literature that has established a relationship between UTIs and adverse pregnancy outcomes. For instance, Kayastha and Tamrakar (10). Reported similar outcomes, emphasizing that UTIs can increase the risk of complications such as preeclampsia.

The demographic analysis showed that the mean age of participants was 29.4 ± 5.8 years, with no significant age difference between the preeclampsia and control groups (29.8 ± 5.6 vs. 29.0 ± 6.0; p = 0.42). Previous studies have indicated that age is a significant factor in pregnancy risk, with older women being at increased risk for a multitude of complications, including preeclampsia (11). In our cohort, the age distribution showed that the majority were in the 26–35-year age range, which corroborates findings from preeclampsia research.

Furthermore, we observed that body mass index (BMI) was significantly associated with preeclampsia. Women in the preeclampsia group had a BMI of 28.6 ± 4.1 compared to 26.9 ± 3.8 in controls (p = 0.01). This reflects findings from literature that assert that higher BMI increases the risk of developing hypertensive disorders during pregnancy (12). Such associations reinforce the relevance of managing weight before and during pregnancy as a strategy for preventing hypertensive conditions.

Notably, our study confirms the association between first-trimester UTI and preeclampsia, as evidenced by an odds Ratio of 2.33 (95% CI: 1.18–4.59, p = 0.01). This elevated likelihood is supported by findings from recent work by Yadufashije et al. [13], which reports that UTIs may predispose pregnant women to various adverse outcomes, including the development of preeclampsia. Our stratified analysis indicates heightened vulnerability among women aged 26–35, with UTI incidence significantly associated with this subgroup (p = 0.04).

In examining the area of residence, we found that urban residents were more prone to UTI-related preeclampsia risk (p = 0.03), supporting previous studies suggesting increased exposure to pathogens and healthcare access disparities in urban settings.

The implications of our findings call for efficient screening protocols for UTIs during early pregnancy, especially in populations at higher risk of preeclampsia. Implementing routine screening in prenatal care settings can facilitate timely interventions, as recommended by Chaemsaithong et al (14). Such practices can mitigate the risk of preeclampsia and related complications while improving maternal and fetal health outcomes through better resource allocation and patient education.

Our results contribute to a growing body of literature demonstrating the importance of recognizing and managing UTIs to reduce the incidence of preeclampsia. We encourage further study to explore the underlying biological mechanisms linking UTIs and preeclampsia, as well as population-specific interventions to improve maternal health systems.

Conclusion

This study demonstrates a significant association between first-trimester urinary tract infection and the subsequent development of preeclampsia among pregnant women in a tertiary care setting in Pakistan. The findings underscore the importance of early antenatal screening for urinary tract infections, particularly among women with higher body mass index and those residing in urban areas. Integrating routine UTI screening and timely treatment into early prenatal care may represent a simple yet effective strategy to reduce the risk of preeclampsia and its associated maternal and fetal complications in resource-limited settings.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-23)

Consent for publication
Approved

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Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

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Review of Literature, Data entry, Data analysis, and drafting an article.
MMT (SR)
Conception of Study, Development of Research Methodology Design
TJB (Professor)
Final Approval, and design of study, conception of study

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

References

1. Chaemsaithong P., Sahota D., & Poon L.First-trimester preeclampsia screening and prediction. American Journal of Obstetrics and Gynecology 2022;226(2):S1071-S1097.e2. https://doi.org/10.1016/j.ajog.2020.07.020
2. Kayastha B. and Tamrakar S. Maternal and perinatal outcome of urinary tract infection in pregnancy at Dhaulikhel Hospital, Kathmandu

University Hospital. Kathmandu University Medical Journal 2022;20(1):82-86. https://doi.org/10.3126/kumj.v20i1.49944
3. Layuk N., Wahyuni S., & Arifuddin S. Differences in heparin-binding protein levels in preeclamptic and non-preeclamptic women. International Journal of Health Sciences 2021;5(2). https://doi.org/10.29332/ijhs.v5n2.1199
4. Miller D., Motomura K., Galaz J., Gershater M., Lee E., Romero R., et al Cellular immune responses in the pathophysiology of preeclampsia. Journal of Leukocyte Biology 2021;111(1):237-260. https://doi.org/10.1002/jlb.5ru1120-787rr
5. Abeid N.. Asymptomatic bacteriuria among pregnant women attending antenatal care. Alq J Med App Sci 2024:622-627. https://doi.org/10.54361/ajmas.247326
6. Mishra D., Kalra A., Bhide A., & Singh M. Risk factors and clinical outcomes of asymptomatic bacteriuria in pregnant women: a comprehensive analysis. Cureus 2024. https://doi.org/10.7759/cureus.59557
7. Tesfa E., Nibret E., Gizaw S., Zenebe Y., Mekonnen Z., Assefa S., et al Prevalence and determinants of hypertensive disorders of pregnancy in Ethiopia: a systematic review and meta-analysis. Plos One 2020;15(9):e0239048. https://doi.org/10.1371/journal.pone.0239048
8. Shen L., Sahota D., Chaemsaithong P., Tse W., Chung M., Ip J.et al.. First-trimester screening for gestational diabetes mellitus with maternal factors and biomarkers. Fetal Diagnosis and Therapy 2022;49(5-6):256-264. https://doi.org/10.1159/000525384
9. Rolnik D., Nicolaides K., & Poon L. Prevention of preeclampsia with aspirin. American Journal of Obstetrics and Gynecology 2022;226(2):S1108-S1119. https://doi.org/10.1016/j.ajog.2020.08.045
10. Kayastha B. and Tamrakar S. Maternal and perinatal outcome of urinary tract infection in pregnancy at Dhaulikhel Hospital, Kathmandu University Hospital. Kathmandu University Medical Journal 2022;20(1):82-86. https://doi.org/10.3126/kumj.v20i1.49944
11. SUMAN K., Bütün Z., BÜYÜK M., SUMAN M., & Dane B.. Analysis of the effectiveness of first-trimester nuchal translucence, free beta-human chorionic gonadotropin, and pregnancy-related plasma protein A in the prediction of pregnancy complications. Black Sea Journal of Health Science 2022;5(3):533-539. https://doi.org/10.19127/bshealthscience.1089239
12. Taha A. Bacteriological profile, antimicrobial susceptibility, and factors associated with urinary tract infection in pregnant women. The Journal of Infection in Developing Countries 2024;18(03):391-398. https://doi.org/10.3855/jidc.18239
13. Yadufashije C., Muhimpundu L., Munyeshyaka E., & Mucumbitsi J.Dysbiosis of the human vaginal microbial community contributes to urinary tract infections during pregnancy: a case study from Gisenyi District Hospital, Rwanda. Asian Journal of Medical Sciences 2021;12(4):127-133. https://doi.org/10.3126/ajms.v12i4.35077
14. Chaemsaithong P., Sahota D., & Poon L.First-trimester preeclampsia screening and prediction. American Journal of Obstetrics and Gynecology 2022;226(2):S1071-S1097.e2. https://doi.org/10.1016/j.ajog.2020.07.020.