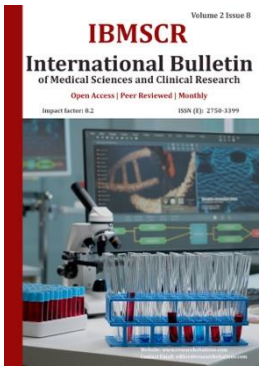

ACUTE RESPIRATORY INFECTIONS AND PYELONEPHRITIS DURING PREGNANCY: MATERNAL RISKS, PATHOPHYSIOLOGICAL MECHANISMS, AND PERINATAL OUTCOMES

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Abstract. Pregnancy is associated with physiological, anatomical, and immunological changes that predispose women to infectious diseases. Acute respiratory infections (ARIs) and pyelonephritis are among the most common causes of maternal morbidity during gestation. The coexistence of these conditions may significantly increase systemic inflammatory responses and contribute to adverse maternal and fetal outcomes. This narrative review summarizes current evidence regarding epidemiology, pathogenesis, clinical manifestations, diagnosis, management, and pregnancy outcomes associated with concurrent ARIs and pyelonephritis. Available evidence suggests that combined infectious processes increase the risk of maternal complications, including sepsis, respiratory insufficiency, anemia, and acute kidney injury, while also contributing to preterm birth, fetal growth restriction, and neonatal morbidity. Early recognition, multidisciplinary management, and preventive strategies remain crucial for improving maternal and perinatal outcomes.

Keywords: pregnancy, acute respiratory infection, pyelonephritis, urinary tract infection, maternal outcomes, perinatal outcomes, inflammation.

Introduction. Infectious diseases remain among the leading causes of maternal and neonatal morbidity worldwide, particularly in low- and middle-income countries [1,2]. Pregnancy is characterized by profound physiological, anatomical, hormonal, and immunological adaptations that are necessary to support fetal growth and development. However, these changes may also increase maternal susceptibility to infectious diseases and contribute to a more severe clinical course compared with non-pregnant women [3,4].

Acute respiratory infections (ARIs) are among the most common infectious conditions encountered during pregnancy and represent a significant public health concern. Viral pathogens such as influenza viruses, respiratory syncytial virus (RSV), rhinoviruses, adenoviruses, and coronaviruses are frequently implicated [5,6]. Pregnancy-associated alterations in pulmonary physiology, including elevated oxygen consumption, decreased functional residual lung capacity, and mucosal edema of the respiratory tract, may predispose women to more severe respiratory symptoms and complications [7]. Several studies have demonstrated that respiratory infections during pregnancy are associated with increased risks of maternal hospitalization, respiratory insufficiency, preterm birth, and adverse neonatal outcomes [8,9].

Urinary tract infections (UTIs) are another common complication of pregnancy, affecting up to 10% of pregnant women, with acute pyelonephritis representing the most severe clinical manifestation [10]. Pyelonephritis occurs in approximately 1–2% of pregnancies and remains one of the leading non-obstetric causes of hospitalization during the antenatal period [11,12]. Escherichia coli is responsible for the majority of cases, although other Gram-negative and

Gram-positive pathogens may also be involved [13]. Pregnancy-related urinary stasis, ureteral dilatation, and progesterone-mediated smooth muscle relaxation facilitate bacterial colonization and ascending infection of the urinary tract [14].

Both ARIs and pyelonephritis independently contribute to adverse maternal and perinatal outcomes. Previous investigations have linked respiratory infections and pyelonephritis with maternal sepsis, anemia, acute respiratory distress syndrome, preterm labor, fetal growth restriction, and low birth weight [9,15–17]. When these infectious conditions occur simultaneously, the resulting systemic inflammatory response may be amplified through increased production of pro-inflammatory cytokines, endothelial dysfunction, and placental impairment [18,19]. Such mechanisms may further compromise maternal health and fetal well-being, increasing the risk of pregnancy complications.

Despite the clinical importance of both conditions, relatively few studies have specifically evaluated the coexistence of acute respiratory infections and pyelonephritis during pregnancy. Most available publications examine respiratory and urinary tract infections separately, resulting in a significant gap in current obstetric literature [20]. A comprehensive understanding of the interaction between these infectious processes is essential for improving diagnostic strategies, optimizing clinical management, and reducing maternal and neonatal morbidity.

Therefore, the aim of this narrative review is to summarize current evidence regarding the epidemiology, pathophysiological mechanisms, clinical manifestations, diagnostic approaches, management strategies, and maternal-perinatal outcomes associated with concurrent acute respiratory infections and pyelonephritis during pregnancy.

Materials and Methods.

Study Design. This study was conducted as a narrative review aimed at summarizing current evidence regarding the coexistence of acute respiratory infections (ARIs) and pyelonephritis during pregnancy, with particular emphasis on epidemiology, pathophysiological mechanisms, maternal complications, diagnostic approaches, management strategies, and perinatal outcomes.

Literature Search Strategy. A comprehensive literature search was performed using the electronic databases PubMed/MEDLINE, Scopus, Web of Science, Google Scholar, and the Cochrane Library. Relevant studies published between January 2010 and December 2025 were identified using combinations of the following keywords and Medical Subject Headings (MeSH) terms:

-"pregnancy"
-"acute respiratory infection"
-"respiratory tract infection"
-"influenza"
-"viral respiratory infection"
-"urinary tract infection"
-"pyelonephritis"
-"maternal outcomes"
-"perinatal outcomes"
-"pregnancy complications"
-"maternal infection"

Boolean operators ("AND", "OR") were used to optimize the search strategy. Reference lists of relevant articles were also manually screened to identify additional publications.

Eligibility Criteria.

Studies were considered eligible if they:

1. Included pregnant women diagnosed with acute respiratory infections, pyelonephritis, or both conditions;
2. Reported maternal, fetal, or neonatal outcomes;
3. Were published in peer-reviewed journals;
4. Were available in English.

The following publications were excluded:

1. Conference abstracts without full-text availability;
2. Editorials, commentaries, and letters to the editor;
3. Animal studies;
4. Studies lacking sufficient clinical or outcome data;
5. Duplicate publications.

Study Selection and Data Extraction. Titles and abstracts retrieved from the databases were independently screened for relevance. Full texts of potentially eligible studies were subsequently reviewed. Information extracted from the selected publications included study characteristics, sample size, maternal demographic data, infectious etiology, clinical manifestations, diagnostic findings, treatment approaches, maternal complications, and perinatal outcomes.

Data Synthesis. Due to substantial heterogeneity among available studies regarding study design, patient populations, diagnostic criteria, and reported outcomes, a quantitative meta-analysis was not performed. Instead, findings were synthesized narratively and organized into thematic sections addressing epidemiology, pathophysiology, clinical presentation, diagnosis, management, and maternal-perinatal outcomes.

Ethical Considerations. As this study was based exclusively on previously published literature and did not involve direct patient participation or access to identifiable personal data, ethical approval and informed consent were not required.

Results.

Search Results and Study Characteristics. The literature search identified a substantial number of publications addressing respiratory tract infections and pyelonephritis during pregnancy. Following screening and eligibility assessment, studies focusing on epidemiology, pathophysiology, maternal complications, diagnostic approaches, and perinatal outcomes were included in this review. Most available studies investigated acute respiratory infections and pyelonephritis separately, whereas evidence specifically evaluating their coexistence during pregnancy remained limited.

The included literature consisted of systematic reviews, observational studies, retrospective cohort studies, clinical guidelines, and expert recommendations. Most publications originated from North America, Europe, and Asia and focused on maternal morbidity, pregnancy complications, and neonatal outcomes associated with infectious diseases during gestation.

Epidemiological Findings. Acute respiratory infections were consistently reported as one of the most common infectious conditions affecting pregnant women worldwide [1–3]. Viral

pathogens, including influenza viruses, respiratory syncytial virus, rhinoviruses, and coronaviruses, represented the predominant etiological agents [4,5].

Pyelonephritis was reported to complicate approximately 1–2% of pregnancies and remained among the leading causes of antepartum hospitalization [6,7]. Escherichia coli accounted for the majority of identified pathogens, followed by Klebsiella species and other Gram-negative organisms [8].

Although both conditions are frequently encountered during pregnancy, studies specifically evaluating simultaneous ARIs and pyelonephritis were scarce, indicating an important gap in current obstetric literature.

Physiological and Pathophysiological Findings. The reviewed studies demonstrated that pregnancy-related physiological adaptations contribute substantially to increased susceptibility to respiratory and urinary tract infections. Reduced cell-mediated immunity, increased oxygen consumption, ureteral dilatation, and urinary stasis were identified as major predisposing factors [9,10].

Several investigations reported elevated concentrations of inflammatory biomarkers, including interleukin-6, tumor necrosis factor-alpha, and C-reactive protein, in pregnant women with severe infections [11,12]. Concurrent respiratory and urinary tract infections may further amplify systemic inflammatory responses, leading to endothelial dysfunction and impaired placental perfusion.

Maternal Outcomes. The reviewed literature consistently demonstrated an association between infectious diseases during pregnancy and adverse maternal outcomes. Commonly reported complications included:

-Maternal sepsis;
-Acute respiratory distress syndrome;
-Acute kidney injury;
-Anemia;
-Hypertensive disorders of pregnancy;
-Prolonged hospitalization;
-Intensive care unit admission [13–15].

Several studies indicated that acute pyelonephritis was associated with bacteremia in up to 20% of affected patients and increased risks of maternal morbidity [16]. Similarly, severe respiratory infections were associated with increased hospitalization rates and respiratory complications during pregnancy [17].

Fetal and Neonatal Outcomes. Adverse fetal and neonatal outcomes were frequently reported among pregnancies complicated by maternal infections. The most common complications included:

-Preterm labor;
-Preterm birth;
-Fetal growth restriction;
-Low birth weight;
-Intrauterine hypoxia;
-Neonatal intensive care unit admission;
-Increased perinatal morbidity [18–20].

Several studies suggested that maternal systemic inflammation and placental dysfunction may represent important mechanisms linking infection with adverse perinatal outcomes. Persistent maternal fever and inflammatory cytokine release were associated with impaired fetal oxygenation and growth abnormalities [19,20].

Diagnostic and Therapeutic Findings. The reviewed evidence emphasized the importance of early diagnosis through clinical assessment, laboratory testing, urine culture, inflammatory biomarkers, and imaging studies when indicated [21]. Timely initiation of antimicrobial therapy, adequate hydration, and multidisciplinary management were consistently associated with improved maternal and neonatal outcomes [22].

Routine screening for asymptomatic bacteriuria, influenza vaccination, and regular prenatal care were identified as important preventive measures capable of reducing infectious complications during pregnancy [23].

Summary of Findings. Overall, the available evidence suggests that both acute respiratory infections and pyelonephritis independently contribute to adverse maternal and perinatal outcomes. Although direct evidence regarding their coexistence remains limited, current data indicate that combined infections may intensify systemic inflammation, increase maternal morbidity, and contribute to unfavorable pregnancy outcomes. Further prospective studies are required to clarify the epidemiology, pathophysiological mechanisms, and optimal management strategies for pregnant women affected by concurrent respiratory and urinary tract infections.

Discussion. The present narrative review highlights the significant clinical implications of acute respiratory infections (ARIs) and pyelonephritis during pregnancy. Although these infectious conditions are traditionally investigated as separate entities, their coexistence may create a complex clinical scenario characterized by amplified systemic inflammation, increased maternal morbidity, and adverse perinatal outcomes. The available evidence suggests that pregnancy-related physiological adaptations play a central role in increasing susceptibility to both respiratory and urinary tract infections, while the simultaneous occurrence of these conditions may further exacerbate disease severity.

Pregnancy represents a unique immunological state characterized by dynamic alterations in innate and adaptive immune responses. These changes are necessary to ensure maternal tolerance of the semi-allogeneic fetus while maintaining protection against infectious agents. However, immunological adaptations may also increase susceptibility to certain viral and bacterial infections. Reduced cell-mediated immunity, alterations in cytokine production, and hormonal changes have been identified as important contributors to increased infection risk during pregnancy. Several studies have demonstrated that pregnant women are more vulnerable to severe manifestations of respiratory infections, particularly influenza and other viral respiratory diseases. Similarly, anatomical and physiological modifications of the urinary tract facilitate bacterial colonization and ascending infection, increasing the risk of pyelonephritis.

The respiratory system undergoes substantial physiological changes throughout pregnancy. Elevation of the diaphragm, increased oxygen consumption, enhanced minute ventilation, and reduced functional residual capacity may limit maternal respiratory reserve. Consequently, respiratory infections may progress more rapidly and result in significant clinical deterioration. Previous investigations have demonstrated that pregnant women with

severe respiratory infections experience higher rates of hospitalization and respiratory complications compared with non-pregnant women. Furthermore, maternal hypoxemia associated with respiratory disease may directly affect fetal oxygen delivery and contribute to adverse pregnancy outcomes.

Similarly, urinary tract infections remain among the most common bacterial infections encountered during pregnancy. Progesterone-induced smooth muscle relaxation promotes ureteral dilatation and urinary stasis, creating favorable conditions for bacterial growth. Escherichia coli continues to represent the predominant pathogen responsible for pyelonephritis during gestation. Untreated bacteriuria may progress to symptomatic infection and subsequently to acute pyelonephritis, which remains one of the leading causes of non-obstetric hospitalization during pregnancy. Previous studies have consistently demonstrated associations between pyelonephritis and maternal complications, including bacteremia, sepsis, anemia, and acute kidney injury.

One of the most important findings emerging from the reviewed literature is the role of systemic inflammation in mediating adverse maternal and fetal outcomes. Both respiratory infections and pyelonephritis trigger activation of inflammatory pathways involving cytokines such as interleukin-6, interleukin-1β, tumor necrosis factor-alpha, and C-reactive protein. These inflammatory mediators contribute to endothelial dysfunction, oxidative stress, and vascular alterations that may impair placental perfusion. When respiratory and urinary tract infections occur simultaneously, inflammatory responses may become amplified, resulting in greater maternal physiological stress and increased risk of complications.

Placental function appears to be particularly vulnerable to maternal infection. Adequate placental perfusion is essential for fetal growth and development. Systemic inflammation may disrupt normal placental vascularization and impair maternal-fetal exchange of oxygen and nutrients. Several studies have suggested that elevated inflammatory markers during pregnancy are associated with placental insufficiency, fetal growth restriction, and preterm birth. Although direct evidence regarding combined ARIs and pyelonephritis remains limited, the biological mechanisms observed in individual infections strongly support the possibility of additive or synergistic adverse effects on placental function.

Maternal complications represent another important aspect of concurrent infectious disease during pregnancy. The reviewed literature consistently identifies sepsis as one of the most serious consequences of severe infection. Sepsis remains a leading cause of maternal morbidity and mortality worldwide and requires prompt recognition and intervention. Acute pyelonephritis has been associated with bacteremia in a substantial proportion of patients, while severe respiratory infections may result in respiratory insufficiency and acute respiratory distress syndrome. The coexistence of these conditions may therefore increase the likelihood of systemic deterioration and intensive care unit admission.

Anemia is another frequently reported complication among pregnant women with infectious diseases. Chronic inflammation may impair erythropoiesis and contribute to anemia of inflammation, while recurrent infection may further exacerbate nutritional deficiencies already common during pregnancy. Maternal anemia has been independently associated with adverse obstetric outcomes, including preterm delivery, low birth weight, and increased perinatal mortality. Consequently, infection-associated anemia may represent an important pathway linking maternal illness with fetal complications.

The relationship between maternal infection and preterm birth has been extensively documented. Infection-induced activation of inflammatory pathways may stimulate prostaglandin synthesis, cervical ripening, and uterine contractility, thereby increasing the risk of spontaneous preterm labor. Multiple studies have demonstrated higher rates of preterm delivery among women diagnosed with pyelonephritis or severe respiratory infections. Preterm birth remains one of the leading causes of neonatal morbidity and mortality worldwide and contributes significantly to long-term neurodevelopmental impairment.

Fetal growth restriction represents another clinically relevant outcome associated with maternal infection. Reduced placental perfusion, chronic inflammation, and maternal hypoxemia may impair fetal growth trajectories. Studies investigating infectious diseases during pregnancy have reported increased frequencies of small-for-gestational-age infants and low birth weight neonates. These findings suggest that maternal infection may exert both acute and chronic effects on fetal development.

Neonatal consequences of maternal infection extend beyond birth outcomes alone. Increased rates of neonatal intensive care unit admission, respiratory complications, neonatal sepsis evaluation, and prolonged hospitalization have been reported among infants born to mothers with significant infectious diseases during pregnancy. These complications contribute substantially to healthcare utilization and economic burden while also affecting long-term child health outcomes.

An important observation from the current review is the limited availability of studies specifically examining concurrent ARIs and pyelonephritis during pregnancy. Most published investigations evaluate respiratory infections and urinary tract infections independently. Consequently, current clinical recommendations are largely extrapolated from evidence generated for individual disease entities. This represents a significant knowledge gap within obstetric medicine. Future research should focus on prospective multicenter investigations capable of evaluating the incidence, risk factors, inflammatory profiles, and clinical outcomes associated with combined infections.

Early diagnosis remains critical for preventing severe maternal and fetal complications. Timely recognition of infection through clinical assessment, laboratory testing, urine culture, and appropriate imaging allows initiation of targeted therapy before disease progression occurs. Screening for asymptomatic bacteriuria during prenatal care has been shown to reduce the incidence of pyelonephritis and remains an important preventive strategy. Similarly, vaccination against influenza and implementation of infection-control measures may reduce the burden of respiratory infections among pregnant women.

The management of concurrent respiratory and urinary tract infections requires a multidisciplinary approach involving obstetricians, infectious disease specialists, nephrologists, pulmonologists, and neonatologists. Treatment strategies should focus on rapid infection control, prevention of maternal deterioration, maintenance of adequate fetal oxygenation, and close maternal-fetal monitoring. The selection of antimicrobial therapy must balance microbiological effectiveness with fetal safety considerations.

Several limitations should be acknowledged. First, available evidence regarding concurrent ARIs and pyelonephritis remains scarce. Second, significant heterogeneity exists among published studies with respect to patient populations, diagnostic criteria, and outcome measures. Third, most available data originate from retrospective investigations, which may be

subject to selection bias and incomplete reporting. These limitations highlight the need for well-designed prospective studies and standardized reporting frameworks.

Despite these limitations, the current review provides a comprehensive overview of the potential interaction between respiratory and urinary tract infections during pregnancy. The evidence suggests that combined infections may intensify systemic inflammation, increase maternal morbidity, and contribute to adverse perinatal outcomes. Recognition of this clinical association may facilitate earlier diagnosis, more effective management, and improved maternal-fetal care.

In summary, the coexistence of acute respiratory infections and pyelonephritis during pregnancy represents a clinically important but insufficiently investigated condition. Pregnancy-related physiological adaptations, systemic inflammatory responses, placental dysfunction, and maternal complications collectively contribute to adverse outcomes. Improved awareness among healthcare professionals and further high-quality research are essential to optimize preventive, diagnostic, and therapeutic strategies for affected patients.

Conclusion. Acute respiratory infections and pyelonephritis are among the most common infectious complications encountered during pregnancy and are independently associated with significant maternal and perinatal morbidity. The coexistence of these conditions may further increase the severity of systemic inflammatory responses, leading to endothelial dysfunction, impaired placental perfusion, and adverse pregnancy outcomes.

The available evidence suggests that concurrent respiratory and urinary tract infections may contribute to an increased risk of maternal complications, including sepsis, anemia, acute kidney injury, respiratory insufficiency, and prolonged hospitalization. In addition, these infections are associated with unfavorable fetal and neonatal outcomes, such as preterm birth, fetal growth restriction, intrauterine hypoxia, low birth weight, and neonatal intensive care unit admission.

Early recognition of infection, comprehensive diagnostic evaluation, prompt initiation of appropriate antimicrobial therapy, and multidisciplinary management are essential for reducing maternal and neonatal complications. Preventive strategies, including routine screening for asymptomatic bacteriuria, vaccination against respiratory pathogens, and regular antenatal surveillance, remain important components of obstetric care.

Despite growing evidence regarding the individual effects of respiratory and urinary tract infections during pregnancy, data concerning their simultaneous occurrence remain limited. Further prospective multicenter studies are needed to clarify the epidemiology, pathophysiological mechanisms, and optimal management strategies for pregnant women affected by concurrent acute respiratory infections and pyelonephritis.

Improved understanding of the interaction between these infectious conditions may facilitate the development of evidence-based clinical guidelines and contribute to better maternal and perinatal outcomes worldwide

References:

1.American College of Obstetricians and Gynecologists. Urinary tract infections in pregnant individuals. Obstet Gynecol. 2023;142(2):e76-e92.
2.Belyayeva M, Jeong JM. Acute Pyelonephritis. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2025.

3.Wing DA, Fassett MJ, Getahun D. Acute pyelonephritis in pregnancy: an 18-year retrospective analysis. Am J Obstet Gynecol. 2014;210(3):219.e1-219.e6.
4.Smaill FM, Vazquez JC. Antibiotics for asymptomatic bacteriuria in pregnancy. Cochrane Database Syst Rev. 2019;11:CD000490.
5.Grette K, Cassity S, Holliday N, Rimawi BH. Acute pyelonephritis during pregnancy: a systematic review of the literature. Obstet Gynecol Surv. 2020;75(10):637-648.
6.Jolley JA, Wing DA. Pyelonephritis in pregnancy: an update on treatment options for optimal outcomes. Drugs. 2010;70(13):1643-1655.
7.Macejko AM, Schaeffer AJ. Asymptomatic bacteriuria and symptomatic urinary tract infections during pregnancy. Urol Clin North Am. 2007;34(1):35-42.
8.Delzell JE Jr, Lefevre ML. Urinary tract infections during pregnancy. Am Fam Physician. 2000;61(3):713-721.
9.McDermott S, Daguise V, Mann H, et al. Perinatal outcomes associated with maternal urinary tract infections. J Reprod Med. 2001;46(8):780-784.
10.Foxman B. Epidemiology of urinary tract infections: incidence, morbidity, and economic costs. Am J Med. 2002;113(Suppl 1A):5S-13S.
11.Rasmussen SA, Jamieson DJ. Influenza and pregnancy: no time for complacency. Obstet Gynecol. 2019;133(5):867-869.
12.Jamieson DJ, Theiler RN, Rasmussen SA. Emerging infections and pregnancy. Emerg Infect Dis. 2006;12(11):1638-1643.
13.Silasi M, Cardenas I, Kwon JY, Racicot K, Aldo P, Mor G. Viral infections during pregnancy. Am J Reprod Immunol. 2015;73(3):199-213.
14.Kourtis AP, Read JS, Jamieson DJ. Pregnancy and infection. N Engl J Med. 2014;370(23):2211-2218.
15.Mertz D, Geraci J, Winkup J, et al. Pregnancy as a risk factor for severe outcomes from influenza virus infection: a systematic review and meta-analysis. Clin Infect Dis. 2019;69(11):1836-1848.
16.Schwartz DA. Viral infection, pregnancy, and fetal outcomes. Clin Obstet Gynecol. 2020;63(1):156-169.
17.Allotey J, Stallings E, Bonet M, et al. Clinical manifestations, risk factors, and maternal and perinatal outcomes of coronavirus disease 2019 in pregnancy: living systematic review and meta-analysis. BMJ. 2020;370:m3320.
18.Villar J, Ariff S, Gunier RB, et al. Maternal and neonatal morbidity and mortality among pregnant women with COVID-19 infection. JAMA Pediatr. 2021;175(8):817-826.
19.Di Mascio D, Khalil A, Saccone G, et al. Outcome of coronavirus spectrum infections during pregnancy: systematic review and meta-analysis. Am J Obstet Gynecol MFM. 2020;2(2):100107.
20.Favre G, Pomar L, Musso D, Baud D. 2019-nCoV epidemic: what about pregnancies? Lancet. 2020;395(10224):e40.
21.Karsnitz DB. Puerperal infections of the genital tract. J Midwifery Womens Health. 2013;58(6):632-642.
22.Mor G, Cardenas I. The immune system in pregnancy: a unique complexity. Am J Reprod Immunol. 2010;63(6):425-433.
23.Racicot K, Mor G. Risks associated with viral infections during pregnancy. J Clin Invest. 2017;127(5):1591-1599.

24.Romero R, Espinoza J, Chaiworapongsa T, Kalache K. Infection and prematurity. Semin Fetal Neonatal Med. 2002;7(4):259-274.
25.Goldenberg RL, Hauth JC, Andrews WW. Intrauterine infection and preterm delivery. N Engl J Med. 2000;342(20):1500-1507.
26.Gonçalves LF, Chaiworapongsa T, Romero R. Intrauterine infection and prematurity. Ment Retard Dev Disabil Res Rev. 2002;8(1):3-13.
27.Schieve LA, Handler A, Hershow R, Persky V, Davis F. Urinary tract infection during pregnancy and its association with adverse pregnancy outcomes. Paediatr Perinat Epidemiol. 1994;8(4):416-428.
28.Mittal P, Wing DA. Urinary tract infections in pregnancy. Clin Perinatol. 2005;32(3):749-764.
29.Kalinderi K, Delkos D, Kalinderis M, Athanasiadis A, Kalogiannidis I. Urinary tract infection during pregnancy: current concepts on a common multifaceted problem. J Obstet Gynaecol. 2018;38(4):448-453.
30.Sharma P, Thapa L. Acute pyelonephritis in pregnancy: a retrospective study. Aust N Z J Obstet Gynaecol. 2007;47(4):313-315.