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## UNDERSTANDING THE INTERPLAY: URINARY TRACT INFECTIONS ACROSS DIVERSE POPULATIONS AND HERBAL INTERVENTIONS

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### ABSTRACT

The intricate dynamics of urinary tract infections (UTIs), focus on pregnancy, children, and populations resistant to conventional treatments. UTIs pose unique challenges in these contexts, necessitating a comprehensive understanding of their etiology and potential mitigation strategies. 2 to 3 episodes of UTI may reoccur in a period of 1 year due to the reintroduction of bacteria from the gastrointestinal tract, which is called recurrent UTIs (rUTI) The review investigates the prevalence and impact of UTIs during pregnancy, childhood, diabetes and obese people, shedding light on the distinct vulnerabilities and complications associated with these populations. Additionally, it delves into the emergence of UTI-resistant populations, emphasizing the urgency for alternative approaches in combating this public health concern. An innovative aspect of this exploration is the examination of herbal plants and their potential roles in mitigating UTIs. Herbal interventions have garnered attention for their diverse bioactive compounds and traditional uses in various medical systems. The abstract discusses recent research on the efficacy of herbal plants in preventing and treating UTIs, considering their antimicrobial properties and potential as adjunct therapies. By synthesizing current knowledge on UTIs in pregnancy, children, and resistant populations, as well as highlighting the promising aspects of herbal interventions, this abstract contributes to a holistic understanding of UTI management. It offers insights into novel strategies for prevention and treatment.

**Keywords:** UTI, Recurrent UTI, Pregnancy, Children, Diabetes, Obesity, Herbal plants, Phytotherapy

## 1 INTRODUCTION

Urinary tract infection (UTI) is a type of infection that can occur in any part of the urinary system. It's a condition that affects both young and old populations, with women being more susceptible to it. UTIs are the second most common type of infection worldwide, after lower respiratory tract infections. In developing countries, they account for 24% of all nosocomial infections [1]. UTIs affect approximately 150 million people each year globally. In 2019, UTI was diagnosed in over 404.6 million individuals worldwide, leading to over 2 lakh deaths [2]. The disease has a higher chance of developing in younger women, with a rate of 3-5%, compared to youthful men, who have a 1% chance [3, 4]. Prevalence of UTI varies from 3% to 10.1% during pregnancy. The normal increase in plasma volume during pregnancy lowers urine concentration, and 70% of pregnant women confront glucosuria, which encourages bacterial growth in urine [5, 6]. The normal pH of urine is 5.8, and its colour varies from light yellow to amber. Bilirubin, RBCs, proteins, and pus cells are absent. If the urine's biochemical properties alter, it suggests a problem and is most likely a urinary tract infection (UTI), which is brought on by a high bacterial count. Because the female urethra is shorter as well as wider than the male urethra, microbial colonization is more prevalent in females

[7]. Except for the distal urethra, which is normally sterile, the urinary tract is a hostile habitat for germs. Infection occurs when the virulence factor of the bacteria outnumbers the multiple host defence mechanisms [8]. Gram-negative organisms mostly cause UTIs compared to Gram-positive organisms [9]. The most prevalent bacterial infection responsible for UTI is *E.coli*. It has a variety of adhesins, and the pathogen can still attach to the uroepithelium despite the flushing effect of urine flow [10-12]. *E.coli* causes roughly 80% of infections, with the remaining 20% caused mostly by *Klebsiella pneumoniae*, *Staphylococcus saprophyticus*, *Proteus mirabilis*, and *Enterococcus faecalis* [2]. When the quantity of causing agents in a urine culture exceeds 10,000 CFU/mL, the incidence of UTI increases significantly [3]. Sexually active women are more likely to develop UTI, particularly those who use spermicidal drugs and diaphragms for contraception.

The clinical manifestations of a UTI include a strong and constant need to pee, a burning sensation when urinating, and regularly passing a tiny volume of urine. It also includes hazy, crimson, pink, bloody, and very odorous urine. Pelvic pain in women occurs in the centre of the pelvis and around the pubic bone. Depending on the severity of the illness, fever, nausea, and vomiting can occur as well [13]. Children under the age of

five are highly susceptible to contracting a urinary tract infection. This ailment is prevalent and should be taken seriously [14]. Lower urinary tract infections, often known as cystitis, are marked by symptoms such as urgency, frequency, and dysuria. If not properly treated, they can proceed to an upper UTI, also known as acute pyelonephritis. It causes fever, nausea, vomiting, and flank irritation [15]. Diabetes increases the possibility of developing a urinary tract infection. The most common cause of UTI in males is prostatic hypertrophy, which increases with increasing age. The risk of UTI is

increased by temporary urinary catheterization, a substantial medical intervention. Other concurrent conditions that enhance the incidence of UTIs in both sexes include diseases related to the neurogenic bladder and the presence of stones or foreign bodies in the urinary system [16]. The review aims to explore the realm of Urinary tract infections and how they affect different populations and to study the herbal plants that can be used to treat UTIs.

## 2 TYPES OF URINARY TRACT INFECTIONS

Table 1: Types of Urinary tract infections

Classification	Definition
Uncomplicated UTI	UTI in which there are no vital functional or anatomical abnormalities, no vital kidney function impairment, and no crucial concurrent conditions increasing the UTI.
Complicated UTI	An infection of the bladder is linked to elements that either lessen the effectiveness of therapy or raise the danger of serious complications. This involves recent instrumentation, anomalies of the urinary system, or vesicoureteral reflux, together with cystitis and a foreign substance (such as a catheter or urinary tract stone). Additionally, it covers UTIs brought on by atypical organisms or multi-drug resistant bacteria, as well as cystitis in males, pregnant women, patients who have had a kidney transplant or other causes of immunocompromised states, and patients with cystitis.
Acute uncomplicated cystitis	Lower urinary tract infection (UTI) is characterized by acute symptoms that solely affect the lower urinary system, such as urgency, dysuria, pollakiuria, and discomfort above the symphysis.
Asymptomatic bacteriuria	Absence of urinary symptoms and positive urine culture (>10 <sup>5</sup> colony-forming units/mL).
Recurrent uncomplicated UTI	If there are two symptomatic episodes within six months or three symptomatic episodes within a year, it is considered a recurrent UTI.

## 3 VIRULENCE FACTORS

### 3.1 Adhesins

The adhesion molecule FimH plays a crucial role in facilitating bacterial colonization. When bacteria attach to the uroepithelium, they become immune to the flushing effects of urine flow and bladder emptying. This attachment is made possible by the binding

of Type 1 fimbriae (FimH) to mannosylated glycoproteins called uroplakins on the bladder surface epithelium. However, this binding can be prevented by Tamm-Horsfall protein found in urine. As a consequence of this attachment, the epithelial cells undergo apoptosis.

### 3.2 Siderophores

In addition to heme absorption, extraintestinal pathogenic *E. coli* can remove iron from the host, which is necessary for bacterial growth.

### 3.3 Toxins

Alpha hemolysin, cytolethal distending toxin, secreted autotransporter toxins and necrotizing factor-I are known toxins of ExPEC that can induce abnormalities in the host cell's shape or function, and the cell cycle arrests cellular lysis.

### 3.4 Protectins

The ability to display a range of resistance mechanisms against the host's antibacterial system is a trait of ExPEC strains. ExPEC contains a group 2 or 3 polysaccharide capsule that prevents phagocytosis and protects against complement-mediated opsonization or lysis a highly glycosylated lipopolysaccharide additional coating [17–20].

## 4 RECURRENCES OF UTI

Recurrent UTI (rUTI) is 2 to 3 episodes of UTI in 1 year. The reintroduction of bacteria from the gastrointestinal tract may cause rUTI. According to literature reports, 2 episodes of infections have a chance to occur within the last 6 months [21]. About 25% of women go through the recurrence of infections by the same or different bacteria. Post-menopausal women are susceptible to this infection compared to pre-menopausal women. Women who suffer from recurrent UTIs are more susceptible to uropathogens

colonizing their vaginal area, which is because uropathogenic *E. coli* has a greater tendency to attach to vaginal epithelial cells, which are highly dense in binding sites, allowing bacteria to colonize more densely [22].

These infections recur due to behavioural disorders from inadequate care or proper treatment [23]. Inherited factors may be significant for women who experience recurring UTIs, particularly those who experience onset before sexual activity or exposure to spermicide [24]. Despite completing a proper course of antibiotics within 48 hours, persistent bacterial infections are most likely due to struvite calculi or not adhering to antibiotic instructions, which can result in abnormal drug metabolism, inadequate bacterial therapy, resistant organisms and malabsorption. Even after medication, the same organism frequently resurfaces on urine cultures in consecutive UTI episodes [25]. Reinfection may take place after a period of two weeks or after a sterile intervening culture, and it can be due to a different or the same bacterial species. Bacteria can enter uroepithelial cells through faecal flora, causing reinfection [24]. Researchers created a mouse replica of rUTI using the C3H mice strain, which displayed greater vesicoureteral reflux than C57BL/6 mice. This paradigm enables mice to be sensitized to future infections.

Following an initial infection treated with antibiotics, "sensitized" mice were more likely than naive mice to develop persistent bacteriuria and chronic cystitis when challenged with a later infection. An excessive inflammatory response to the first infection is thought to produce bladder remodelling, predisposing the patient to recurring infections or more inflammatory effects. This model might help researchers better understand the proclivity for recurring infections and suggest future medicines that might cause problems with or slow this process [26].

According to a survey of postmenopausal women aged 55 to 75 living in a community, the recurrence of UTI was 7 occurrences per 100 person-years. Regardless of gender, the odds of being clinically diagnosed with UTI grow as people age. A study carried out in the United Kingdom between 2004 and 2014 discovered that the prevalence of UTIs in women went up from 9-11 incidences

per 100 person-years in subjects between the ages of 65 and 74, to 11.4-14.3 incidents and 14.7-19.8 incidents per 100 person-years in people aged between 75 and 84 and above 85 years, respectively. Men had an increase as well in the same age categories with 2.8-3.0, 5.9-6.1, and 8.1-10.5 incidents per 100 person-years [27]. To prevent recurrent UTIs in young women, it's essential to educate them about the link between frequency of sexual intercourse and recurrent UTIs. Also, they should avoid using spermicide-containing products [28, 29]. Using estrogen is found to be a very effective technique for preventing recurrent UTIs in post-menopausal women. New approaches, such as probiotics and vaccines, are also being explored to prevent recurrent UTIs. Women who have recently taken antimicrobials are at higher risk of contracting an antibiotic-resistant uropathogenic infection [28].

**Table 2: Concurrent diseases that cause recurrent UTI and prevention [30]**

Concurrent condition	Prevention
Post-menopausal women	Estrogen from vagina
Urinary catheter with intermittent use	Catheter maintenance or aseptic technique
Advanced uterine prolapse	Vaginal pessary or Surgery
Nephrolithiasis	Removal of stone, increased fluid intake
Poor bladder emptying	Bladder emptying by referring to the speciality care unit.
Enterovesical fistula	Suppressive antibiotic until surgery.
Benign prostatic outlet obstruction	Until transurethral resection of the prostate, alpha-blockers or 5-alpha reductase inhibitors are utilized. (TURP)
Diabetes mellitus	Hyperglycaemia, bladder emptying, and glucosuria are managed.

## 5 PATHOGENESIS

The urinary tract in humans is a distinct area composed of mucosa lined with transitional cells. Notably, it is a sterile environment with an impenetrable lining, unlike the gastrointestinal tract [31]. Most bacteria that cause urinary tract infections enter through the urethra and travel up to the bladder [32]. The body's natural defence mechanisms are designed to prevent bacteria from entering or lingering in the urinary tract [33]. Studies have revealed that women who experience recurrent urinary tract infections are more prone to vaginal colonization by uropathogens. Additionally, such women are likely to experience longer and more intense colonization by Gram-negative bacilli compared to those without a history of recurrent UTIs [24]. UTI occurs when harmful bacteria invade and adhere to the urinary tract as shown in **Figure 1**. Typically, urination flushes out bacteria from the bladder. However, nutrients in urine, such as amino acids and glucose, can foster bacterial growth. Under abnormal urination with residual urine or bacterial adhesion, simple urination may not suffice in eradicating the bacteria. As a result, a UTI may develop. The urinary tract can become infected in three ways:

- (1) Retrograde ascent of faecal-perineal bacteria
- (2) Nosocomial or bacterial introduction in a medical setting through instrumentation

- (3) Urinary tract involvement as part of a systemic infection.

The most common way bacteria enter the urinary tract is through retrograde ascent, where the bacteria can invade the urinary tract by travelling back up from the bowel. There are specific factors that increase one's susceptibility to infection. Type-1 fimbriae have an affinity for receptors that contain mannose and can be counteracted by free mannose. *P. fimbriae*, on the other hand, attach to the Gala (1-4) Gal part of the P blood group and cannot be deterred by mannose. Once the bacteria have attached, they can switch between fimbriae to ensure survival. External variables like as temperature, nutrition, and growth circumstances influence the development of type-1 fimbriae. Similarly, depending on nutrition availability, *P fimbriae* expression can be turned on and off.

Once bacteria attach and ascend in the urinary system, their rapid proliferation poses a threat for infection. Some processes use urease to alter urine acidity or to induce iron-scavenging protein expression. The control of virulence variables, such as bacterial toxin production, is being studied, as is the function of environmental factors such as osmolarity, anaerobic conditions and temperature. Transfer of virulence factors between bacteria via "pathogenicity islands" up to 200 kilobases long is likely mediated by bacterial phages and viruses,

similar to the transfer of genes resistant to antibiotics between bacteria. Urinary infection is the third most prevalent nosocomial infection in intensive care units and is commonly associated with urethral

catheterization. Gram-positive bacteriuria caused by urinary tract seeding from a systemic infection may occur in infants, young children, and some immunocompromised people [31, 34].

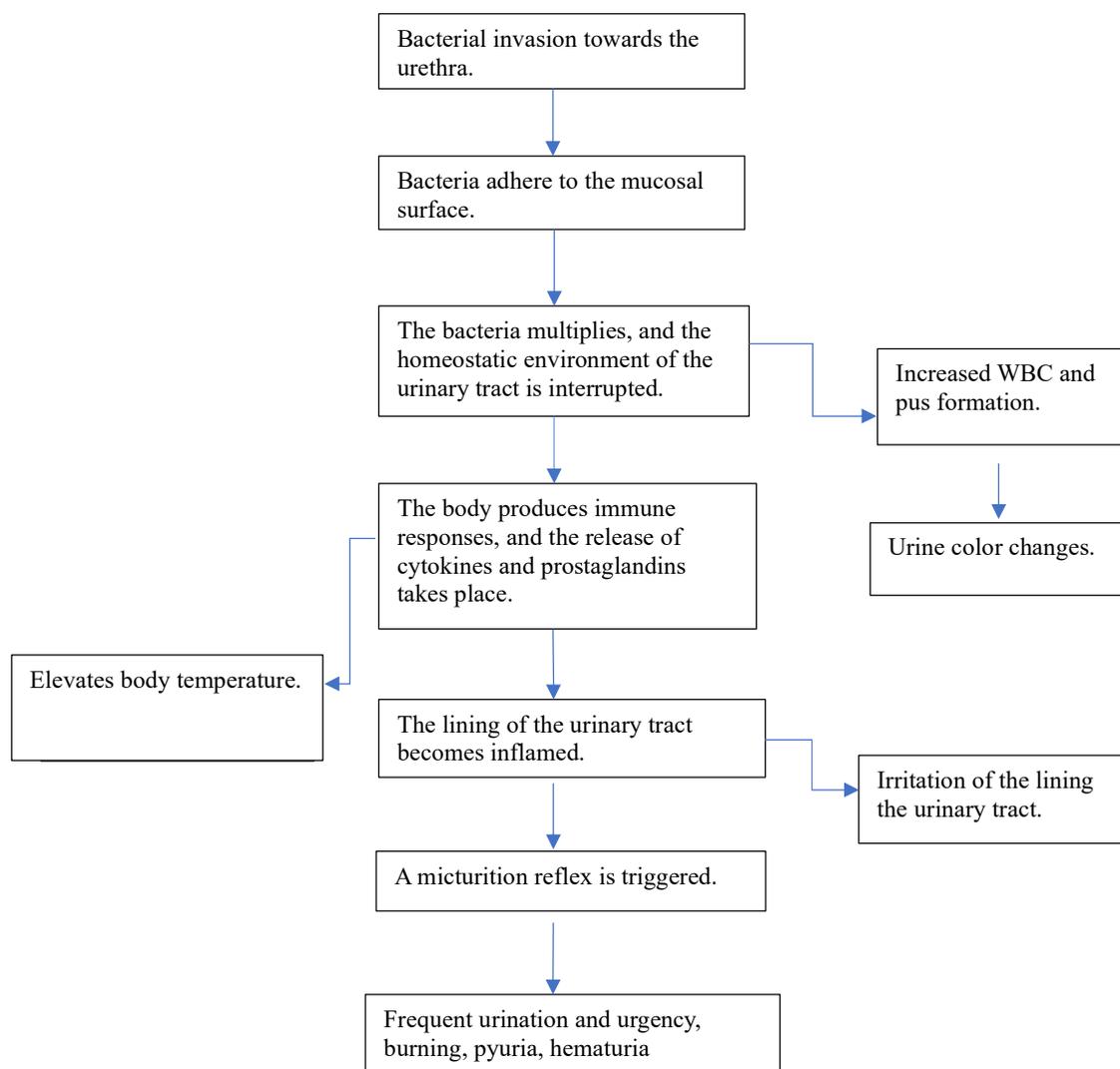


Figure 1: Pathogenesis of UTI

## 6 UTI IN CHILDREN

By the age of 6, up to 7% of girls and 2% of boys will develop a UTI, with a larger risk for newborns. Most UTIs among children

are caused by rising infectious bacteria called *E. coli*. The prevalence of UTIs varies, with around 3% of prepubertal girls and 1% of prepubertal boys being

diagnosed [35]. Due to the concentration of bacterial skin flora beneath the diaper in infancy and the shorter female urethral distance and foreskin surface area in uncircumcised men, females and uncircumcised males are more vulnerable to UTIs. Toilet training during the toddler years might result in voluntary retention and bladder stasis, resulting in UTIs. Furthermore, research has revealed that white newborns (8%) had a greater rate of UTIs than black newborns (4.7%).

Adolescent girls have a higher prevalence of UTIs, which is likely because of the sexual activity which disturbs microorganisms around the urethral entrance. UTI susceptibility can be increased by conditions that restrict urine flow, such as urogenital abnormalities or neurogenic bladder. It is critical to remember that urinating flushes germs out of the urinary system, and reduced urine flow can lead to stasis in the urinary system, giving bacteria a larger reservoir and more time to infect.

Furthermore, impaired immune function might raise the likelihood of unusual viral and fungal UTI causes [36]. Obstructive abnormalities are detected in a small percentage of children being evaluated for their first urinary tract infection, ranging from 0-4%. Furthermore, vesicoureteral reflux is prevalent in a higher proportion, ranging from 8-40% [37].

In children, symptoms such as painful urination, frequent urine, or stomach discomfort may suggest a UTI. A newborn may have a UTI if they exhibit non-specific symptoms such as a high temperature, irritation, jaundice, nausea, or failure to grow. However, other illnesses, such as acute urethritis or vulvovaginitis caused by numerous irritants, might resemble UTI symptoms [38]. Bladder and bowel dysfunction, constipation, vesicoureteral reflux, encopresis, bladder instability, and obesity have all been recognized as risk factors. Renal scarring has been related to febrile urinary tract infections (UTIs), and each successive febrile UTI increases the chance of scarring by 2.8% [29].

## **7 FREQUENCY OF GESTATIONAL URINARY TRACT INFECTIONS**

It is common for pregnant women to have a greater susceptibility to urinary tract infections than men due to several factors, such as anatomy with a short urethra and the possibility of faecal flora contaminating the urinary tract. The risk of UTI peaks in the 22<sup>nd</sup> and 24<sup>th</sup> week and less risk in the 6<sup>th</sup> week. Other factors that can contribute to the risk of UTIs, are lower socioeconomic status, poor hygiene, anaemia sickle cell trait increased age, number of childbirths, frequency of intercourse per week, lack of prenatal care, functional urinary tract abnormalities, and diabetes mellitus. Research indicates that symptomatic urinary

tract infections affect pregnant women at a rate of 1% to 18%. The prevalence of asymptomatic bacteriuria during pregnancy [9]. The prevalence of symptomatic UTIs during pregnancy can range up to 27.6% in diabetic pregnant women [39]. According to studies, up to 4 % of pregnant women are susceptible to acute cystitis for the initial time during their period of pregnancy. A maximum of 2 % of pregnant women might develop acute pyelonephritis in the subsequent part of their pregnancy. If UTIs are left untreated during pregnancy may result in serious repercussions, including an increased risk of foetal death, early delivery, cerebral palsy or mental impairment in progeny. According to one study, maternal UTIs in the 3rd trimester increased the overall risk of mental impairment, foetal mortality and developmental delay. Treatment for UTIs in the third trimester exhibited no impact on foetal death [39, 40]. This infection can also lead to premature labour [41–45]. Pregnant women should take additional precautions against urinary tract infections that result from changes in their bodies, such as hygiene, staying hydrated, and seeking prenatal care [46]. After anaemia, UTI is the most prevalent problem among pregnant women. If neglected, it may adversely affect the unborn child's health [4].

### **7.1 Mechanism of Urinary Tract Infections in Pregnancy**

The body undergoes an increase in plasma volume during pregnancy, which results in a reduction in urine concentration. This may result in glycosuria, a disease that promotes bacterial growth in the urine that affects around 70% of pregnant women. According to some experts, increasing levels of urine progesterins and estrogens may impair the lower urinary tract's capacity to withstand bacterial infection. This might be caused by a reduction in ureteral tone or by the selective proliferation of certain bacterial strains. Due to decreased peristalsis, dilatation of the renal pelvis and ureter, decreased bladder tone and hormonal fluctuations during pregnancy may raise the risk of urinary tract infections. It is often assumed that pregnant women are more susceptible to pyelonephritis.

### **7.2 Nitric Oxide, Pregnancy, and Infection**

During pregnancy, nitric oxide (NO) helps to soothe the uterus and defend against infections. Scientists from the Nowicki and Yallampalli research centres collaborated to determine those pregnant mice with inhibited NO died twice as often as those without inhibition. The mortality rate increased from 30% to over 60%. Nonpregnant animals were unaffected by this therapy. This led to the hypothesis that the NO system may play a significant protective function during pregnancy. Recent research on pregnant rats with NO

and GBS infections found that inhibiting NO increased the incidence of group B streptococcal (GBS) infection, resembling the effects of *E. coli*. Modifying the NO response during gestation could possibly have an impact on the ability of a woman to resist urogenital infections [22].

## 8 THE PREVALENCE OF DIABETIC URINARY TRACT INFECTION

Type 2 diabetes includes a set of disorders characterized by decreased insulin secretion varying levels of insulin secretion and increased glucose production. Urinary tract infections (UTIs) can cause severe complications in people with diabetes mellitus (DM), affecting their genitourinary system due to factors such as age, poor metabolic control, long-term diabetes, microvascular complications, urinary incontinence, and cerebrovascular disease or dementia [33, 47]. Diabetic patients with UTIs require more blood sugar monitoring, experience decreased quality of life, and face additional treatment costs [48]. The immune system may become compromised, and reduced immune function increases the risk of infection, affecting cell-mediated and humoral immunity [49]. Autonomic neuropathy and poor metabolic control in patients with diabetes can result in inadequate bladder emptying and an increased risk of urinary tract infections (UTIs). Elevated glucose levels in the urine

can also foster the growth of potentially harmful bacteria [50]. Patients with diabetes are at an increased risk of UTIs, urination issues and overactive or underactive bladder due to structural and functional impairment of the lower urinary tract [51]. Women with DM are more susceptible to UTIs due to their weakened immune systems compared to non-diabetic women [52-54]. Men with diabetes are more likely to develop abscesses, chronic prostatitis, bacterial prostatitis, and infections after prostate operations such as trans-rectal biopsy [55].

According to a study conducted in Bengaluru, India, patients with lower socioeconomic classes had a greater frequency of diabetic UTIs than patients with higher socioeconomic status. In patients with diabetes, the study found that individuals with lower socioeconomic positions had a 56.4% occurrence of UTI, compared to 43.6% in non-diabetic patients. Higher socioeconomic class diabetes patients had a 51.6% prevalence of UTI, compared to a 48.4% prevalence among non-diabetics [56].

A research was performed to determine the occurrence of UTI and renal scarring in diabetic patients which included 128 healthy controls and 155 (76 F, 79 M) diabetes patients. In diabetes patients, UTIs occurred more frequently than in the control group, and diabetic females experienced UTIs more

frequently than diabetic men. Additionally, compared to individuals without UTI, diabetic patients with UTI had a greater frequency of renal scarring [57]. The risk of UTI is increased by poor glycaemic management and deficiencies in polymorphonuclear leukocyte activity [58, 59]. The length of diabetes is one of the critical threats of diabetic UTI [60]. The use of sodium-glucose cotransporter 2 inhibitors slightly increases the incidence of UTI in individuals with diabetes [61, 62].

### **9 UTI AND OBESITY**

Obesity is a harmful health condition that has a negative impact on our well-being. It has become a major global health issue, with the World Health Organization (WHO) reporting an estimated 650 million obese adults in 2016. Obesity is strongly associated with higher rates of illness and death. The body mass index is a common way to determine if someone is obese. [63]. It's important to be aware of the potential risks associated with obesity, including an increased risk of UTIs in certain conditions. Studies have shown that patients with obesity who are admitted to intensive care, undergo significant surgery, or experience traumatic injury are at a higher risk of UTIs compared to nonobese patients. This risk is

also present in overweight and obese children under 2 years of age who present with fever. Managing body weight and monitoring urinalysis early on in these cases can be helpful. In addition, research has confirmed the negative impact of obesity on the prognosis of UTIs in patients under 18 years old. It's important to be mindful of these risks and take steps to maintain a healthy weight and prevent UTIs [64].

### **10 MEDICINAL PLANTS COMMONLY USED IN THE TREATMENT OF UTI**

The use of medicinal plants in the treatment and prevention of various diseases, including UTIs, has been a common practice for centuries. Some of the most popular medicinal plants used for UTI treatment include cranberry, uva ursi, dandelion, echinacea, and garlic. Herbal remedies are gaining popularity and reliability worldwide due to their easy availability, fewer reported side effects, cost-effectiveness, and tolerance towards patients with UTIs. Additionally, the lack of bacterial resistance is another factor that makes them a preferred choice. Given the growth of antibiotic resistance, researchers are increasingly studying the antibacterial properties of various plants and their constituents to find alternative solutions [65].

Table 3: Plants used in the treatment of UTI

Botanical name	Family	Common/Local name	Active phytochemicals	Parts used	Properties
<i>Chenopodium album</i>	Amaranthaceae	Goosefoot	Saponin, cinnamic acid amide, phenolic amide, lignans, apocortinoid, xyloside, alkaloid chinalbicin and phenols.	Leaves	Antibacterial activity against <i>Staphylococcus</i> spp., <i>Pseudomonas</i> spp., and <i>Enterobacter</i> spp. [66]
<i>Enydra fluctuans</i>	Asteraceae	Buffalo spinach	Flavonoids, tannins and phenolics, sesquiterpene lactones, Phytosterols.	Leaves	Shows antibacterial activity against all the pathogens.[67, 68]
<i>Arctostaphylos uva-ursi</i>	Ericaceae	Bearberry	Arbutin, methyl arbutin, ellagic acid, Ericolin, Taraxenol, Ursolic acid, Uvaol.	Leaves	Strong antibacterial action, particularly against <i>E. coli</i> . [69]
<i>Ocimum sanctum</i>	Lamiaceae	Tulsi	Phenolic compounds, glycosides, flavonoids, tannins, and saponins	Leaves	Possess antibacterial, antifungal, and antioxidant effects.
<i>Punica granatum</i>	Lythraceae	Pomegranate	Punicalagin, ellagic acid, penicillins and gallic acid	Peel	Development of biofilm cellular adhesion of uropathogenic <i>E.coli</i> , bacterial motility, and generation of polyamines is limited.
<i>Nyctanthes arbortristis</i> Linn	Oleaceae	Parijat	D-mannitol, $\beta$ sitosterol, flavonol, astragalin, nyctanthic acid, glycosides, sitosterolnicotiflorin, methyl salicylate, oleanolic acid, tannic acid, ascorbic acid	Leaves	Reduces inflammation on the walls of urinary tract.
<i>Vetiveria zizanioides</i>	Poaceae	Khuskhus	Phlobatannins, saponins, flavonoids, steroids, alkaloids, carbohydrates, proteins, anthraquinone, oil and resin, terpenoids, and glycosides	Root	The crude root extract of <i>V. zizanioides</i> has substantial antimicrobial property.

## CONCLUSION

In conclusion, this comprehensive exploration into the realm of urinary tract infections (UTIs) has unveiled the multifaceted nature of this prevalent health concern, particularly in the contexts of pregnancy, childhood, and populations resistant to conventional treatments. In recent years, *E. coli* has been the most frequent pathogen responsible for

uncomplicated cystitis or acute pyelonephritis. 2-3 episodes of UTI may reoccur in a period of 1 year with multiple symptomatic episodes. The same or different pathogen may cause it. Unfortunately, treating UTIs with allopathic medicines has become more difficult due to rising antibiotic resistance.

A noteworthy aspect of this review has been the investigation into the potential role of

herbal plants in mitigating UTIs. Due to their safety, affordability, and ease of use, medicinal plants have several benefits, but their most significant advantage is that bacteria still need to develop resistance to them. By understanding the nuances of UTIs in diverse populations and embracing the potential of herbal interventions, we move closer to a comprehensive and adaptable framework for addressing this global health challenge.

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### Conflict of Interest

The authors have no potential conflict of interest to disclose.

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