Original Research Article

Frequency of urinary tract infections in type 2 diabetes patients receiving SGLT-2 inhibitors

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Abstract: *Urinary tract infection (UTI) is a clinically relevant concern in patients with type 2 diabetes mellitus (T2DM), particularly among those receiving sodium-glucose cotransporter-2 (SGLT-2) inhibitors. In Pakistan, many patients initially seek treatment from community pharmacies rather than hospitals, which may delay formal diagnosis and management.* **Objective:** *To determine the frequency of urinary tract infections among patients with type 2 diabetes mellitus receiving SGLT-2 inhibitor therapy.* **Methods:** *This descriptive cross-sectional study was conducted at the Department of Medicine, Bahawal Victoria Hospital, Bahawalpur, from 17 June 2025 to 7 October 2025. A total of 136 male and female patients aged 30 to 70 years with T2DM who had been receiving SGLT-2 inhibitors for more than three months were included. Pregnant women, patients with a history of coronary artery disease, current catheterization, recent UTI within the preceding two weeks, or spinal injuries were excluded. Midstream urine samples were collected in sterile containers and sent for microbiological examination. Urine culture was performed on cysteine-lactose-lysozyme-deficient agar, and the plates were incubated at 37°C for 24 hours. A consultant pathologist reviewed culture reports to confirm the presence or absence of UTI. Data were analyzed using descriptive statistics, and continuous variables were presented as mean ± standard deviation, while categorical variables were reported as frequencies and percentages.* **Results**: *The mean age of the participants was 55.48 ± 12.19 years. Of the 136 patients, 77 (56.62%) were male, and 59 (43.38%) were female. The mean body mass index was 27.60 ± 3.02 kg/m², while the mean duration of diabetes mellitus was 11.56 ± 4.31 years. Urinary tract infection was identified in 19 patients, yielding a frequency of 13.97% among T2DM patients receiving SGLT-2 inhibitors.* **Conclusion:** *Urinary tract infection was observed in a notable proportion of patients with type 2 diabetes mellitus receiving SGLT-2 inhibitors. These findings suggest the need for careful clinical monitoring and early recognition of UTI in this patient population to improve treatment outcomes.*
Keywords: diabetes mellitus, SGLT-2 inhibitors, urinary tract infections.

Introduction

According to World Health Organization (WHO) studies, diabetes mellitus is a global problem, and Pakistan ranks seventh among the nations with the greatest number of diabetic patients. (1) If the right actions are not performed in a timely manner, this load will significantly increase. The lack of resources in Pakistan's healthcare system is one of the primary reasons for this rise in load. (2) Seven major medication classes are utilized to help diabetic patients maintain blood sugar levels within an ideal range. Among these pharmacological classes, SGLT-2 inhibitors are regarded as a novel and potent class. These medications are used both alone and in conjunction with other medications. (3) Inhibiting glucose reabsorption in the kidney's proximal convoluted tubule is how sodium glucose cotransporter-2 (SGLT2) inhibitors prevent diabetes. (4) Drug-related and non-drug-related processes may be involved in diabetic individuals' genitourinary infections. In terms of drug-related mechanisms, patients with type 2 diabetes can be treated with around eight different classes of antidiabetic medications. The danger of genitourinary infections is the main worry with SGLT2 inhibitors. (5,6) In one trial, the SGLT2 inhibitor group experienced an overall incidence rate of UTI of 33.49%. (7) The average age of the 121 patients in a different research was 53 years ± 8.761. There were 71 male patients (59%) and 50 female patients (41%). Compared to more than 7 patients (6%), 114 patients (94%) did not have a UTI. (8) According to Ashfaq M et al(9), the incidence of UTIs was 10.1% and 14.7%, respectively, in individuals using dapagliflozin and empagliflozin. In a different study

(10), the SGLT2 inhibitor group had an overall UTI incidence rate of 54.9%.
Since pharmacists in drug stores can provide medicines to treat UTIs, UTIs are one of the illnesses for which many patients in Pakistan avoid going to hospitals. Therefore, if events are observed solely from urine test results, underreported UTI cases may occur. The variety of results we obtained underscores the continued need for this patient group to assist us in determining the relationship between SGLT2 inhibitors and UTIs. Additionally, studies such as these are necessary to clarify the normative factors that contribute to this relationship in individuals with diabetes. Optimizing patient care and treatment approaches requires a thorough understanding of the incidence and clinical implications of UTIs in T2DM patients taking SGLT-2 inhibitors. Therefore, the purpose of this study is to examine the prevalence of UTIs among patients with T2DM treated with SGLT-2 inhibitors. To reduce population morbidity, the work aims to enhance healthcare policies and procedures and enable evidence-based decision-making for early diagnosis and management by displaying the relative frequency of UTIs in these patients.

Methodology

This descriptive cross-sectional study was carried out by the Department of Medicine at Bahawal Victoria Hospital in Bahawalpur from 17 June 2025 to 17 October 2025. Following institutional ethical review committee approval, non-probability sequential sampling was used to choose 136 patients. Informed consent was obtained from every patient. With a 95% confidence level, a 4% margin of error, and a 6.0% (8)

percentage of urinary tract infections among type 2 diabetic patients on SGLT-2 inhibitors, the sample size determined by the WHO calculator for a single proportion is 136. All male and female diabetes patients aged 30 to 70 years who were using SGLT-2 inhibitors for more than three months and whose HbA1c was equal to or more than 6.5% for at least six months were included. Pregnant women, those with a positive history of coronary artery disease, any T2D patients who had UTIs confirmed by culture within a month of starting SGLT-2 inhibitors, patients who were currently on catheters, those who had a history of UTI within two weeks before the study began, and patients with spinal injuries were not included.

Age, gender, height, weight, BMI, length of diabetes mellitus, residence, SGLT2 inhibitor type, occupation (domestic, office, or field), and level of education (educated vs. uneducated) were all recorded. The patients were then instructed to collect urine in the middle of the process into a sterile urine bottle for microbiological examination. Urine was cultured on cysteine-lactose-egg-yolk electrolyte-deficient agar. The plates were incubated for 24 hours at 37 °C. The consultant pathologist interpreted the report, and the researcher himself noted whether there was a UTI (history of dysuria and frequency of urine (>6 times/day) from >2 days duration), the presence of bacteria ≥105/ml of urine on microscopy, positive leucoesterase or nitrites, or positive urine culture). A freshly created proforma was used to record all of the data.

SPSS version 25.0 was used to conduct the statistical analysis. The mean and standard deviation (SD) or the median (IQR) for age, height, weight, BMI, and duration of DM were reported. The following factors were presented as frequencies and percentages: gender, residence (rural/urban), type of SGLT2 inhibitor taken (dapagliflozin/empagliflozin), occupation (office/field/domestic), education (uneducated/educated), and urinary tract infection (present/absent). Age, gender, BMI, length of DM, urban/rural residence, SGLT2 inhibitor type (empagliflozin/dapagliflozin), occupation (home, office, or field), and education (uneducated/educated) were all stratified. To assess their impact on UTI frequency, the post-stratification chi-square/Fisher's exact test was used, and a p-value <0.05 was considered statistically significant.

Results

Mean age was 55.48 ± 12.19 years. According to Figure 1, the majority of the 82 (60.29%) patients were between the ages of 51 and 70 years. Out of 136 patients, 77 (56.62%) were men and 59 (43.38%) were women. A mean BMI of 27.60 ± 3.02 kg/m2 was recorded. The mean duration of diabetes mellitus was 11.56 ± 4.31 years. Table 1 displays the distribution of patients by confounding variables.

In my study, the urinary tract infections were observed in 19 (13.97%) patients with type 2 diabetes receiving SGLT-2 inhibitors (Figure 2). Stratification of hypoalbuminemia with respect to confounding variables showed no statistically significant effect (p-value >0.05) of any variable. (Table 2)
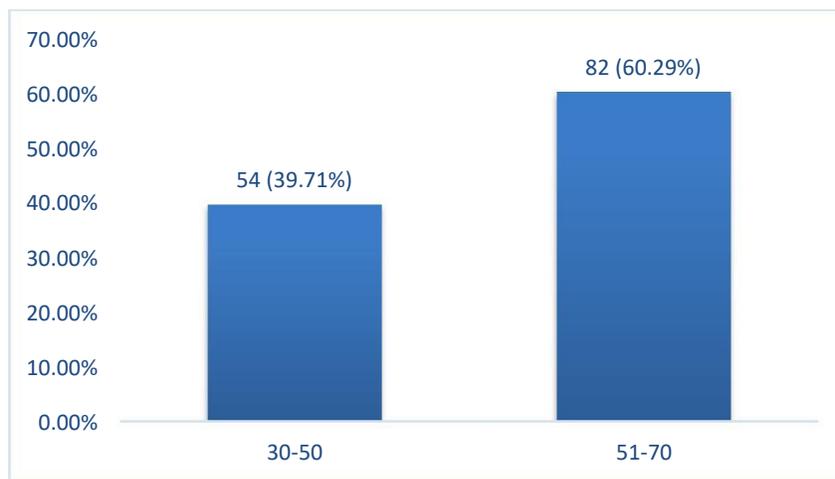

Figure 1: Age distribution (n=136).

Table 1: Distribution of different variables (n=136)

Confounding variables		Frequency	%age
Gender	Male	77	56.62
	Female	59	43.38
BMI (kg/m²)	≤25	35	25.74
	>25	101	74.26
Duration of DM (years)	≤10	63	46.32
	>10	73	53.68
Type of SGLT2 inhibitors taking	Dapagliflozin	83	61.03
	Empagliflozin	53	38.97
Education	Uneducated	51	37.50
	Educated	85	62.50
Occupation	Office	31	22.79
	Field	50	36.76
	Others	55	40.44
Place of living	Rural	51	37.50
	Urban	85	62.50

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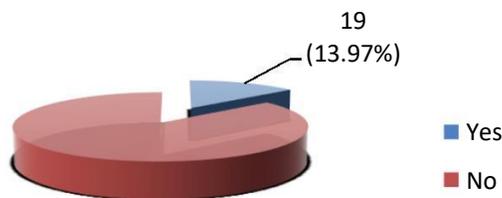*Nazeer et al., (2025)*

19
(13.97%)

Yes

No

Figure 2: Frequency of urinary tract infections in type 2 diabetes patients receiving SGLT-2 inhibitors (n=136).

Table 2: Stratification of UTI with respect to confounding variables

		Yes (n=19)	No (n=117)	Chi square	P-value
Age (years)	30-50	05 (9.26%)	49 (90.74%)	1.65	0.198
	51-70	14 (17.07%)	68 (82.93%)		
Gender	Male	07 (9.09%)	70 (90.91%)	3.52	0.061
	Female	12 (20.34%)	47 (79.66%)		
BMI (kg/m^2)	≤25	04 (11.43%)	31 (88.57%)	0.253	0.615
	>25	15 (14.85%)	86 (85.15%)		
Duration of DM (years)	≤10	05 (7.94%)	58 (92.06%)	3.56	0.059
	>10	14 (19.18%)	59 (80.82%)		
Type of SGLT2 inhibitors taking	Dapagliflozin	11 (13.25%)	72 (86.75%)	0.091	0.763
	Empagliflozin	08 (15.09%)	45 (84.91%)		
Education	Uneducated	09 (17.65%)	42 (82.35%)	0.918	0.338
	Educated	10 (11.76%)	75 (88.24%)		
Occupation	Office	02 (6.45%)	29 (93.55%)	2.27	0.321
	Field	07 (14.0%)	43 (86.0%)		
	Others	10 (18.18%)	45 (81.82%)		
Place of living	Rural	05 (9.80%)	46 (90.20%)	1.18	0.278
	Urban	14 (16.47%)	71 (83.53%)		

Discussion

According to the current study, urinary tract infections affect roughly 14% of diabetic patients taking SGLT-2 inhibitors, and susceptibility to infection varies significantly by demographics. Participants in the study were on average 55.48 ± 12.19 years old. The majority of the 82 patients (60.29%) were aged 51-70 years. The majority of patients with diabetes were older, with a mean age of 54.4 ± 7.7 years, according to research by Shrikrishna and colleagues.(11) According to Khan et al(5), the patients' average age was 55.2 ± 6.2 years. Hussain and associates. The patients' average age was 38 ± 12 years. (12) Of those with diabetes, 77 (56.62%) were men and 59 (43.38%) were women, according to this study. According to a study by Khan et al., 43.5% of participants were women and 56.5% were men. (5) A study by Shrikrishna et al. revealed that 48.3% of participants were women and 51.7% of participants were men. (11) According to the survey, most people had diabetes for one to five years. According to a recent study by Azhar et al., the average lifespan of those with diabetes was 6.1±2.6 years. (6) In the current study, 103 people (79.2%) took dapagliflozin, while 27 people (20.7%) used empagliflozin. According to a study by Shrikrishna et al., 60% of people took empagliflozin, with the remaining 40% receiving either canagliflozin or dapagliflozin. (11) According to Azhar et al., 52% of participants received empagliflozin, whereas 48.0% received dapagliflozin. (6)

The UTI prevalence of 13.97% in the current study among diabetic patients taking SGLT-2 inhibitors is consistent with several regional studies, especially Dayo et al. (13), who reported a UTI frequency of 10.7% in a Pakistani cohort. It also falls within the ranges noted by Shaikh et al. (14) at 14.9% and by Aziz et al. (15) at 8.8%. A rather consistent pattern of UTI incidence in South Asian diabetic populations after SGLT-2 therapy is shown by the convergence of results from several Pakistani centers. Our findings, however, stand in stark contrast to lower rates reported by Wazir et al. (16) (6%), Hussain et al. (12) (4.3-6.5%), and Azhar et al. (6) (4.3-6.74%). These differences may not be due to actual epidemiological differences, but rather to differences in diagnostic criteria, patient selection, or study technique.

The findings of several studies, such as Hussain et al(12), Azhar et al(6), Shaikh et al(14), and Radi et al. (18), are strongly supported by the significantly higher UTI frequency in females (20.34%) compared to males (9.09%) in our study. This confirms the pattern of female predisposition to SGLT-2 inhibitor-associated urogenital infections across a variety of populations. The thorough analysis by Radi et al(17) supports our finding that longer SGLT-2 treatment duration increases the risk of UTIs (>12 months: 16.3% vs. ≤12 months: 4.5%). They showed that longer exposure periods are associated with higher infection rates, indicating a cumulative effect of sustained glucosuria on urogenital bacterial colonization.

Although not statistically significant in our cohort, the trend toward higher UTI rates in patients with longer diabetes duration is consistent with findings from Dayo et al(13) who reported a 23% UTI frequency in patients with diabetes duration >10 years and Ubaid et al(19) who pointed to prolonged disease duration as a risk factor, which is likely due to progressive diabetic complications that affect bladder physiology and immune function. The numerically higher UTI rates we observed with empagliflozin compared to dapagliflozin are interesting because they are consistent with findings from several studies, such as Hussain et al(12) (6.5% vs. 4.3%), Azhar et al (6) (6.74% vs. 4.3%), and Dayo et al(13) (14.8% vs. 9.7%). This suggests that there may be drug-specific variations in glucosuric effects or pharmacokinetic characteristics that call for additional mechanistic research.

Our study's moderate UTI frequency is also consistent with Aziz et al.'s (6) conclusion that the frequency of UTIs in their sample was moderate, and Wazir et al.'s (8) 6% incidence is consistent with earlier findings and encourages ongoing clinical attention. The results of Dayo et al. (13) and Aziz et al. (15) showed significantly higher infection rates in older patients (>50 years), which contrasts with our study's lack of a significant association between UTI occurrence and age groups. This could be due to differences in cohort characteristics or sample size limitations that may have obscured age-related effects in our population.

According to a study by Shrikrishna and colleagues (11), there is no significant correlation between UTI and the patient's age, gender, illness duration, or SGLT2i type. In a study, Khan and colleagues (5) discovered a strong correlation between UTI and age, sex, and symptoms, but not with antibiotic dosage. An additional study of a similar nature conducted by Azhar and colleagues in 2023 demonstrated a strong correlation between UTI and gender, but not with antibiotic dosage. (6)

Although SGLT2 inhibitors are increasingly frequently given to people with type 2 diabetes, some research has shown that SGLT2 inhibitor users are more likely to get a UTI, which presents a problem for both patients and physicians. (19) Hospitalization for UTIs has been found to be a significant contributor to adverse cardiovascular events among infectious infections, indicating a higher risk of MACE during the acute phase ($\leq$30 days post-UTI) and the follow-up period that follows. (20) For SGLT2 inhibitor users, early detection and careful monitoring of UTIs in T2DM patients, particularly those at high risk, continue to be priorities. Our study found that stopping SGLT2 inhibitors was linked to higher risks of adverse cardiovascular and renal events, as well as mortality, even though UTI has been demonstrated to be the primary reason for doing so. (21,22) However, stopping SGLT2 inhibitors did not lower the risk of recurrent UTI. According to these results, continuing SGLT2 inhibitors may improve the cardiovascular and renal prognosis even if a UTI develops.

It is important to recognize several limitations when interpreting these results. The results may not be generalizable to larger populations or other healthcare settings with diverse patient demographics, clinical practices, and diagnostic processes, given the single-center design at a single tertiary care hospital. The study's cross-sectional design makes it impossible to determine a clear causal association between the usage of SGLT-2 inhibitors and the onset of UTIs over time. Despite being sufficient for preliminary analysis, the very small sample size of 136 patients may not have been sufficient to identify significant relationships for several variables, especially given the small number of UTI occurrences (n=19). This could have resulted in type II errors in statistical testing.

Conclusion

According to our study results, urinary tract infections are a prominent complication among patients with diabetes undergoing SGLT-2 inhibitor therapy. Female gender and the length of treatment are found to be important risk factors for the development of infections. The results show that SGLT-2 inhibitors are linked to a higher risk of urogenital infections, especially in women. This is probably due to the interaction between gender-specific anatomical predispositions and the glucosuria-induced encouragement of bacterial growth.

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