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Association of Body Mass Index (BMI) and Urinary Glucose Levels with Urinary Tract Infections

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Abstract: This study aimed to investigate the association of body mass index (BMI) and urinary glucose levels with urinary tract infection (UTI) among patients at West Nusa Tenggara Provincial Hospital. A cross-sectional study was conducted at the hospital in October 2025. A total of 104 participants were selected using simple random sampling. BMI data were obtained from medical records based on body weight and height measurements recorded using a weighing scale and stadiometer. Urinary glucose data were retrieved from laboratory records and measured using a Dialab AutoLyser. Data were analyzed using univariate analysis, Spearman's rank correlation for bivariate analysis, and ordinal logistic regression for multivariable analysis. The results showed a significant positive correlation between BMI and UTI category (correlation coefficient = 0.286; $p = 0.003$). Urinary glucose levels were also significantly and positively correlated with UTI category (correlation coefficient = 0.333; $p = 0.001$). The multivariable analysis yielded a Nagelkerke R^2 value of 0.186. BMI was significantly associated with UTI category ($p = 0.032$; OR = 1.58), as were urinary glucose levels ($p = 0.003$; OR = 2.80). In conclusion, BMI and urinary glucose levels were significantly associated with urinary tract infection categories among patients at West Nusa Tenggara Provincial Hospital.
Keywords: Body mass index; urinary glucose levels; urinary tract infection

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INTRODUCTION

Urinary tract infection (UTI) is one of the most prevalent infectious diseases worldwide and represents a significant public health concern. Globally, approximately 150 million UTI cases are estimated to occur each year. UTIs may affect different parts of the urinary tract, including the urethra (urethritis), urinary bladder (cystitis), and kidneys (pyelonephritis). Most cases are caused by *Escherichia coli*, which has been reported to account for more than 80% of UTIs. However, other microorganisms, including *Klebsiella* spp., *Proteus* spp., and *Staphylococcus saprophyticus*, may also cause infection (Mochtar & Noegroho, 2015; Widiyastuti & Soleha, 2023; Annisah, Setyawati & Amri, 2024).

UTIs are among the most common infections encountered in both primary healthcare settings and hospitals. The risk is particularly high among women, older adults, catheter users, and individuals with metabolic disorders, especially diabetes mellitus. Previous studies have shown that more than 50% of adult women experience at least one episode of UTI during their lifetime. The prevalence is even higher among older adults because of age-related anatomical changes and declining immune function (Admir, Jankovic & Marina, 2021; Widiyastuti & Soleha, 2023; Florin et al., 2025).

In Indonesia, UTIs are among the most frequently reported infectious diseases and rank second only to upper respiratory tract infections. Their high incidence presents a substantial healthcare challenge because it is associated with increased healthcare visits, antibiotic use, and medical costs. UTI incidence also tends to increase among adults and older individuals, particularly those with comorbid conditions such as diabetes mellitus (Annisah et al., 2024; Kumala et al., 2024).

In West Nusa Tenggara Province, UTIs remain a common health problem among hospitalized patients. Medical record data from West Nusa Tenggara Provincial Hospital showed that 1,630 patients were diagnosed with UTIs between January and December 2024, with most cases classified as nonspecific UTIs. These data indicate that UTIs remain an important health concern requiring particular attention in the region (Puspitasari et al., 2024).

The occurrence of UTIs is influenced by various demographic, anatomical, and metabolic risk factors. One factor that has received considerable attention is body mass index (BMI). Obesity may increase the risk of UTIs through several mechanisms, including enhanced bacterial colonization in the genital area due to a moist local environment, impaired bladder emptying, and a greater likelihood of recurrent infection. Several studies have also shown that individuals with obesity have a higher prevalence of bacteriuria than those with normal nutritional status (Hidayati et al., 2022; Ginting & Ardiana, 2025; Jayadi et al., 2025). Over the long term, recurrent UTIs in individuals with an above-normal BMI may further impair renal function and increase the risk of chronic kidney disease (CKD) (Amirudin & Sumariana, 2024).

Another metabolic factor that may contribute to UTI occurrence is glucosuria. Glucosuria refers to the presence of glucose in the urine and commonly results from hyperglycemia or impaired glucose metabolism, particularly in patients with diabetes mellitus. Urinary glucose may provide a favorable environment for bacterial growth, thereby increasing susceptibility to UTIs. Glucosuria has also been associated with recurrent UTIs, delayed resolution of infection, and renal complications in patients with diabetes mellitus (Widiatmoko et al., 2019). Tuntun & Aminah (2021) reported that patients with glucosuria had a higher risk of developing UTIs. In contrast, Saraswati et al. (2021) found no significant association between glucosuria and UTI occurrence. These inconsistent findings indicate that the relationship between glucosuria and UTIs requires further investigation.

Recurrent UTIs not only cause physical symptoms, such as pain and urinary disturbances, but may also reduce quality of life and productivity while increasing the risk of serious complications, including sepsis and chronic kidney impairment. Although numerous studies have investigated UTI risk factors, most have focused on individual factors, such as catheterization or comorbid diseases. Studies examining the simultaneous associations of BMI and glucosuria with UTI occurrence remain limited, particularly in eastern Indonesia (Yuliet et al., 2022; Widhawati et al., 2024).

The high number of UTI cases at West Nusa Tenggara Provincial Hospital, together with the limited evidence regarding the combined roles of BMI and glucosuria, provided the rationale for this study. The findings are expected to provide scientific evidence regarding the associations of BMI and glucosuria with UTI occurrence and to support the early detection, prevention, and control of UTI-related risk factors. This study also offers novelty as one of the first investigations in West Nusa Tenggara Province to simultaneously assess the associations of body mass index and glucosuria with UTIs among patients treated at West Nusa Tenggara Provincial Hospital.

METHOD

Study Design and Setting

This study employed a cross-sectional analytical design based on a retrospective review of medical records. This design was used to examine the associations of body mass index (BMI) and urinary glucose levels with UTI classification at a single observation period. Because all participants had already been diagnosed with a UTI, the outcome was classified as urethritis, cystitis, or pyelonephritis rather than as the presence or absence of UTI.

The study was conducted at West Nusa Tenggara Provincial Hospital. Medical-record data were collected in October 2025 from patients treated between January and December 2024. The variables obtained from the medical records included BMI, urinary glucose levels, demographic characteristics, and laboratory and clinical findings used to establish the diagnosis and classification of UTI.

Study Population and Sample

The study population comprised 1,630 inpatients and outpatients diagnosed with UTIs at West Nusa Tenggara Provincial Hospital between January and December 2024 (Duarsa et al., 2021; Ramdayanti and Furqaani, 2023). The required sample size was calculated using Slovin's formula, resulting in a minimum sample of 104 patients (Greaney et al., 2014; Masturoh & Anggita, 2018).

Participants were selected using simple random sampling. Each medical record that met the eligibility criteria was included in the sampling frame and had an equal probability of being selected. The final sample consisted of 104 patients who met the predefined inclusion and exclusion criteria.

Eligibility Criteria

The inclusion criteria were as follows: (1) inpatients or outpatients diagnosed with a UTI at West Nusa Tenggara Provincial Hospital between January and December 2024; (2) a diagnosis supported by urinalysis and urine culture findings; (3) a UTI diagnosis classified as urethritis, cystitis, or pyelonephritis; and (4) complete medical-record information on age, sex, body weight, height, urinary glucose levels, and the variables required for analysis.

Patients were excluded when the UTI diagnosis was not specifically classified as urethritis, cystitis, or pyelonephritis, or when the medical record was missing or contained incomplete information for one or more study variables.

Data Collection and Variable Measurement

Data were obtained from patients' medical records at West Nusa Tenggara Provincial Hospital. The collected variables included age, sex, body weight, height, BMI, urinary glucose levels, and UTI classification. BMI was determined using the following formula:

$$\text{BMI} = \frac{\text{Body Weight (kg)}}{\text{Height (m)}}$$

Based on the categories used in the study, BMI was classified as underweight (<18.5 kg/m²), normal (18.5–25.0 kg/m²), overweight (>25.0–27.0 kg/m²), or obese (≥27.0 kg/m²). Urinary glucose levels were obtained from laboratory records and categorized as negative, +1, or +2. The UTI outcome was categorized as urethritis, cystitis, or pyelonephritis according to the diagnosis recorded in the patients' medical records and supported by the available laboratory findings.

Statistical Analysis

Data were analyzed using univariate, bivariate, and multivariable analyses. Univariate analysis was used to summarize participant characteristics and the distribution of BMI categories, urinary glucose levels, and UTI classifications. Categorical variables were presented as frequencies and percentages.

Spearman's rank correlation test was used in the bivariate analysis to assess the associations between BMI category and UTI classification and between urinary glucose category and UTI classification. The strength and direction of each association were expressed using Spearman's correlation coefficient (r_s).

Ordinal logistic regression was subsequently performed to evaluate the independent associations of BMI and urinary glucose levels with increasingly severe UTI classifications. The regression coefficients were exponentiated and reported as odds ratios (ORs). Model fit was evaluated using a goodness-of-fit test and Nagelkerke's pseudo-(R^2).

All statistical tests were two-sided, and statistical significance was defined as a *p*-value <0.05. Estimates were reported with 95% confidence intervals where applicable.

RESULTS AND DISCUSSION

The age distribution of the study sample was as follows: 5 participants (4.8%) were aged 1–5 years, 6 (5.8%) were aged 6–12 years, 3 (2.9%) were aged 13–17 years, 68 (65.4%) were aged 18–59 years, and 22 (21.2%) were older than 60 years.

Distribution of Urinary Tract Infections

To provide an overview of the clinical distribution of urinary tract infections among the study participants, the frequencies of urethritis, cystitis, and pyelonephritis were analyzed. The distribution of participants according to UTI category is presented in Figure 1.

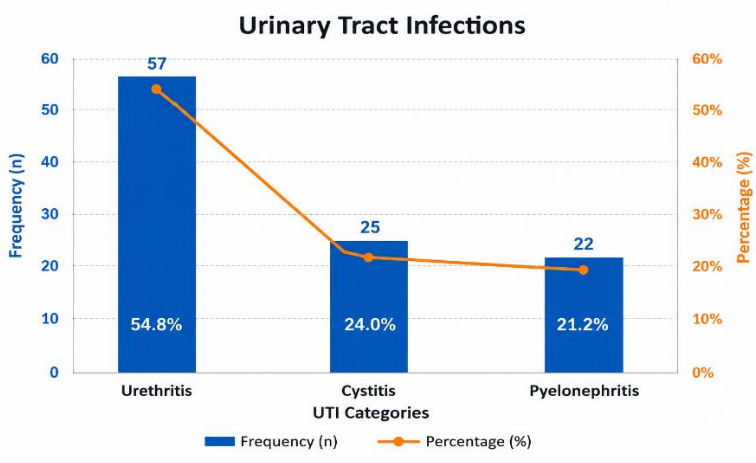

Figure 1. Distribution of urinary tract infections

Figure 1 shows that the 104 study participants were distributed across three urinary tract infection (UTI) categories. Urethritis was the most frequently diagnosed condition, affecting 57 participants (54.8%), followed by cystitis in 25 participants (24.0%) and pyelonephritis in 22 participants (21.2%).

According to epidemiological data from the Indonesian Ministry of Health, cystitis is generally the most common form of UTI, accounting for approximately 27–44% of cases (KEMENKES, 2025). In contrast, urethritis was the most prevalent UTI category in the present study. Several factors may explain this discrepancy. An initial diagnosis of suspected urethritis may have been recorded but not subsequently updated in the medical record after further clinical or laboratory findings became available. The relatively small sample size may also have influenced the observed distribution. In addition, other clinical and administrative factors not examined in this study may have contributed to the predominance of urethritis.

Distribution of Body Mass Index

In addition to the distribution of UTI categories, the nutritional status of the participants was assessed using body mass index (BMI). The distribution of participants across the underweight, normal-weight, overweight, and obese categories is presented in Figure 2.

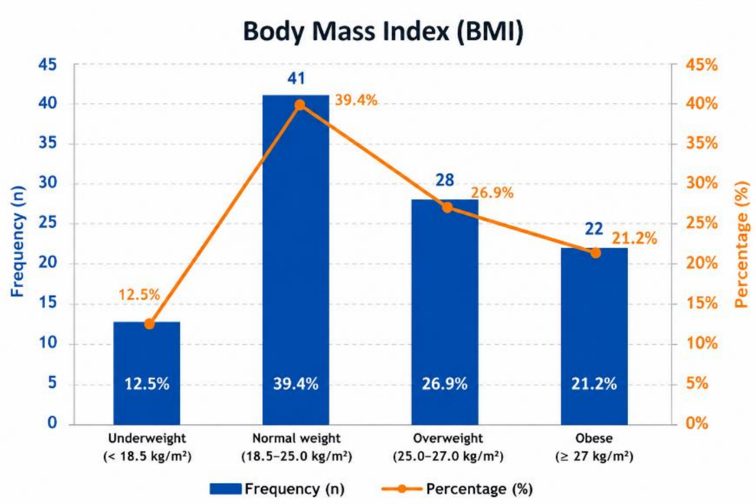

Figure 2. Distribution of body mass index

Figure 2 shows that 13 participants (12.5%) were underweight, 41 (39.4%) had a normal BMI, 28 (26.9%) were overweight, and 22 (21.2%) were obese. Participants with a normal BMI constituted the largest group, followed by those who were overweight.

This distribution demonstrates that UTI occurred across all BMI categories and was not limited to participants with excess body weight. Nevertheless, the proportions of cystitis and pyelonephritis appeared to increase among participants with obesity, suggesting a possible relationship between increasing BMI and more severe UTI categories. This relationship was further examined through bivariate and multivariable analyses.

Distribution of Urinary Glucose Levels

Urinary glucose levels were also examined to characterize the metabolic profile of the study participants. The distribution of urinary glucose results, classified as negative, 1+, and 2+, is presented in Figure 3.

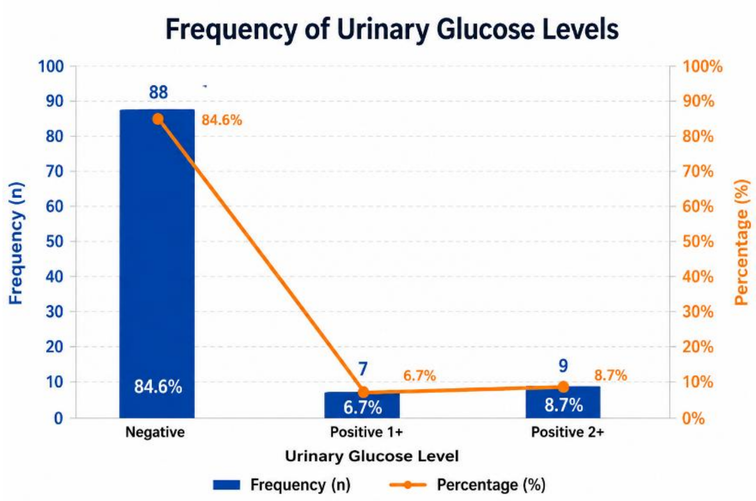

Figure 3. Distribution of urinary glucose levels

Figure 3 shows that 88 participants (84.6%) had negative urinary glucose results, 7 (6.7%) had urinary glucose levels of 1+, and 9 (8.7%) had levels of 2+. Thus, most participants did not have glucosuria, whereas detectable urinary glucose was found in 16 participants.

Although glucosuria was present in only a small proportion of the study population, higher urinary glucose levels were more frequently observed among participants with pyelonephritis. This pattern suggests that glucosuria may be more strongly associated with UTI severity than with the overall frequency of infection.

Association Between Body Mass Index and Urinary Tract Infection

To examine the relationship between BMI and UTI category, the distribution of urethritis, cystitis, and pyelonephritis across BMI categories was analyzed using Spearman’s rank correlation. The results of the bivariate analysis are presented in Table 1.

Table 1. Bivariate analysis of BMI and UTI category

BMI category	Urethritis, n (%)	Cystitis, n (%)	Pyelonephritis, n (%)	Total, n (%)	r_s	*p*-value
Underweight	7 (6.7)	4 (3.8)	2 (1.9)	13 (12.5)		
Normal	29 (27.9)	8 (7.7)	4 (3.8)	41 (39.4)	0.286	0.003
Overweight	16 (15.4)	4 (3.8)	8 (7.7)	28 (26.4)		
Obese	5 (4.8)	9 (8.7)	8 (7.7)	22 (21.2)		
Total	**57 (54.8)**	**25 (24.0)**	**22 (21.2)**	**104 (100.0)**		

As shown in Table 1, 13 participants (12.5%) were underweight. Of these, 7 (6.7%) had urethritis, 4 (3.8%) had cystitis, and 2 (1.9%) had pyelonephritis. Among the 41 participants (39.4%) with a normal BMI, 29 (27.9%) had urethritis, 8 (7.7%) had cystitis, and 4 (3.8%) had pyelonephritis.

Among the 28 overweight participants (26.4%), 16 (15.4%) had urethritis, 4 (3.8%) had cystitis, and 8 (7.7%) had pyelonephritis. Of the 22 participants with obesity (21.2%), 5 (4.8%) had urethritis, 9 (8.7%) had cystitis, and 8 (7.7%) had pyelonephritis.

Spearman’s rank correlation analysis yielded a correlation coefficient of 0.286 and a *p*-value of 0.003. These findings indicate a statistically significant but weak positive association between BMI and UTI category among patients at West Nusa Tenggara Provincial Hospital.

Urethritis was the most frequent UTI category among participants who were underweight, had a normal BMI, or were overweight. However, among participants with obesity, cystitis and pyelonephritis were more common than urethritis. This pattern suggests that higher BMI categories may be associated with a shift toward more severe UTI categories. An additional analysis indicated that the association between BMI and UTI appeared stronger among female participants than among male participants.

Body mass index is a widely used measure for assessing nutritional status and classifying body weight relative to height. It is calculated by dividing body weight in kilograms by height in meters squared (kg/m²). BMI is commonly used to classify individuals as underweight, normal weight, overweight, or obese (Untan, 2017).

The positive correlation observed in the present study indicates that increasing BMI was associated with higher UTI categories. Although the strength of the correlation was weak, BMI remained significantly associated with the distribution of urethritis, cystitis, and pyelonephritis among the study participants.

In contrast, Sahputri et al. (2019) reported no statistically significant association between BMI and UTI among women with type 2 diabetes mellitus, as demonstrated by a chi-square *p*-value of 0.746. The absence of a significant association may have been related to the predominance of overweight participants and the relatively similar BMI distributions between the UTI and non-UTI groups. The small sample size of 45 participants may also have reduced the statistical power to detect an association. Furthermore, UTI among patients with diabetes is influenced by several interacting factors, including glycemic control, glucosuria, disease duration, bladder neuropathy, and impaired immunity, which may obscure the independent effect of BMI (Sahputri et al., 2019).

However, Seolistijo et al. (2021) supported the findings of the present study by reporting that individuals with a BMI of ≥27 kg/m² had a 1.66-fold higher risk of UTI than individuals with normal body weight. The risk increased to nearly twofold among older women. These findings suggest that elevated BMI may not only be associated with UTI occurrence but may also contribute to greater infection severity through obesity-related immune dysfunction, including chronic inflammation and reduced innate immune responses (Jeong, Lee & Joo, 2021).

Kim et al. (2021) similarly found that obesity, particularly among individuals classified as metabolically unhealthy obese, increased the risk of several urological disorders, including cystitis. The hazard ratios were higher than those observed among metabolically healthy, non-obese individuals. Adverse metabolic conditions associated with obesity may increase susceptibility to infection and potentially contribute to the progression of UTI from urethritis to cystitis or pyelonephritis (Kim et al., 2021).

Taramian et al. (2024) also reported an increase in UTI prevalence across BMI categories, from 7.1% among individuals with normal body weight to 10.9% among those with obesity. Although the association was no longer statistically significant after adjustment for other variables, the unadjusted analysis indicated an increasing pattern of UTI risk with higher BMI. This finding supports the view that obesity may predispose individuals to more severe UTI, particularly in the presence of additional factors such as diabetes, advanced age, or low levels of physical activity (Taramian et al., 2024).

An association between nutritional status and UTI has also been observed in children. A nationwide Korean cohort study by Yim et al. (2021), which included more than 1.6 million children, found that obesity was associated with an increased risk of UTI, cystitis, and pyelonephritis. Among girls with obesity, the hazard ratio for pyelonephritis was 1.41 (95% CI: 1.13–1.75) compared with girls with normal body weight. The relationship followed a U-shaped pattern, indicating that UTI risk increased at the extremes of body weight (Yim et al., 2021).

Several biological mechanisms may explain the positive association between BMI and UTI. Obesity is characterized by chronic low-grade systemic inflammation driven by pro-inflammatory cytokines, including tumor necrosis factor-α and interleukin-6, which are secreted by adipose tissue. Chronic inflammation may impair innate immune responses to bacterial infection. In addition, visceral adiposity may increase intra-abdominal pressure, leading to urinary retention and stasis and thereby creating conditions that favor the growth of uropathogenic bacteria, particularly *Escherichia coli*. Perineal skin folds associated with obesity may also increase bacterial colonization in the genital and perineal regions (Alhabeeb et al., 2021; Varra et al., 2024).

Although findings across studies remain inconsistent, evidence from large-scale investigations supports the hypothesis that obesity is an independent risk factor for UTI, particularly among individuals with very high BMI. Weight management may therefore be relevant not only to the prevention of metabolic disorders but also to reducing susceptibility to urinary tract infections (Alhabeeb et al., 2021).

Reginawati et al. (2023) identified female sex as the factor most strongly associated with UTI. In that study, 56.2% of patients at risk of UTI were women, representing a higher proportion than that observed among men. Anatomically, the female urethra is approximately 3.8 cm long, whereas the male urethra is approximately 20 cm long. The shorter female urethra facilitates the ascent of bacteria, particularly *Escherichia coli*, into the urinary tract. Moreover, the female urethral opening is located closer to the anus and vagina, increasing the likelihood of bacterial contamination. These anatomical characteristics provide a biological explanation for the higher prevalence of UTI among women. Reginawati et al. (2023) reported a statistically significant association between female sex and UTI, with $p = 0.002$.

In addition to biological factors, Reginawati et al. (2023) identified several potentially harmful behaviors that were more common among adult and older women, including delaying urination, inadequate genital hygiene, and consuming fewer than eight glasses of water per day. Delayed urination may cause urine to remain in the bladder for prolonged periods, thereby facilitating bacterial multiplication and infection. This observation is consistent with evidence that urinary retention increases the risk of bacterial colonization and recurrent infection.

Genital hygiene is also important. Women who do not clean the genital area properly after urination may be more susceptible to UTI. Cleaning from back to front or failing to dry the genital area may facilitate bacterial migration toward the urethra and bladder. These findings indicate that hygiene-related behaviors may substantially influence UTI risk among women (Reginawati et al., 2023).

Association Between Urinary Glucose Levels and Urinary Tract Infection

The relationship between urinary glucose levels and UTI category was subsequently examined to determine whether increasing glucosuria was associated with differences in the distribution of urethritis, cystitis, and pyelonephritis. The results of the bivariate analysis are presented in Table 2.

Table 2. Bivariate analysis of urinary glucose levels and UTI category

Urinary Glucose Level	Urethritis, n (%)	Cystitis, n (%)	Pyelonephritis, n (%)	Total, n (%)	r_s	*p*-value
Negative	53 (51.0)	22 (21.2)	13 (12.5)	88 (84.6)		
1+	3 (2.9)	1 (1.0)	3 (2.9)	7 (6.7)	0.333	0.001
2+	1 (1.0)	2 (1.9)	6 (5.8)	9 (8.7)		
Total	**57 (54.8)**	**25 (24.0)**	**22 (21.2)**	**104 (100.0)**		

Table 2 shows that 88 participants (84.6%) had negative urinary glucose results. Of these, 53 (51.0%) had urethritis, 22 (21.2%) had cystitis, and 13 (12.5%) had pyelonephritis. Seven participants (6.7%) had urinary glucose levels of 1+, including 3 (2.9%) with urethritis, 1 (1.0%) with cystitis, and 3 (2.9%) with pyelonephritis. Nine participants (8.7%) had urinary glucose levels of 2+, including 1 (1.0%) with urethritis, 2 (1.9%) with cystitis, and 6 (5.8%) with pyelonephritis. Spearman's rank correlation analysis yielded a coefficient of 0.333 and a *p*-value of 0.001. These findings indicate a statistically significant but weak positive association between urinary glucose levels and UTI category.

When participants with negative urinary glucose results were excluded, 9 of the 16 participants with glucosuria, or 56.3%, had pyelonephritis. In comparison, 4 participants (25.0%) had urethritis and 3 (18.8%) had cystitis. This distribution suggests that glucosuria, particularly at higher levels, was more prominently associated with pyelonephritis.

Tuntun & Aminah (2021) reported no statistically significant association between glucosuria and UTI, with $p = 0.279$. Among the seven participants with glucosuria, none had a culture-confirmed UTI based on urine culture as the diagnostic gold standard. The low proportion of participants with glucosuria, representing only 7.61% of the study population, may have reduced the statistical power of the analysis. Glucosuria is also not a direct diagnostic indicator of UTI because leukocyte esterase and nitrite are the principal dipstick parameters used to indicate urinary infection. This finding is consistent with evidence showing that not all patients with diabetes and glucosuria develop UTI (Tuntun & Aminah, 2021).

Glucose in the urine, or glucosuria, is considered a factor that may increase susceptibility to UTI. Urinary glucose can serve as an energy source for microorganisms and create an environment that supports the growth of pathogenic bacteria, particularly Gram-negative bacteria, which are common causes of UTI. Glucosuria frequently occurs in patients with diabetes mellitus, in whom blood and urinary glucose levels may increase because of metabolic disturbances such as insulin resistance or reduced insulin production. Nurdin et al. (2023) reported that 38% of patients with abnormal urinary glucose levels had positive cultures for UTI-causing bacteria, with a statistically significant association ($p = 0.014$) (Nurdin, 2023).

Physiologically, glucosuria creates a nutrient-rich urinary environment that facilitates bacterial colonization and biofilm formation on the urinary epithelium. This process may accelerate bacterial growth, increase the risk of recurrent infection, and contribute to more severe infections such as pyelonephritis. In an experimental mouse study, Saenkham et al. (2021) found that hyperglucosuria increased bacterial counts by up to 10,000-fold compared with controls without glucosuria, supporting the role of urinary glucose as an important facilitator of bacterial colonization (Saenkham et al., 2021).

Tanrıverdi et al. (2023) reported that glucosuria was a significant predictor of UTI. Their retrospective analysis found that the presence of glucose in the urine significantly increased the risk of UTI. Logistic regression analysis produced an odds ratio of 12.48, indicating that patients with glucosuria had more than 12 times the odds of developing UTI compared with those without glucosuria (Tanrıverdi et al., 2023).

Glucose also plays an important role in the pathogenesis of infection by providing an energy source for uropathogenic *Escherichia coli* (UPEC). Glucose in the urinary tract may directly influence the ability of bacteria to colonize and infect the urinary epithelium. The interaction between *E. coli* and glycoproteins on the surface of uroepithelial cells is mediated by sugar-based receptors, including mannosylated and glucosylated structures, which facilitate bacterial adhesion.

Glucosuria enriches the urinary environment with simple carbohydrates that not only provide metabolic substrates for bacterial growth but may also influence virulence-gene expression and biofilm production. To resist urinary flow and colonize the bladder, UPEC uses surface structures such as pili or fimbriae to attach to urothelial cells. This attachment is mediated by adhesins, which are carbohydrate-binding proteins located at the tips of pili that recognize specific glycans on host-cell surfaces. High glucose concentrations may enhance bacterial attachment and persistence on the urinary tract epithelium (Lupo, Ingersoll & Pineda, 2021).

Glucosuria may also impair local immune function. High glucose concentrations can inhibit neutrophil activity and phagocytosis, thereby reducing the effectiveness of the immune response to bacterial infection. This mechanism is particularly relevant among patients with diabetes mellitus, who frequently experience both glucosuria and hyperglycemia and consequently have a greater risk of recurrent and more severe UTI.

High urinary glucose concentrations may further compromise local immunity by reducing the activity of mannose-binding proteins and antimicrobial peptides, which normally provide first-line protection against infection. This mechanism may explain why individuals with glucosuria, including patients with diabetes and users of sodium–glucose cotransporter 2 inhibitors, may be more susceptible to recurrent or severe UTI. Urinary glucose not only supports bacterial proliferation but may also weaken mucosal defense mechanisms within the urinary tract. Therefore, glucosuria may contribute to increased bacterial colonization and greater susceptibility to UTI (Lupo, Ingersoll & Pineda, 2021).

Association of BMI and Urinary Glucose Levels with UTI Severity

Following the bivariate analyses, ordinal logistic regression was performed to simultaneously evaluate the associations of BMI and urinary glucose levels with UTI severity. The results of the multivariable analysis are presented in Table 3.

Table 3. Multivariable analysis of BMI and urinary glucose levels With UTI severity

Variable	Estimate	*p*-value	95% CI	Nagelkerke R^2
BMI	0.460	0.032	0.039–0.881	0.186
Urinary glucose	1.061	0.003	0.363–1.758	

As presented in Table 3, a total of 104 participants were included in the multivariable analysis, comprising 57 cases of urethritis, 25 cases of cystitis, and 22 cases of pyelonephritis. The goodness-of-fit test yielded p = 0.224, indicating no statistically significant difference between the observed and model-predicted values. The ordinal logistic regression model was therefore considered to fit the study data adequately.

The Nagelkerke R^2 value was 0.186, indicating that BMI and urinary glucose levels explained 18.6% of the variation in UTI category. The remaining 81.4% was attributable to other factors not included in the model. BMI was significantly associated with UTI severity, with a regression coefficient of 0.460 and p = 0.032. Exponentiation of the coefficient produced an odds ratio of 1.58. This finding indicates that each one-unit increase in BMI was associated with 1.58 times higher odds of being classified in a more severe UTI category.

Urinary glucose level was also significantly associated with UTI severity, with a coefficient of 1.061 and p = 0.003. The corresponding odds ratio was 2.89, indicating that each one-level increase in urinary glucose was associated with 2.89 times higher odds of being classified in a more severe UTI category, such as pyelonephritis, compared with participants in a lower urinary glucose category.

Overall, both BMI and glucosuria were significantly associated with UTI severity. The odds ratio for glucosuria was higher than that for BMI, indicating that urinary glucose level had a stronger association with UTI severity in the fitted model. Nevertheless, the relatively low Nagelkerke R^2 value suggests that other factors may explain most of the variation in UTI severity. These factors may include age, sex, diabetes mellitus, urinary catheter use, urinary tract obstruction, personal hygiene, hormonal status, and immune function.

CONCLUSION

Body Mass Index (BMI) and urinary glucose levels were significantly and positively associated with urinary tract infection (UTI) classification among patients at West Nusa Tenggara Provincial Hospital. BMI showed a weak positive correlation with

UTI classification (r_s = 0.286, p=0.003), while urinary glucose levels also demonstrated a weak positive correlation (r_s = 0.333, p=0.001). In the ordinal logistic regression analysis, BMI and urinary glucose levels remained significantly associated with higher UTI categories, with odds ratios of 1.58 and 2.89, respectively. Urinary glucose levels showed a stronger association than BMI. However, the model explained only 18.6% of the variation in UTI classification, indicating that other clinical, metabolic, and behavioral factors may contribute substantially. Given the cross-sectional design, these findings should be interpreted as associations rather than causal relationships.

RECOMMENDATION

This study addressed its objective of examining the relationships between urinary glucose levels, Body Mass Index (BMI), and urinary tract infections (UTIs). However, further research is needed to evaluate other potentially relevant factors, including personal hygiene, history of urinary catheterization, urinary tract obstruction, metabolic disorders such as diabetes mellitus, and hormonal factors. Assessing these variables may provide a more comprehensive understanding of factors associated with UTIs. Future studies should employ an analytical cohort design to clarify the temporal and potentially causal relationships among urinary glucose levels, BMI, and UTIs, rather than limiting the interpretation to cross-sectional associations.

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