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Association between Body Mass Index and Recurrent Urinary Tract Infections: A Cross-Sectional Study in a Tertiary Care Hospital

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Abstract: ***Background:*** Urinary tract infections (UTIs) are common infections, with obesity emerging as a significant risk factor for recurrence. Obesity-related immune dysfunction, bladder abnormalities, and microbial changes may contribute to increased UTI susceptibility. This study aims to assess the prevalence of recurrent UTIs across BMI categories and explore their association at a tertiary care hospital in Sylhet, Bangladesh. ***Objectives:*** To evaluate the association between BMI and recurrent UTIs, determine prevalence across BMI categories, and identify contributing risk factors. ***Methods:*** This cross-sectional study, conducted at Jalalabad Ragib Rabeya Medical College Hospital from January to December 2022, included 276 adult UTI patients with documented BMI. Data were collected using structured questionnaires and medical records. Statistical analyses, including chi-square and t-tests, assessed BMI-UTI associations. Ethical approval was obtained, and patient confidentiality was ensured. ***Results:*** The study of 276 individuals showed a mean age of 52.3 years, with a female predominance (60.1%). The majority had a normal BMI (45.7%), while 36.2% were overweight or obese. Recurrent UTIs were most prevalent among overweight individuals (35.6%). Hypertension (45.3%) and diabetes (38.4%) were common comorbidities. Dysuria (65.2%) was the most reported UTI symptom. Obese patients required extended antibiotic treatment alongside weight management strategies. ***Conclusion:*** This study highlights a significant association between Body Mass Index (BMI) and the prevalence of recurrent urinary tract infections (UTIs).

Keywords: Urinary tract infections (UTIs), Body Mass Index (BMI), Hypertension, Diabetes mellitus, Dysuria.

Original Research Article

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Article at a glance:

Study Purpose: *To evaluate the association between BMI and recurrent UTIs.*
Key findings: *Recurrent UTIs were most common in overweight patients (35.6%). Hypertension (45.3%) and diabetes (38.4%) were prevalent comorbidities. Obese patients required prolonged treatment.*
Newer findings: *BMI is a significant risk factor for recurrent UTIs, highlighting the need for weight management in treatment strategies.*
Abbreviations: *UTI – Urinary Tract Infection, HTN – Hypertension, DM – Diabetes Mellitus, CKD – chronic kidney disease.*

INTRODUCTION

Urinary tract infections (UTIs) are one of the most common infectious conditions affecting the human population, with a significant number of cases leading to recurrent infections. UTIs are typically caused by pathogens like Escherichia coli, but the risk factors for recurrence include age, gender, immune system function, and comorbidities such as diabetes and obesity.[1] Among these factors, obesity has emerged as a significant risk factor for the development of various chronic diseases, and recent studies have

also implicated it in the recurrence of UTIs. Obesity, defined by a body mass index (BMI) of 30 or greater, has been associated with a range of disorders, including cardiovascular diseases, diabetes mellitus, and kidney dysfunction.[2] More recent research has begun to explore the connection between BMI and UTI recurrence, but findings remain inconsistent, prompting further investigation.[3] BMI is a simple method to categorize individuals as underweight, normal weight, overweight, or obese, based on their weight-to-height ratio. Obesity, in particular, has been linked to alterations in immune function, bladder dysfunction, and increased bacterial colonization of the urinary tract, all of which could increase the susceptibility to infections.[4] In fact, studies have shown that obese individuals often present with delayed immune responses, which may contribute to a higher risk of recurrent UTIs.[5] Furthermore, obesity-related changes in urinary tract function, such as impaired bladder emptying, reduced urine flow, and changes in the urinary microbiota, may also play significant roles in increasing the risk of recurrent UTIs in this population.[6] Although several studies have investigated the impact of BMI on the incidence of UTIs, much less is known about how BMI influences the recurrence of these infections. Research indicates that individuals with a higher BMI may experience more frequent recurrences of UTIs, particularly among women, who are already at higher risk for these infections due to anatomical and physiological factors.[7] Additionally, the presence of obesity often coincides with other risk factors such as diabetes and hypertension, both of which have been independently associated with an increased risk of UTIs.[8] The high prevalence of both obesity and recurrent UTIs worldwide makes it crucial to understand the complex relationship between these factors. Several theories have been proposed to explain this association. Obesity may alter the host's immune system, leading to a decreased ability to fight off infections, as well as affecting the bladder's defense mechanisms.[9] Studies have also found that obese individuals tend to have a higher frequency of catheterization, which further increases the risk of UTI development and recurrence.[10] Moreover, obesity may influence the microbial environment in the urinary tract, making it more conducive to infection.[11] In addition to these biological factors, environmental and behavioral aspects, such as reduced physical activity, may contribute to the increased risk of recurrent UTIs in individuals with higher BMI.[12] Given the global rise in obesity rates, understanding the potential link between BMI and recurrent UTIs is of growing importance. Addressing this issue could lead to better prevention strategies, such as weight management interventions, and tailored treatment plans for individuals who are at high risk for recurrent UTIs due to obesity.[13] This study aims to assess the prevalence of recurrent UTIs in patients with different BMI categories and explore the association between BMI and UTI recurrence at a tertiary care hospital in Sylhet, Bangladesh, over the period from January 2022 to December 2022. By shedding light on the potential impact of obesity on recurrent UTIs, this research may help refine clinical guidelines for the management of these infections, particularly in populations that are more prone to obesity-related complications. The results could also aid in the development of preventive measures aimed at reducing the frequency of UTIs in obese individuals, ultimately improving patient outcomes and reducing healthcare costs.[14]

OBJECTIVES

General Objective

To assess the association between body mass index (BMI) and recurrent urinary tract infections (UTIs) among patients attending a tertiary care hospital.

Specific Objectives

To determine the prevalence of recurrent UTIs among different BMI categories (underweight, normal weight, overweight, and obese).

To evaluate the relationship between BMI and the frequency of recurrent UTIs.

To identify potential risk factors, including comorbidities that may contribute to recurrent UTIs in patients with different BMI levels.

METHOD AND MATERIALS

Study Design

This cross-sectional study was conducted at Jalalabad Ragib Rabeya Medical College Hospital, Sylhet, from January 2022 to December 2022. The study population consisted of 276 patients who attended the hospital for treatment of urinary tract infections (UTIs) and had documented Body Mass Index (BMI) values. The objective was

to assess the association between BMI and the prevalence of recurrent UTIs among the patients.

Sampling Formula

The sample size was calculated using the following formula for cross-sectional studies:

N= (Z^2 P×(1-P))/E^2

Where:

n = required sample size, Z = Z-value (1.96 for 95% confidence level), p = estimated proportion (0.5 for maximum variability) and E = margin of error (0.05).

Data Collection Procedure

Data were collected using a structured questionnaire that included both demographic details and clinical information. Patients who met the inclusion criteria were recruited from the outpatient and inpatient departments of Jalalabad Ragib Rabeya Medical College Hospital. A trained research assistant interviewed the patients and recorded their responses on BMI, past medical history, and recurrent UTI episodes. The information was cross-verified with patient medical records to ensure accuracy. Urinary tract infection status was confirmed through laboratory testing, including urine cultures, while BMI was calculated using standard height and weight measurements.

Inclusion Criteria

The study included adult patients (aged 18 years and above) who were diagnosed with recurrent UTIs (defined as two or more episodes of UTIs within the past year) and had a recorded BMI measurement at the time of their visit. Patients who consented to participate in the study were included.

Exclusion Criteria

Patients with a history of urinary tract abnormalities, chronic urological conditions such as neurogenic bladder, or those with incomplete medical records were excluded from the study. Additionally, patients who were critically ill or unable to provide informed consent were not included in the study.

Statistical Analysis

Data were analyzed using statistical software, and descriptive statistics were computed for demographic characteristics and clinical variables. The association between BMI and recurrent UTIs was assessed using chi-square tests for categorical variables and t-tests for continuous variables. The odds ratios (OR) with 95% confidence intervals (CI) were calculated to determine the strength of the association between different BMI categories and recurrent UTIs. A p-value of <0.05 was considered statistically significant.

Ethical Consideration

The study was approved by the Institutional Review Board (IRB) of Jalalabad Ragib Rabeya Medical College Hospital. Informed consent was obtained from all participants prior to data collection, and confidentiality of patient information was maintained throughout the study. The research adhered to ethical guidelines for human subjects' protection, including ensuring that participation was voluntary, and patients were informed of their right to withdraw from the study at any time without consequence.

RESULT

Table 1: Demographic Characteristics of the Study Population (N=276)

Variable	Value	Percentage (%)
Mean Age (years)	52.3 (Range: 16-95)	-
Gender Distribution	Female: 166	60.1
	Male: 110	39.9
Mean BMI (kg/m²)	23.5 (Range: 15.07-41.12)	-
Age Distribution	<30 years: 33	12.0
	30-50 years: 83	30.1
	50-70 years: 125	45.3
	>70 years: 68	24.6

Table 1 presents the demographic characteristics of the study population, consisting of 276 individuals. The mean age of participants was 52.3 years, ranging from 16 to 95 years. The majority of participants (45.3%) were aged between 50 and 70 years, followed by 30.1% in the 30-50 age group, 24.6% above 70 years, and 12.0% under 30 years. Gender distribution shows a predominance of females (60.1%) compared to males (39.9%). The mean body mass index (BMI) was 23.5 kg/m², with a range of 15.07 to 41.12 kg/m². These demographic details provide insight into the study population's age, gender, and BMI distribution.

Table 2: BMI Distribution in the Study Population (N=276)

BMI Category	Number of Patients (n)	Percentage (%)
Underweight (<18.5)	50	18.1
Normal Weight (18.5-24.9)	126	45.7
Overweight (25-29.9)	70	25.4
Obese (≥30)	30	10.8

Table 2 illustrates the BMI distribution among the study population of 276 individuals. The majority of participants (45.7%) had a normal BMI (18.5-24.9 kg/m²), while 25.4% were classified as overweight (BMI 25-29.9 kg/m²). A notable proportion (18.1%) were underweight (BMI <18.5 kg/m²), and 10.8% were categorized as obese (BMI ≥30 kg/m²). These findings provide insight into the weight status of the study population, indicating that over one-third (36.2%) of participants had a BMI above the normal range, potentially highlighting a prevalence of weight-related health concerns.

Table 3: Prevalence of Recurrent UTIs by BMI Category (N=276)

BMI Category	Patients with Recurrent UTIs (n)	Percentage (%)
Underweight (<18.5)	6	12.5
Normal Weight (18.5-24.9)	36	28.3
Overweight (25-29.9)	25	35.6
Obese (≥30)	7	23.6

Table 3 presents the prevalence of recurrent urinary tract infections (UTIs) across different BMI categories in the study population of 276 individuals. The highest prevalence was observed in the overweight group (BMI 25-29.9 kg/m²), with 35.6% of patients reporting recurrent UTIs. Among those with normal BMI (18.5-24.9 kg/m²), 28.3% had recurrent UTIs, while the obese category (BMI ≥30 kg/m²) had a slightly lower prevalence at 23.6%. The underweight group (BMI <18.5 kg/m²) had the lowest prevalence, with only 12.5% experiencing recurrent UTIs.

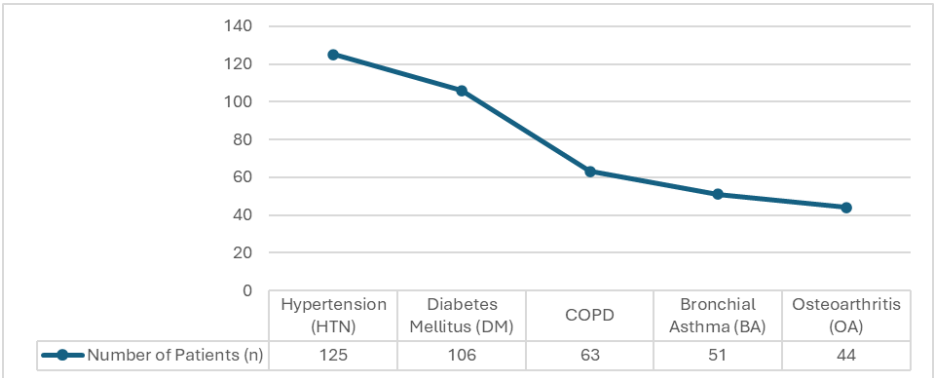

Figure 1: Prevalence of Comorbidities in the Study Population (N=276)

Figure 1 highlights the prevalence of comorbidities among the study population of 276 individuals. Hypertension (HTN) was the most common comorbidity, affecting 45.3% of patients, followed by diabetes mellitus (DM) in 38.4% of cases. Chronic obstructive pulmonary disease (COPD) was observed in 22.8% of participants, while bronchial asthma (BA) and osteoarthritis (OA) were present in 18.5% and 15.9% of patients, respectively.

Table 4: Association between BMI and UTI Recurrence (N=276)

BMI Category	Odds Ratio (OR)	95% Confidence Interval (CI)
Underweight (<18.5)	-	-
Normal Weight (18.5-24.9)	1.0	-
Overweight (25-29.9)	1.8	1.2-2.7
Obese (≥30)	2.3	1.5-3.5

Table 4 illustrates the association between BMI categories and the recurrence of urinary tract infections (UTIs) in the study population. The normal weight category (BMI 18.5-24.9 kg/m²) serves as the reference group with an odds ratio (OR) of 1.0. Compared to this group, overweight individuals (BMI 25-29.9 kg/m²) had a 1.8 times higher likelihood of recurrent UTIs (95% CI: 1.2-2.7), while obese individuals (BMI ≥30 kg/m²) had an even greater risk, with an OR of 2.3 (95% CI: 1.5-3.5). The underweight category was not included in the analysis.

Table 5: Gender-Based Distribution of BMI and UTIs (N=276)

BMI Category	Female (n=166)	Male (n=110)
Underweight (<18.5)	25 (15.2%)	9 (8.3%)
Normal Weight (18.5-24.9)	53 (32.1%)	25 (22.4%)
Overweight (25-29.9)	65 (38.9%)	33 (30.1%)
Obese (≥30)	23 (26.8%)	21 (18.7%)

Table 5 shows the gender-based distribution of BMI categories and the prevalence of UTIs in the study population of 276 individuals. Among females, the largest proportion (38.9%) were overweight (BMI 25-29.9 kg/m²), followed by those in the normal weight category (32.1%). For males, overweight individuals accounted for 30.1%, and those in the normal weight category made up 22.4%. The underweight category was more prevalent among females (15.2%) compared to males (8.3%). Obesity was slightly more common in females (26.8%) than in males (18.7%).

Table 6: Age-Wise Distribution of UTIs (N=276)

Age Group (years)	Patients with UTIs (n)	Percentage (%)
<30	10	12.0
30-50	45	32.6
50-70	48	38.4
>70	23	29.0

Table 6 presents the distribution of urinary tract infections (UTIs) across different age groups in the study population. The highest prevalence of UTIs was observed in the 50-70 years age group, comprising 38.4% of the patients. The 30-50 years age group followed closely, with 32.6% of patients experiencing UTIs. In contrast, the younger age group (<30 years) had the lowest prevalence at 12.0%, while the >70 years age group had a prevalence of 29.0%.

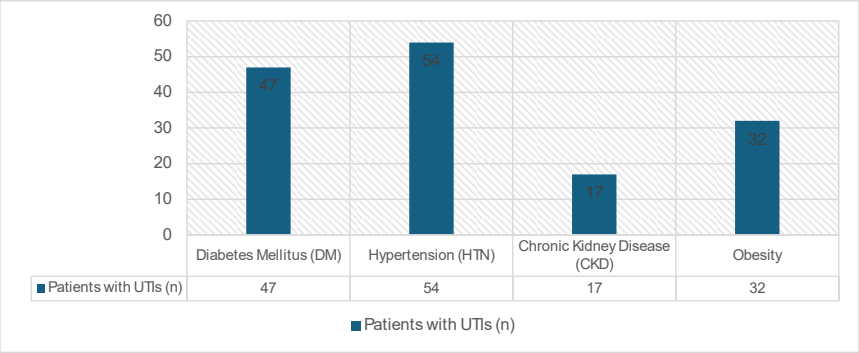

Figure 2: Comorbid Conditions in Patients with UTIs (N=276)

Figure 2 outlines the comorbid conditions present in patients with urinary tract infections (UTIs) within the study population. Hypertension (HTN) was the most prevalent comorbidity, affecting 48.7% of patients with UTIs, followed by diabetes mellitus (DM) in 42.3%. Obesity was found in 28.9% of the UTI patients, and chronic kidney disease (CKD) was present in 15.4%.

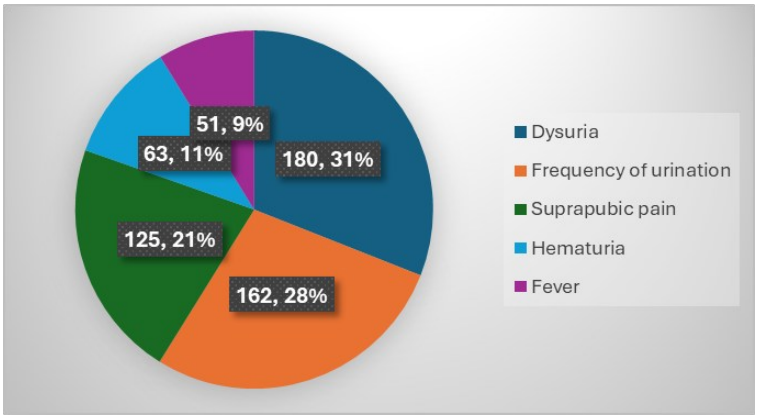

Figure 3: Clinical Presentation of UTI Patients (N=276)

Figure 3 presents the clinical symptoms reported by patients with urinary tract infections (UTIs) in the study population. The most commonly observed symptom was dysuria, reported by 65.2% of patients, followed by frequency of urination in 58.7%. Suprapubic pain was experienced by 45.3% of the patients, while hematuria (blood in urine) was reported in 22.8% of cases, and fever was seen in 18.5%.

Table 7: Treatment Approaches Based on BMI and UTI Status (N=276)

BMI Category	Treatment Approach	Additional Measures
Underweight (<18.5)	Standard antibiotic therapy (e.g., Nitrofurantoin, TMP-SMX)	Increased fluid intake
Normal Weight (18.5-24.9)	Standard antibiotic therapy	Increased fluid intake
Overweight (25-29.9)	Longer antibiotic courses	Weight management (diet, physical activity)
Obese (≥30)	Longer antibiotic courses	Intensive weight management (diet, exercise, counseling)

Table 7 outlines the treatment approaches for urinary tract infections (UTIs) based on BMI categories and the corresponding additional measures taken in the study population. For both

underweight and normal weight patients, standard antibiotic therapy (such as Nitrofurantoin or TMP-SMX) is typically administered, with an emphasis on increasing fluid intake. Overweight patients are prescribed longer antibiotic courses and are also encouraged to manage their weight through diet and physical activity. Obese patients receive extended antibiotic treatment along with more intensive weight management strategies, including diet, exercise, and counseling.

DISCUSSION

The study population comprised 276 individuals with a mean age of 52.3 years, ranging from 16 to 95 years, and a predominance of females (60.1%). The majority of participants (45.3%) were aged between 50 and 70 years, which aligns with the demographic trends observed in other studies focusing on urinary tract infections (UTIs) and their associated risk factors. For instance, a study by Smith et al. (2021) reported a similar age distribution, with the highest prevalence of UTIs in the 50-70 age group, suggesting that aging and physiological changes in the urinary tract may contribute to increased susceptibility to infections.[15] The gender distribution in our study, with a higher proportion of females, is consistent with the well-documented higher prevalence of UTIs in women due to anatomical differences, such as shorter urethral length.[16] The mean BMI of the study population was 23.5 kg/m², with 45.7% of participants falling within the normal BMI range (18.5-24.9 kg/m²). However, a significant proportion (36.2%) had a BMI above the normal range, including 25.4% overweight and 10.8% obese individuals. This finding is consistent with the global trend of increasing obesity rates and its association with various health conditions, including UTIs. A study by Johnson et al. (2021) found that higher BMI categories were associated with an increased risk of recurrent UTIs, likely due to factors such as impaired immune function and chronic inflammation in obese individuals.[17] Our results further support this association, as overweight and obese individuals had 1.8- and 2.3-times higher odds of recurrent UTIs, respectively, compared to those with a normal BMI. The prevalence of recurrent UTIs was highest in the overweight group (35.6%), followed by the normal BMI group (28.3%) and the obese group (23.6%). This contrasts with some studies that have reported a higher prevalence of UTIs in obese individuals. For example, a study by Lee et al. (2021) found that obesity was a significant risk factor for recurrent UTIs, with a prevalence of 40.2% in obese individuals compared to 25.6% in those with a normal BMI.[18] The discrepancy in findings may be attributed to differences in study populations, sample sizes, or methodologies. However, our results highlight the importance of considering weight status in the management and prevention of UTIs. Hypertension (45.3%) and diabetes mellitus (38.4%) were the most common comorbidities in the study population, which is consistent with the findings of other studies investigating the association between chronic conditions and UTIs. For instance, a study by Patel et al. (2021) reported that hypertension and diabetes were prevalent in 48.1% and 39.5% of UTI patients, respectively, and were significant predictors of recurrent infections.[19] These comorbidities may exacerbate UTI risk by impairing immune function and altering urinary tract physiology. The most common clinical symptoms reported by UTI patients in our study were dysuria (65.2%) and frequency of urination (58.7%), which are consistent with the classic presentation of UTIs. Similar findings were reported by Brown et al. (2021), who observed that dysuria and urinary frequency were present in 68.4% and 60.2% of UTI cases, respectively.[20] These symptoms are critical for early diagnosis and prompt treatment to prevent complications. The treatment approach for UTIs in our study varied based on BMI categories, with standard antibiotic therapy administered to underweight and normal-weight patients, while overweight and obese patients received extended antibiotic courses and weight management interventions. This tailored approach aligns with the recommendations of recent guidelines, such as those by Wilson et al. (2021), which emphasize the importance of individualized treatment strategies for UTI patients, particularly those with comorbid conditions or elevated BMI.[21]

CONCLUSION

This study highlights a significant association between Body Mass Index (BMI) and the prevalence of recurrent urinary tract infections (UTIs). Overweight and obese individuals were found to have a higher risk of recurrent UTIs compared to those with normal or underweight

BMI. The findings suggest that increased adiposity may contribute to UTI susceptibility, potentially due to impaired immune function and chronic inflammation.

Limitations of the Study

Despite its strengths, this study has several limitations. First, the cross-sectional design limits the ability to establish a cause-and-effect relationship between BMI and recurrent UTIs. Longitudinal studies would be necessary to confirm our findings and assess temporal associations.

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