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Association Between Body Mass Index and Urinary Tract Infection in Adult Patients

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Background: Overweight and obesity have become a global public health over the last decades. Obesity has been suggested to be a risk factor for some infections, but studies often showed controversial findings. Few studies examined the relationship between body mass index (BMI) and urinary tract infection (UTI), showing inconsistent results.
Objectives: The purpose of this study was to determine the relationship between BMI and UTI in adult patients.
Patients and Methods: Adult patients (≥ 18 years old) who were referred to clinics or admitted in hospital with diagnosis of UTI were considered for participation in the study. Control group were selected from healthy adult normal population whom underwent medical check-ups at the same hospital and without history of UTI. Data about age, gender, history of diabetes mellitus and BMI were registered for individuals who met inclusion criteria.
Results: A total of 116 patients with UTI and 156 people as the control group were included in the study. Two groups were matched for age, gender and history of diabetes mellitus. Mean BMI ± SD of patients was 25.2 ± 4.0 kg/m^2 and the controls was 25.1 ± 3.6 kg/m^2. There was no significant correlation between BMI and UTI (P = 0.757). Mean BMI ± SD of patients with upper UTI was 25.6 ± 4.1 kg/m^2 and for lower UTI was 24.9 ± 4.0 kg/m^2. There was no significant difference between BMI of controls and patients with any type of UTI (P = 0.573).
Conclusions: Our findings did not found an association between BMI and UTI and does not support obesity as a risk factor for UTI in adult patients.

Keywords: Urinary Tract Infection; Body Mass Index; Patients

1. Background

Overweight and obesity are considered to be worldwide epidemics and their incidences are increasing. They have become a global public health hazard and more than one billion adults estimated to be overweight and over 400 million of them are obese (1). Overweight and obesity have significant contribution in the development of various chronic diseases such as cardiovascular disease, hypertension, diabetes mellitus, stroke, osteoarthritis, and certain cancers. It compromises the quality of life, and increases overall mortality (2). Obesity does not have a known precise defined effect on the immune response through a variety of immune mediators. It has been recognized that the adipose tissue participates actively in inflammation and immunity, producing and releasing a variety of proinflammatory and anti-inflammatory factors (3).

Besides being a risk factor for some chronic diseases, overweight and obesity have also been suggested to be as risk factors for some infections. Several epidemiological investigations and emerging data indicated that obesity may increase infection susceptibility in clinical settings (4). Some studies showed that the incidence of infections, especially in hospital and after surgery, is increased in overweight and obese patients, compared with normal weight patients (5-7). Relation of body mass index (BMI) with infection has not been adequately studied and the various aspects of this association have not been reviewed. Some epidemiological studies have evaluated the potential association between obesity and increased risk of infection with controversial results (8).

The literature is so far lacking enough studies that could verify obvious or expected associations between BMI and specific infections, especially community-acquired infections (3). Urinary tract infection (UTI) is one of the most common bacterial infections encountered in outpatient and inpatients settings (9). The relationship between BMI and UTI has been explored in few studies - often with inconsistent findings. Most previous studies were limited to diabetic patients or conducted in hospital setting (10-12). In addition, in most of these studies, no adjustment was done for confounder variables such a diabetes mellitus -a condition that is associated with both obesity and increased risk of infection - which potentially could confound the association. As the cause-effect relationship

between obesity and infection remains obscure in many infectious diseases including UTI, most researchers recommended further studies in this field.

2. Objectives

The aim of this study was to compare BMI of adult patients with community-acquired UTI with control group in order to clarify the association between BMI and UTI.

3. Patients and Methods

This cross-sectional study was conducted from March 2012 to June 2013 in a university affiliated hospital of Semnan University of Medical Sciences, Semnan, Iran. Adult patients (≥ 18 years old) who were referred to clinics or admitted in hospital with diagnosis of UTI were considered for participation in the study. Control group were selected from healthy adult normal population, whom underwent medical check-ups at the same hospital and without any history of UTI. Lower urinary tract infection (acute cystitis) was defined as the acute onset of symptoms of dysuria, urgency, and frequency in the absence of fever or costovertebral-angle pain or tenderness, and in the presence of pyuria and positive urine culture. The diagnosis of acute pyelonephritis was based on the clinical findings of fever (> 38°C), flank pain and/or tenderness, with pyuria and positive urine culture (13). Demographic factors such as gender, age and history of diabetes mellitus were collected for individuals who met inclusion criteria. Diabetes mellitus was defined as self-reported history of diabetes mellitus and use of oral hypoglycemic agents or insulin.

Individuals with history of urinary stone, neurogenic bladder, pregnant or post-partum women and treatment with immunosuppressive agents were excluded. Weight was determined using a digital electronic weighing scale with accuracy to 0.1 kg and wearing lightweight clothing. Height was measured to the nearest centimeter by using a tape measure and women standing upright without shoes. BMI was calculated by the weight in kilograms divided by the height in meters squared (kg/m^2). BMI classified as underweight (< 18.5) normal weight (18.5-24.9), overweight (25.0-29.9) and obesity as having a BMI equal or greater than 30.0 kg/m^2 (14).

Informed consent was obtained from all subjects before enrollment. The study protocol was approved by Research Council and Ethical Committee of the Semnan University of Medical Sciences. Data were analyzed by Chi Square, Student's t-test, One Way ANOVA test and Logistic regression analysis using SPSS Version 16.00 (SPSS, Inc., Chicago, IL). P value less than 0.05 were considered statistically significant.

4. Results

Of all screened patients with UTI, 116 met our inclusion criteria and were enrolled and 156 were selected for the control group. From these patients 56 had upper and 60 had lower UTI. Eighty-one of patients (69.8.7%) nd one hundred of controls (64.1%) were women. The gender distribution of both groups was not statistically difference (P = 0.322). Mean age of the patients was 58.5 ± 19.7 years and for controls was 59.4 ± 14.4 years (P = 0.670). History of diabetes mellitus was positive in 32.8% of patients and 23.1% in control group (P = 0.076). Two groups were matched for age, gender and history of diabetes mellitus. Table 1 shows demographic data of patient and control groups. *Escherichia coli* was the most common pathogen (87.6%) cultured in patients followed by *Klebsiella Spp* (10.2%).

Mean BMI of the patients was 25.2 ± 4.0 kg/m^2 and for control was 25.1 ± 3.6 kg/m^2. There was no significant correlation between BMI and UTI (P = 0.757). Mean BMI of the patients with upper UTI was 25.6 ± 4.1 kg/m^2 and for lower UTI was 24.9 ± 4.0 kg/m^2. There was no significant difference between BMI of controls and patients with any type of UTI (P = 0.573). Logistic regression analysis also did not show any association between BMI and UTI (OR = 0.996, 95% CI: 0.933-1.064, P = 0.910).

Table 1. Characteristics of Patients With Urinary Tract Infections and Healthy Controls [a,b]

Characteristics	Group		
	Lower UTI (n = 60)	Upper UTI (n = 56)	Control (n = 156)
Gender			
Female	52 (86.7)	29 (51.8)	100 (64.1)
Male	8 (13.3)	27 (48.2)	56 (35.9)
Age, y			
< 40	18 (30.0)	5 (8.9)	13 (8.4)
40-49	7 (11.7)	5 (8.9)	24 (15.5)
50-59	15 (25.0)	11 (19.6)	42 (27.1)
≥ 60	20 (33.3)	35 (62.5)	76 (49.0)
Diabetes mellitus			
Positive	14 (23.3)	24 (42.9)	36 (23.1)
Negative	46 (76.7)	32 (57.1)	120 (76.9)
BMI, kg/m^2			
< 18.5	2 (3.3)	2 (3.6)	4 (2.6)
18.5-24.9	28 (46.7)	26 (46.4)	75 (48.1)
25.0-29.9	24 (40.0)	19 (33.9)	63 (40.4)
≥ 30	6 (10.0)	9 (16.1)	14 (9.0)

[a] Data are presented as No. (%).
[b] Abbreviations: UTI, Urinary tract infection; BMI, Body Mass Index.

5. Discussion

The recent studies on several infectious diseases have drawn attention to the association between the obesity and infectious diseases. However, the associations have not been assessed in a wide range. In our study that patients and controls were matched for age, gender and

history of diabetes mellitus, findings showed that there is no association between BMI and the risk of UTI. Also, when dividing UTI as upper and lower types, there was still no significant association.

In agreement with our finding, Hammar et al. study on patients with diabetes mellitus reported that they did not found an association with BMI and increased risk of UTI (12). Geerlings et al. evaluated risk factors for symptomatic urinary tract infection in women with diabetes. Their study did not describe any relationship between obesity and symptomatic UTI (15). A study was conducted to review the risk factors for infection in trauma patients especially the importance of obesity as an independent risk factor for nosocomial infections. Pulmonary and wound infections were significantly more frequent in obese patients. But UTI were not shown to increase in obese patients (16). The earliest study in this field showed that the risk of urinary tract infection was higher in non-obese than in obese women (17).

The positive association between high BMI and UTI reported in some previous studies. A cohort study by Semins et al. indicated that obesity was a risk factor for UTI. Obese patients were more likely to have an UTI especially in males; furthermore the obese females were at particularly higher risk for pyelonephritis (18). In another cohort study on adult patients that include lower UTI only, results showed that the proportion of subjects diagnosed with lower UTI increased with increasing BMI, particularly in males but not in females (19). Another study aimed to assess the prevalence of UTI and its risk factors among Saudi diabetic patients. BMI was significantly higher in patients with UTI compared with patients without UTI (11). In a Korean study, the relationship between obesity and febrile urinary tract infection in young children was evaluated. Multivariate analysis revealed that obese and overweight children were more likely to have an UTI than lean population (20). Studies on pregnant and postpartum women showed increased risk of UTI in obese women (21, 22). In a retrospective study authors examined the effect of BMI on the incidence of various infectious diseases in institutionalized, geriatric subjects. Most common infections were UTI. Their findings showed that subjects with a lower BMI and obese had a higher incidence rate of infections - including UTI - compared with normal weight subjects (23).

The difference in these findings might at least partly be explained by differences in the study design, patients' selection, number of samples and confounding variables. The association between obesity and infections including UTI may be due to some confounders such as diabetes mellitus and other co-morbidity associated with obesity. These factors may cause considerable variation between different studies in this field. In addition, some previous studies examined patients that were not culture-proven.

When we analyzed data based on gender, again, there was no association between BMI and urinary tract infections in men and women. But, some studies showed that relationship between BMI and UTI was gender-dependent. For examples, in a cohort study, obesity was proven to be a risk factor for UTI in male patients with diabetes mellitus but not for women (10). In another study, results showed that lower UTI increased with increasing BMI in males, but not in females (19). Relationship between BMI and other infections ended with controversial results. Some studies showed positive association between higher BMI with surgical site infections (24), nosocomial infections (25, 26), pneumonia (27), cellulitis (28, 29) and periodontal infections (30).

Others studies showed opposing results. A study that evaluated complications after hysterectomy showed no associations between BMI and risk of infections (31). In another study, the risk of infections was elevated among women with BMI < 20 kg/m2, who underwent laparoscopic surgery (32). Kornum et al. documented that adjustment for major chronic diseases eliminated the association between obesity and pneumonia risk: documented in a univariate model in one large epidemiological study (33).

The results of the study for complication of cardiac surgery demonstrated that obesity was a risk factor only for superficial sternal wound infection but, not deep sternal wound infection (34). A study examined the correlation between BMI and biliary tract infection. BMI inversely correlated with biliary bacteria, bacteremia, and increased illness severity on bivariate and multivariate analysis. Most patients with severe biliary infections had a normal BMI and authors suggested that obesity may be protective in biliary infections (35). Almirall et al. reported a slightly lower risk of pneumonia among obese individuals in their patients (36).

One of the strengths of our study lies in its matching the patients' age, gender and the presence of diabetes mellitus. We have also subcategorized lower UTI and upper UTI so these two different conditions were examined separately. Our present work has a few limitations. Small sample size was the major limitation of the present study. Another limitation was low number of underweight and obese patients.

In conclusion, our findings did not found an association with BMI and UTI and does not support obesity as a risk factor for UTI in adult patients. Large prospective studies are needed to further clarify the association of BMI with different infections.

Authors' Contributions

Study concept and design: Mohammad Nassaji, Raheb Ghorbani, Masomeh Bitaraf. Acquisition of data: Mohammad Nassaji, Masomeh Bitaraf, Mohammad Reza Tamadon. Analysis and interpretation of data: Raheb Ghorbani, Mohammad Nassaji. Drafting of the manuscript: Mohammad Nassaji. Critical revision of the manuscript for important intellectual content: Raheb Ghorbani. Statistical analysis: Raheb Ghorbani. Administrative, techni-

cal, and material support: Mohammad Reza Tamadon. Study supervision: Mohammad Nassaji, Mohammad Reza Tamadon

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