

## Lower Urinary Tract Symptoms and Erectile Dysfunction in Men With Type 2 Diabetes Mellitus

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**Purpose:** To assess the prevalence of lower urinary tract symptoms (LUTS) and erectile dysfunction (ED) and the relationships between LUTS, ED, depression, and other factors in Korean men with type 2 diabetes mellitus (T2DM).

**Methods:** This cross-sectional study included 124 male patients with T2DM who attended a university hospital diabetes clinic between October 2010 and April 2012. Data were collected using structured interviews and chart reviews. LUTS were measured using the International Prostate Symptom Score (IPSS), ED using the five-item Korean version of the International Index of Erectile Function (IIEF), depression using the Center for Epidemiologic Studies Depression Scale, and glycosylated hemoglobin level from clinical data.

**Results:** The IPSS score was  $9.2 \pm 6.6$ . The total IPSS scores indicated that 53.3% of the subjects had either moderate or severe symptoms. The mean IIEF score was  $7.3 \pm 8.6$ , indicating the severity of ED to be mild, mild to moderate, moderate, and severe in 10.5%, 9.7%, 1.6%, and 66.9% of the participants, respectively. LUTS showed a significant negative correlation with ED ( $r = -0.26$ ,  $P = 0.003$ ) and a significant positive correlation with depression ( $r = 0.33$ ,  $P < 0.001$ ). ED was negatively correlated with age ( $r = -0.44$ ,  $P < 0.001$ ), duration of diabetes ( $r = -0.26$ ,  $P = 0.004$ ), and depression ( $r = -0.24$ ,  $P = 0.008$ ).

**Conclusions:** LUTS and ED were found to have a high prevalence among Korean men with T2DM. More severe ED was associated with worse LUTS, whereas more severe depressive symptoms were found to be associated with more severe ED and LUTS.

**Keywords:** Lower urinary tract symptoms; Erectile dysfunction; Type 2 diabetes mellitus; Depression

### INTRODUCTION

Diabetes mellitus is a significant global health concern, and its prevalence has been rising steadily over recent decades, especially in Asia [1,2]. The prevalence of type 2 diabetes mellitus (T2DM) has increased significantly in South Korea [3,4]. According to Korea Health Statistics (2010) [5], the prevalence of diabetes in South Korea was 10.1% among adults older than 30 years and 22.7% among adults older than 65 years.

It is well known that diabetes mellitus is a chronic metabolic condition that is associated with numerous complications [6].

Lower urinary tract symptoms (LUTS) are common in adults with diabetes mellitus and cause a considerable health burden for patients [2,7]. The impact of diabetes mellitus on the lower urinary tract is multifactorial and includes osmolarity diuresis, metabolic perturbations, and microvascular damage. Neuropathy caused by diabetes mellitus may lead to dysfunction of the smooth muscle, urothelium, and neuronal components of the bladder [8,9]. The development of LUTS, and the underactivity or overactivity of the detrusor muscle are common symptoms associated with diabetes progression [8]. Lee et al. [10] reported that female patients with diabetes had significantly higher noc-

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turia scores, weaker urinary streams, and lower voided volumes compared with nondiabetic women.

Erectile dysfunction (ED) is a common occurrence in diabetic men [11]. In a multicenter study, Cho et al. [12] found that the overall prevalence of ED was 65.4% in Korean men with T2DM. Lu et al. [13] showed that the prevalence of ED was 83.6% (severe ED, 43.2%) among Taiwanese men with T2DM when assessed using the International Index of Erectile Function (IIEF-5) questionnaire. ED occurs at an earlier age in diabetic men in comparison with the general population [14,15]. Taken together, LUTS and ED are highly prevalent and burdensome conditions among men with T2DM; however, most care providers have failed to pay sufficient attention to the treatment of these conditions. Early detection and efficient management may minimize the negative impact of LUTS and ED on quality of life.

Previous epidemiological studies have suggested that LUTS are strongly associated with ED [16,17]. Depressive symptoms are more prevalent among individuals with T2DM than among nondiabetic individuals [18]. In addition, surveys have demonstrated that depression is strongly associated with LUTS [19] and ED [11]. These findings suggest that a comprehensive assessment of the relationship between LUTS, ED, depression, and diabetic factors is necessary.

The purpose of this study was therefore to assess the prevalence of LUTS and ED and the relationships between LUTS, ED, depression, duration of diabetes, and HbA1c levels in men with T2DM.

## MATERIALS AND METHODS

### Study Design

Cross-sectional study with one-time data collection

### Study Participants and Data Collection

Between October 2010 and April 2012, 124 men with T2DM who attended the Diabetes Outpatient Clinic of the National University Hospital, Jeju, South Korea, were recruited. The inclusion criteria were male sex, age > 40 years, diagnosis of T2DM, and receiving pharmacological treatment for diabetes. Data were collected via face-to-face interviews conducted by the principal investigator and a well-trained research assistant who explained the study purpose and data collection method to the subjects individually. Interviews were conducted using a standardized questionnaire, and written informed consent was obtained before data collection was initiated. Interviews were per-

formed in a quiet room in the hospital, and the questionnaire took approximately 20 minutes to complete. Each patient's medical records were reviewed to collect information relating to other diabetic factors, including duration of T2DM, metabolic control as measured by HbA1c levels, and concurrent medical conditions. The study protocol was approved by the institutional review board of Jeju National University Hospital.

### Measures

A structured questionnaire was used as guide in the interviews. The subjects were asked about their general characteristics (e.g., age and living arrangements). Body mass index (weight [kg]/height [m<sup>2</sup>]) was calculated on the basis of height and weight.

Symptoms of depression were assessed using the Korean language version of the Center for Epidemiologic Studies Depression Scale (CES-D) [20], a 20-item, four-point Likert scale that includes questions relating to how often the subject felt or behaved in a particular manner within the preceding week. Scores range from 0 (not at all depressed) to 60 (very depressed), with a cutoff score of 21 as an indicator of major depressive symptoms [21]. Cronbach's  $\alpha$  for the CES-D scale was 0.90 in this study.

LUTS were assessed using the Korean version of the International Prostate Symptom Score (IPSS) [22]. The IPSS includes seven LUTS indicators, including four voiding symptoms (straining, intermittency, weak stream, and incomplete emptying) and three storage symptoms (frequency, urgency, and nocturia). The subjects were asked to indicate the frequency of each of the seven symptoms over the preceding 6 months. Each symptom is graded from 0 (not at all) to 5 (almost always) according to the frequency of occurrence. Scores from the individual symptoms were aggregated to obtain a total IPSS score, which ranges from 0 to 35 and is categorized as either mild (0–7), moderate (8–19), or severe (20–35). Cronbach's  $\alpha$  for the LUTS scale was 0.69 in this study.

ED in men with T2DM was assessed using the Korean version of the IIEF-5 [23]. The IIEF-5 evaluates five items relating to sexual function. Each item is rated on a 6-point scale (between 0 and 5), except for one item that was rated on a five-point scale (between 1 and 5). The subjects were asked to indicate the frequency of each of the five symptoms during the preceding 6 months. A total score, ranging from 1 to 25, was calculated by adding the score for each individual item. A score between 22 and 25 was considered to represent normal function; a score between 17 and 21, mild ED; and a score < 17, significant ED. Scores indicating significant cases of ED can be further

subdivided into mild to moderate ED (12–16), moderate ED (8–11), and severe ED ( $\leq 7$ ) [24]. Cronbach's  $\alpha$  for the IIEF-5 scale was 0.95 in this study.

HbA1c levels were reviewed on the basis of blood test results, with samples collected within 3 months of clinical treatment preceding data collection.

### Data Analysis

Descriptive data are reported to provide an overview of the general characteristics of the participants. The relationships between LUTS, ED, age, duration of diabetes, HbA1c levels, and depression were analyzed using Pearson correlation coefficient. A  $P < 0.05$  was considered to be statistically significant. All statistical procedures were performed using the SAS ver. 9.2 (SAS Institute Inc., Cary, NC, USA).

## RESULTS

### Characteristics of Participants

A total of 124 men with T2DM were enrolled in the study. The

**Table 1.** General characteristics of the participants (n = 124)

Characteristic	Value
Age (yr)	64.57 $\pm$ 9.45
< 65	64 (51.61)
$\geq 65$	60 (48.39)
Living arrangements	
Lives without spouse	16 (12.90)
Lives with spouse	108 (87.10)
Body mass index (kg/m <sup>2</sup> )	25.40 $\pm$ 13.96
< 25	75 (60.48)
$\geq 25$	49 (39.52)
Duration of diabetes (yr)	11.20 $\pm$ 10.50
< 10	68 (54.84)
$\geq 10$	56 (45.16)
HbA1c (%) <sup>a)</sup>	7.74 $\pm$ 1.63
< 7	37 (35.24)
$\geq 7$	68 (64.76)
Depression	7.71 $\pm$ 9.74
No (< 21)	112 (90.32)
Yes ( $\geq 21$ )	12 (9.68)

Values are presented as mean  $\pm$  standard deviation or number (%). HbA1c, glycosylated hemoglobin.

<sup>a)</sup>Nineteen of the participants was missed.

mean age of the participants was 64.6  $\pm$  9.5 years, ranging from 46 to 85 years. In terms of age groups, 52% of the men were younger than 65 years and 48% were older than 65 years. Of the participants, 87% were living with a spouse. The mean body mass index (BMI) was 25.4 kg/m<sup>2</sup>, and 40% of the participants had a BMI  $\geq 25$  kg/m<sup>2</sup> (overweight). Forty-five point two percent (45.2%) had T2DM for  $\geq 10$  years, and the mean duration of T2DM was 11.2  $\pm$  10.5 years. The mean HbA1c level was 7.7%  $\pm$  1.6%, with 65% of the participants with a HbA1c level  $\geq 7$ %. Approximately 10% of the participants had depressive symptoms (CES-D score  $> 21$ , Table 1).

### Prevalence of LUTS and ED

The mean IPSS score was 9.2  $\pm$  6.5. In terms of LUTS severity, 46.8% of the participants were in the mild group, 44.4% were in the moderate group, and 8.9% were in the severe group (Table 2). Of the scores of individual LUTS (range, 0–5), nocturia showed the highest score with a mean of 2.0, followed by weak stream (mean, 1.9) and incomplete bladder emptying (mean, 1.2; Table 3).

The mean IIEF-5 score for ED was 7.3  $\pm$  8.6. In terms of ED severity, 11.3% of the participants had no ED, 10.5% had mild ED, 9.7% had mild to moderate ED, 1.6% had moderate ED, and 66.9% had severe ED (Table 2).

### Correlations Between LUTS, ED, Age, Duration of Diabetes, HbA1c Levels, and Depression

LUTS showed a statistically significant positive correlation with depression ( $r = 0.33$ ,  $P < 0.001$ ) and a negative correlation with

**Table 2.** Prevalence of lower urinary tract symptoms and erectile dysfunction (n = 124)

Characteristic	Value
Lower urinary tract symptoms	9.2 $\pm$ 6.5
Mild (0-7)	58 (46.77)
Moderate (8-19)	55 (44.35)
Severe ( $\geq 20$ )	11 (8.87)
Erectile dysfunction	7.26 $\pm$ 8.61
Normal (22-25)	14 (11.30)
Mild (17-21)	13 (10.50)
Mild to moderate (12-16)	12 (9.70)
Moderate (8-11)	2 (1.60)
Severe ( $\leq 7$ )	83 (66.90)

Values are presented as mean  $\pm$  standard deviation or number (%).

ED ( $r = -0.26$ ,  $P = 0.003$ ), indicating that diabetic men with worse LUTS tended to have more severe depression and/or worse ED.

ED was significantly negatively correlated with age ( $r = -0.44$ ,  $P < 0.001$ ), duration of diabetes ( $r = -0.026$ ,  $P = 0.004$ ), and depression ( $r = -0.24$ ,  $P = 0.008$ ), indicating that older men, those with a longer duration of diabetes, and/or those with more severe depression had worse ED. LUTS and ED were not significantly correlated with HbA1c level ( $r = 0.13$ ,  $P = 0.167$ ;  $r = -0.16$ ,  $P = 0.875$ ; Table 4).

## DISCUSSION

In this study, 53% of Korean men with T2DM, with a mean age of 65 years, were found to have moderate to severe LUTS (IPSS score  $> 7$ ). In a study in one diabetes clinic, Wang et al. [25] reported that 30% of 226 T2DM men aged  $< 45$  years had moderate to severe LUTS. These results demonstrate that T2DM increases the risk of moderate to severe LUTS in both old and young individuals.

It is well known that diabetes can negatively impact on the bladder and affect the more common LUTS among diabetic male patients [26]. Over 50% of patients with diabetes have been

found to exhibit bladder dysfunction characterized by large bladder capacity, diminished bladder sensation, poor contractility, and elevated postvoid residual urine [27]. Diabetic bladder dysfunction may be induced by diabetic neuropathy and/or diuresis associated with diabetes [28,29].

Of all seven LUTS assessed, the mean scores for nocturia and weak urinary stream were the highest. Sarma et al. [26] also reported that among the symptoms experienced by 170 men with T2DM, nocturia was the most common of the storage-related symptoms and weak stream was the most common of the voiding-related symptoms.

Similarly, nocturia and weak stream showed higher scores among women with T2DM, suggesting a similar severity of these symptoms between males and females with T2DM [26]. In particular, nocturia may have a severe impact on an individual's sleep quality, which in turn can negatively affect quality of life in T2DM patients [30]. Regular assessment is therefore required for the evaluation of each LUTS to improve quality of life for patients with T2DM. Moreover, Lee et al. [31] reported that a high LUTS score might be a good marker for the assessment of diabetic bladder dysfunction. Regular assessment and evaluation of LUTS is critical to detect urinary complications.

The mean IIEF-5 score in this study was 7.3, and 78% of the participants had significant ED (IIEF-5 score  $< 17$ ). According to Sasaki et al. [15], 64% of 1,118 Japanese men with T2DM (mean age, 59 years) had significant ED. Even though the mean age of their sample was slightly different, it is clear that ED is highly prevalent among T2DM men. In terms of the relationship between LUTS and ED, epidemiological community-based studies have demonstrated that LUTS are correlated with ED [16,32]. El-Sakka [33] reported that among 476 male patients with ED, there was a relationship between LUTS and both longer duration of ED and increased severity of ED, as well as between risk factors for LUTS and ED, including age and diabetes. According to Wang et al. [25], the relationship between LUTS and ED exists among younger men with T2DM. Our study also shows that

**Table 3.** Mean score of each lower urinary tract symptom (n = 124)

LUTS	Mean $\pm$ SD
Incomplete emptying	1.19 $\pm$ 1.69
Frequency	1.19 $\pm$ 1.64
Urgency	1.04 $\pm$ 1.48
Intermittency	1.12 $\pm$ 1.58
Weak stream	1.91 $\pm$ 1.86
Straining	0.71 $\pm$ 1.31
Nocturia	2.02 $\pm$ 1.40

LUTS, lower urinary tract symptoms; SD, standard deviation.

**Table 4.** Correlations between lower urinary tract symptoms, erectile dysfunction, age, duration of diabetes, HbA1c levels, and depression

	Age	BMI	Duration of diabetes	HbA1c level	Depression	ED
LUTS	0.110 (0.209)	-0.020 (0.830)	-0.010 (0.982)	0.13 (0.167)	0.330 ( $< 0.001$ )	-0.260 (0.003)
ED	-0.440 ( $< 0.001$ )	0.120 (0.193)	-0.260 (0.004)	-0.160 (0.875)	-0.240 (0.008)	

Values are presented as correlation (P-value).

HbA1c, glycosylated hemoglobin; BMI, body mass index; ED erectile dysfunction; LUTS lower urinary tract symptoms.

increased severity of LUTS in 124 men with T2DM significantly increased the severity of ED.

LUTS increase with age [16]. However, there was no obvious relationship between LUTS and age in this study. The HbA1C levels and duration of diabetes were not found to be significantly correlated with LUTS in this study.

The results of our study support the hypothesis that a longer duration of diabetes and older age lead to more severe ED. Previous studies have reported that young men with T2DM have a higher prevalence of ED [25] and that T2DM is independently associated with ED risk [12]. Early and regular assessment for ED among T2DM men may be required to improve quality of life in this group. Moreover, in this study, the prevalence of severe ED (IIEF-5 score  $\leq 7$ ) was even higher, at 66.9%. Given the high prevalence and severity of ED, both health-care providers and patients should pay greater attention to the proper and early management of the condition.

Our study showed that depression among T2DM men was significantly correlated with ED and LUTS. According to the results of the Boston Area Community Health Survey conducted by Fitzgerald et al. [34], urologic and sexual symptoms are associated with depression. Moreover, the development of ED has also been found to be associated with a highly significant increase in depressive symptoms and a marked decrease in the quality of sexual life [35].

This study had several limitations. First, LUTS and ED were assessed based on self-reporting in the context of a structured interview, without any attempt to confirm diagnosis using clinical procedures. Furthermore, the study design was cross-sectional; therefore, causal relationships could not be established. For example, it is not clear whether an improvement in glycaemic control, assessed here using HbA1c level, can lead to a reduction in LUTS and/or ED. In addition, the convenience sample comprised T2DM men from one diabetic clinic in one city in Korea and may therefore not be representative of the wider Korean population.

Randomized clinical trials with prospective repeated data collections are required to clarify the causal relationship between LUTS, ED, and the other factors assessed in this study.

In conclusion, the findings of this study demonstrate that LUTS and ED are highly prevalent among Korean men with T2DM. Of the LUTS tested, nocturia and weak stream were found to be the most common. Of the men studied, 66.9% had severe ED and diabetic men with more severe ED also tended to have more severe LUTS. More severe depressive symptoms

were associated with the more severe ED and LUTS. Regular assessment and proper management of ED and LUTS may improve quality of life among men with T2DM.

## CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

## ACKNOWLEDGEMENTS

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