BMC Urology

RESEARCH

Open Access

An evaluation of lower urinary tract symptoms in diabetic patients: a cross-sectional study

Hala Qasrawi[1], Mahmoud Tabouni[2], Sara W. Almansour[3], Mohammad Ghannam[4], Amjad Abdalhaq[5], Faris Abushamma[6,7*], Amer A. Koni[8,9] and Sa'ed H. Zyoud[9,10,11*]

Abstract

Background: Lower urinary tract symptoms (LUTS) are common among diabetic patients and represent hidden and mysterious morbidity. The pathophysiology of LUTS among diabetes mellitus (DM) patients is multifactorial. Importantly, LUTS is known to cause physical and psychological distress. Thus, this study describes LUTS among DM patients, investigates factors that may associate with it, and assesses the possible relationship between LUTS and the quality of life of diabetics.

Methods: Over 6 months, data were collected from 378 diabetic patients in primary health care clinics. Demographic and clinical characteristics, Urogenital Distress Inventory-6 (UDI-6), and Incontinence Impact Questionnaire-7 (IIQ-7) were used to collect data. Univariate and multivariate analyses were performed.

Results: Three hundred seventy-eight participants were included in this study. (29.9%) were (58–67) years old. 49% were female. Half of the cohort was overweight, and a third were obese. 81% were Type 2 DM. Almost all of them are on medical treatment. A median score of 5.50 (2.00–8.00) for the UDI-6 scale and a median score of 5 (0.00–10.00) for the IIQ-7 scale were reported. Multiple linear regression models showed that residency ($p=0.038$) and regular exercise ($p=0.001$) were significantly and negatively correlated with the UDI-6 score, while female gender ($p=0.042$), insulin use ($p=0.009$) and the presence of comorbidities ($p=0.007$) were positively correlated with this score. Furthermore, age ($p=0.040$) and body mass index (BMI) ($p<0.001$) were significantly and positively associated with the IIQ-7 score.

Conclusion: LUTS is significant morbidity among DM patients. Factors such as age, BMI, and co-morbidities exacerbate LUTS, which can be modified and controlled. On the other hand, regular exercise and weight loss strategies help diabetic patients to improve LUTS.

Keywords: LUTS, Prevalence, Diabetes mellitus, UDI-6, IIQ-7, Urinary distress symptoms

Background

Diabetes mellitus (DM) is a common health problem in developing countries [1]. Type 1 and type 2 DM have several manifestations that affect vital organs such as the kidney, heart, and vascular systems [2]. Thus, DM may lead to significant morbidity and mortality attributed to heart attacks, end-stage renal failure, and peripheral vascular disease. Nevertheless, DM is known to affect

*Correspondence: farisabushamma@hotmail.com; saedzyoud@yahoo.com

[6] Department of Medicine, College of Medicine and Health Sciences, An-Najah National University, Nablus 44839, Palestine

[9] Department of Clinical and Community Pharmacy, College of Medicine and Health Sciences, An-Najah National University, Nablus 44839, Palestine

Full list of author information is available at the end of the article

the urinary tract by several mechanisms, such as recurrent urinary tract infections (UTIs), urinary tract calculi, and bladder dysfunction [3, 4]. Recently, several studies linked DM to Lower urinary tract symptoms (LUTS), investigating factors that may exacerbate LUTS in DM patients, such as gender, the level of Hemoglobin A1C (Hba1c), and body mass index (BMI) [5, 6]. Moreover, LUTS has been proven to negatively affect the quality of life (QoL) among different cohorts of patients [7–9]. Therefore, the prevalence of LUTS among DM and factors that may exacerbate LUTS are important concerns that need to be explored and studied.

LUTS is a broad spectrum of symptoms, including storage, voiding, and incontinence [10]. In addition, LUTS in diabetic patients may represent underlying pathology such as UTIs [11–13]. Nevertheless, LUTS may represent a denovo phenomenon reflecting bladder dysfunction or bladder outlet problem, especially in men with concomitant prostate problems [14–16]. Thus, LUTS in DM requires detailed history taking and physical examination before proceeding with invasive procedures. Furthermore, lifestyle modification and risk adjustment strategies may help relieve LUTS. For instance, weight loss, decreased caffeinated drink intake, and decreased fluid intake are all strategies that have been proven to alleviate LUTS [17–19]. However, particularly in DM, further studies are required to show factors that may cause or exacerbate LUTS to create a DM-focused strategy to avoid LUTS.

Generally, DM bothers patients when complications appear [20–23]. LUTS also is known to cause physical and psychological distress [9, 24]. Thus, any measures to improve the DM patients' LUTS symptoms are paramount. However, tight control of DM is not known if it directly helps with LUTS [25–27]. Regular exercise, weight loss, and fluid adjustment were found to improve LUTS but not specifically in DM patients. Thus, a detailed analysis of LUTS in DM is required to uncover modifiable risk factors that may contribute to LUTS, thus preventing minor but significant morbidity.

In Palestine, no studies show the prevalence of LUTS among DM patients nor explore risk factors that may cause LUTS. Thus, this study aims to explore the LUTS problem among DM patients attending primary health care centers given the prevalence of LUTS and risk factors. The current study assesses the possible impact of LUTS and the quality of life among diabetic patients by analyzing the association between the severity of LUTS measured by the UDI-6 and the QoL of the patients measured by IIQ-7. We aim that the results of this study may help to help DM patients by identifying adjustable risk factors for LUTS and, consequently, alleviating their symptoms. Furthermore, in Palestine, the results of this study may act as a trigger point for policymakers and stakeholders, so a strategy to screen and identify LUTS early may be put in place, which helps DM patients to recognize their symptoms earlier and get appropriate counseling and treatment.

Methods

Study design

A cross-sectional study was designed to assess LUTS prevalence among diabetic patients and its risk factors. A questionnaire-based interview was used to collect data from study participants.

Study setting and study population

The survey was carried out in two diabetic clinics in primary health care centers of the Ministry of Health, Nablus, Palestine. The target population was diabetic patients. Data were collected between May 2021 and October 2021. During interviews, we committed to all infection control measures due to the COVID-19 pandemic including social distancing and masks. The appointments were made between 8 AM and 3 PM, which are the official hours assigned to conducting follow-up appointments for diabetic patients in the clinics studied.

Sample size and sampling method

During the study period, the approximate number of patients who visited the diabetes clinics at the Nablus health center was 2000. This number was used to determine the sample size for the current analysis. Using the Raosoft sample size calculator, a sample size of 323 was determined by setting the response distribution at 0.50, the error margin at 5% and the confidence interval at 95%. The target sample size was increased to 378 participants to improve the reliability of the research and decrease erroneous outcomes. The convenience sampling technique was used to achieve the target sample.

Inclusion and exclusion criteria

All patients who were confirmed to have DM by laboratory tests were included. These patients are also required to visit the diabetes clinics in Nablus medical center due to DM or its complications. Patients with an established diagnosis of a urogenital condition, a history of urological surgery or recurrent UTIs, or those with a psychiatric disease were excluded.

Data collection tool

The data collection tool was an Arabic-language questionnaire composed of three sections. The first section was about the demographic features. The structured questionnaire in this study was used in previously published studies [28–33]. Indeed, we asked about age (< 38,

38–47 years, 48–57 years, 58–67 years, or ≥ 68 years [34]), marital status, weight, height, residency, smoking status, alcohol intake, employment status, level of education, income, physical exercise, presence of any medical disorders, long-term medication use, type of treatment, duration of DM and last HbA1c reading. BMI was measured as weight in kilograms (kg) divided by height in meters squared (m2), based on self-reported weight and height. Based on their calculated (BMI), participants were classified into four groups: obese (BMI ≥ 30 kg/m^2), overweight (BMI = 25–29.9 kg/m^2), normal weight (BMI = 18.5–24.9 kg/m^2), or underweight (BMI < 18.5 kg/m^2) [35].

In the short form of the second section, the Urogenital Distress Inventory 6 (UDI-6) short form, which is similar to its full version, assesses the severity of urinary distress symptoms based on the level of discomfort during the past month [28–30]. UDI-6 contains six multiple-choice questions that cover three areas: irritative symptoms (questions 1–2), stress symptoms (questions 3–4), and obstructive or discomfort symptoms (questions 5–6). The participants responded to each section using a scale of four options: 'greatly', 'moderately', 'a little bit', and 'not at all'. Each answer ranged from zero to three points, with 'greatly' receiving three points and 'not at all' receiving zero points. Therefore, the highest possible UDI score is 18. The internal consistency of UDI was 0.720, tested by the Cronbach alpha coefficient. We obtained permission from the developer to use the Arabic version of this tool in our study [29].

The third section included the short versions of the Incontinence Impact Questionnaire-7 (IIQ-7). IIQ-7 is a tool designed to assess the impact of urinary incontinence on QoL. Similarly, to its full version, IIQ-7 focuses on four areas: physical activity (questions 1–2), travel (questions 3–4), social relations (question 5), and emotional well-being (questions 6–7). The severity of symptoms is rated on a scale from zero to three, while zero is the least severe, and three is the most severe [30]. The highest possible IIQ-7 score is 21. The Cronbach alpha coefficient previously tested this tool; its internal consistency was 0.894. The developer obtained approval to include the Arabic version of this tool in our study.

All scores for UDI-6 and IIQ-7 were converted to a scale of 0 to 100 to compare measures with each other [36]. UDI-6 and IIQ-7 are valid and reliable questionnaires to evaluate subjective phases of urinary incontinence and the impact of LUTS on QoL. Both tests are feasible and have a level of validation according to the ICI grades. The Arabic version of this scale was validated and used in previous studies [28–30]. They helped determine the severity of incontinence, the efficiency of treatment, and make a management plan [37, 38].

Ethics

Approvals from the Institutional Review Board of An-Najah National University and the Ministry of Health were obtained to carry out the current investigation. Before the interviews, all study aspects were discussed in detail with all patients, and we confirmed that their confidentiality was secured. After that, verbal consent was obtained.

Statistical analysis

This study used the Statistical Package for the Social Sciences (IBM-SPSS) version 21 for data analysis. We presented the characteristics as percentages and frequencies, and the questionnaire scores as medians and interquartile ranges. We used the Kolmogorov–Smirnov test to establish the normality of the variables. The Mann–Whitney and Kruskal–Wallis tests were also used to test for differences in the scores between different categories of participants. The correlations between the different scales were evaluated by Spearman correlation. Furthermore, multiple linear regressions were performed to predict the variables that had a significant relationship with UDI-6 and IIQ-7 scores. The P-value of < 0.05 was assumed significant.

Results

Demographic

A total of 378 participants participated in the study. The highest number of subjects was 58–67 years (29.9%) and had an overweight BMI (49.5%). In addition, 50.8% of the participants were men and more than half were smokers (57.7%). The majority of them were married, and approximately a third had high school educational levels (61.6%, and 31.5%, respectively), with a 46.0% living in the village area (Table 1).

Clinical characteristics

Most of our participants had T2DM with a median duration of 14 years. Among all subjects, only 3.7% were on lifestyle modification, 56.6% were on a single therapy, and the rest (39.7%) used combination therapy. In addition, most subjects had different co-morbidities other than diabetes with a percentage of 65.3% (Table 1).

Participants' responses to the UDI-6 and IIQ-7 questions

Regarding urinary distress observations, subjects scored a median of 5.50 out of 18 points (Q1–Q3, 2.00–8.00) on the UDI-6 scale, and a median of 5 out of 21 points (Q1–Q3, 0.00–10.00) points for the IIQ-7 scale.

Tables 2 and 3 represent the distribution of responses to each question in urogenital symptom scales in

Table 1 Relationship between the participants' characteristics and their UDI score and IIQ-7 score

Characteristic	Frequency (%) N = 378	UDI-6 score Median [Q1–Q3]	Mean Rank (UDI-6 score)	P-value*	IIQ-7 score Median [Q1–Q3]	Mean Rank (IIQ-7 score)	P-value*
Age category				**0.003**[a]			**< 0.001**[a]
Under 38	62 (16.4)	3 (2–6)	150.07		0 (0–3)	130.19	
38–47	34 (9.0)	5 (4–6.3)	185.13		3 (0–4.5)	146.24	
48–57	93 (24.6)	6 (1.5–8)	185.97		4 (0–9)	183.01	
58–67	113 (29.9)	6 (2–9)	191.62		7 (0–10.5)	202.59	
68 and older	76 (20.1)	6 (3–11)	224.78		9 (5–11)	245.72	
Sex				**0.007**[b]			**< 0.001**[b]
Male	192 (50.8)	5 (2–7)	174.69		3 (0–8)	169.36	
Female	186 (49.2)	6 (2–10)	204.79		7 (0–11)	210.29	
Smoking Status				0.91[b]			0.072 [b]
Smoker	218 (57.7)	6 (2–80	188.76		4 (0–8)	177.88	
Non-smoker	160 (42.3)	5 (2–9)	190.04		7 (0–10.5)	198.03	
BMI				**0.010**[a]			**< 0.001**[a]
Normal	74 (19.6)	4 (2–6)	158.34		0 (0–6.3)	138.99	
Overweight	187 (49.5)	6 (2–8)	190.78		4 (0–9)	180.52	
Obese	117 (31.0)	6 (2–10)	207.17		8 (3–12)	235.80	
Marital Status				**0.008**[b]			**0.022**[b]
Single	145 (38.4)	6.0 (3.0–11.0)	208.27		7.0 (0.0–11.0)	205.55	
Married	233 (61.6)	5.0 (2.0–7.5)	177.82		4.0 (0.0–9.0)	179.51	
Residency				**0.037**[a]			**0.027**[a]
City	168 (44.4)	4 (2–7)	174.47		3 (0–8)	172.92	
Village	174 (46.0)	6 (2–9.25)	198.43		6 (0–10)	202.68	
Refugee camp	36 (9.5)	6 (3–12)	216.49		7 (0–9)	203.19	
Educational level				**0.043**[b]			**< 0.001**[b]
School	219 (57.9)	6.0 (2.0–10.0)	199.15		7.0 (1.0–11.0)	212.36	
University	159 (42.1)	5.0 (2.0–7.0)	176.20		2.0 (0.0–8.0)	158.01	
Job				**0.013**[b]			**< 0.001**[b]
Unemployed	248 (65.6)	6.0 (2.0–9.8)	199.51		7.0 (0.0–11.0)	207.5	
Employed	130 (34.4)	4.0 (2.0–7.0)	170.41		2.0 (0.0–7.0)	155.16	
Income				**0.017**[a]			**< 0.001**[a]
Less than 2000 NIS	171 (45.2)	5 (2–8)	185.84		7 (0–11)	210.67	
2000–5000 NIS	139 (36.8)	6 (3–9)	208.70		5.5 (0–9)	188.24	
5000–10,000 NIS	58 (15.3)	4 (3–6.25)	163.16		1 (0–4.25)	142.58	
More than 10,000	10 (2.6)	3 (0–9)	137.90		0.5 (0–4)	117.20	
Type of insurance				**< 0.001**[a]			**< 0.001**[a]
None	50 (13.2)	8 (4.75–12)	250.30		9.5 (2.75–12)	240.74	
Governmental	294 (77.8)	5 (2–8)	183.59		5 (0–9)	188.44	
Private	34 (9.0)	4 (2–5.25)	151.19		0 (0–3.25)	123.35	
Place of Birth				0.859[b]			0.604[b]
In Palestine	350 (92.6)	5 (2–8)	189.78		5 (0–10)	190.31	
Outside Palestine	28 (7.4)	6 (2–7)	185.98		2.5 (0–10)	179.36	
Type of DM				**0.009**[b]			**< 0.001**[b]
Type 1 DM	73 (19.3)	4 (2–6)	159.60		0 (0–6)	134.01	
Type 2 DM	305 (80.7)	6 (2–8.75)	196.66		6 (0–10)	202.78	
Duration of DM (years)				0.069[a]			0.271[a]
1–3	42 (11.1)	3.5 (2.0–7.0)	153.65		3.5 (0.0–11.0)	192.70	
4–5	42 (11.1)	4.0 (2.8–8.3)	186.48		3.0 (0.0–8.3)	164.24	
> 5	294 (77.8)	6.0 (2.0–9.0)	195.05		5.0 (0.0–9.3)	192.65	

Table 1 (continued)

Characteristic	Frequency (%) N = 378	UDI-6 score Median [Q1–Q3]	Mean Rank (UDI-6 score)	P-value*	IIQ-7 score Median [Q1–Q3]	Mean Rank (IIQ-7 score)	P-value*
Treatment type				**0.000**[a]			**0.009**[a]
Lifestyle modification	14 (3.7)	2.5 (0–4)	106.21		1 (0–14)	167.07	
Monotherapy	214 (56.6)	5 (2–8)	180.12		4 (0–9)	176.43	
Combined therapy	150 (39.7)	6 (3–10)	210.65		7 (1–11)	210.23	
Insulin use				**0.043**[b]			0.649[b]
Yes	201 (53.2)	6 (3–9.75)	200.14		4 (0–9)	187.13	
No	177 (46.8)	4 (2–8)	177.42		6 (0–10)	192.19	
Co-morbidities				**< 0.001**[b]			**< 0.001**[b]
Yes	247 (65.3)	6 (3–10)	210.20		7 (1–10)	209.46	
No	131 (34.7)	4 (2–6)	150.47		1 (0–8)	151.87	
Total number of co-morbidities				**< 0.001**[a]			**< 0.001**[a]
0	131 (34.7)	4.0 (2.0–6.0)	150.47		1.0 (0.0–8.0)	151.87	
1	194 (51.3)	6.0 (3.0–10.0)	212.51		7.0 (1.0–10.0)	203.38	
≥ 2	53 (14.0)	6.0 (2.0–10.5)	201.76		8.0 (2.5–13.5)	231.72	
Regular Exercise				**< 0.001**[b]			**< 0.001**[b]
Yes	108 (28.6)	3 (0–6)	146.69		0 (0–4)	127.50	
No	270 (71.4)	6 (3–9)	206.62		7 (1–11)	214.30	
Alcohol intake				**0.002**[b]			**0.041**[b]
Yes	11 (2.9)	0 (0–3)	90.95		0 (0–9)	124.18	
No	367 (97.1)	6 (2–8)	192.45		5 (0–10)	191.46	

UDI-6 Urinary Distress Inventory—Short Form, IIQ-7 Incontinence Impact Questionnaire—Short Form, BMI body mass index, NIS New Israeli Shekel (1 NIS = 0.29 US Dollars)

*Significant p-values are in bold

[a] Calculated by using the Kruskal–Wallis test

[b] Calculated by using the Mann–Whitney U test

Table 2 Distribution of responses to each question in the urinary distress inventory short-form (UDI-6) on a four-point Likert scale ranged from 0 to 3 (not at all, a little bit, moderately, and greatly)

Do you experience and, if so, how much are you bothered by	Not at all n (%)	A little bit n (%)	Moderately n (%)	Greatly n (%)
"Frequent Urination?"	70 (18.5)	86 (22.8)	144 (38.1)	78 (20.6)
"Urine leakage related to urgency?"	166 (43.9)	120 (31.7)	69 (18.3)	23 (6.1)
"Urine leakage related to physical activity?"	209 (55.3)	106 (28.0)	46 (12.2)	17 (4.5)
"Small amounts of urine leakage?"	197 (52.1)	116 (30.7)	54 (14.3)	11 (2.9)
"Difficulty emptying your bladder or difficulty urinating?"	187 (49.5)	119 (31.5)	54 (14.3)	18 (4.8)
"Pain or discomfort in your lower abdominal, pelvic, or genital area?"	128 (33.9)	143 (37.8)	72 (19.0)	35 (9.3)

[a] Adapted from Uebersax et al. [28]

diabetic patients. For example, 49.7% of the study population mentioned that their urinary symptoms affect their ability to do household chores. In addition, 51.3%, 48.1%, and 50% had limitations in recreational, entertaining and social activities (respectively). The scale also showed that 55.4% of the participants decreased their ability to travel more than 30 min by car or bus. Regarding the effect on emotional health, 54.2% mentioned some kind of nervousness and depression related to their condition and 52.1% described a frustrating feeling about their symptoms (Tables 2 and 3).

Correlation between UDI-6, IIQ-7, and HbA1c readings

The responses on UDI-6 significantly correlated with their responses on the IIQ-7 scale and their last HbA1c readings ($r = 0.546$, $p < 0.001$ and

Table 3 Distribution of responses to each question in the incontinence impact questionnaire, short-form (IIQ-7) on a four-point Likert scale ranged from 0 to 3 (not at all, slightly, moderately, and greatly)

Has urine leakage (incontinence) affected your	Not at All n (%)	Slightly n (%)	Moderately n (%)	Greatly n (%)
"Ability to do household chores"	190 (50.3)	108 (28.6)	70 (18.5)	10 (2.6)
"Physical recreation such as walking, swimming or other exercises?"	184 (48.7)	118 (31.2)	58 (15.3)	18 (4.8)
"Entertaining activities (movies, concerts, etc.)?"	196 (51.9)	103 (27.2)	71 (18.8)	8 (2.1)
"Ability to travel by car or bus more than 30 min from home?"	168 (44.4)	101 (26.7)	89 (23.5)	20 (5.3)
"Participation in social activities outside your home?"	189 (50.0)	102 (27.0)	75 (19.8)	12 (3.2)
"Emotional health (nervousness, depression, etc.)?"	173 (45.8)	108 (28.6)	75 (19.8)	22 (5.8)
"Feeling frustrated?"	181 (47.9)	112 (29.6)	61 (16.1)	24 (6.3)

[a] Adapted from Uebersax et al. [28]

r = 0.163, p-value < 0.001, respectively). Likewise, their responses to IIQ-7 also significantly correlated with their last HbA1c readings (r = 0.252, p < 0.001).

Results of a univariate analysis

The correlations between each variable with the UDI-6 and IIQ-7 scores are presented in Table 1. Our analysis showed that female participants, those who are single, unemployed, have low levels of education or reside outside the city, had significantly higher scores on both scales. Similarly, both scores increase significantly with age and BMI. Additionally, certain clinical variables were significantly associated with UDI and IIQ-7 scores, such as type of diabetes and number of co-morbidities. However, there was no statistically significant association between the duration of DM and the scores of both scales. On the other hand, using insulin as part of the treatment regimen was associated with an increased UDI-6 score but without a similar increase in the IIQ-7 score.

Regarding urinary distress observations, subjects scored a median of 5.50 out of 18 points (Q1–Q3, 2.00–8.00) on the UDI-6 scale, and a median of 5 out of 21 points (Q1–Q3, 0.00–10.00) points for the IIQ-7 scale.

Participants' responses on UDI-6 were significantly correlated with their responses on the IIQ-7 scale (r = 0.546, $p < 0.001$). Likewise, their responses to UDI-6 and IIQ-7 were significantly correlated with their last HbA1c readings (0.163, $p < 0.001$; r = 0.252, $p < 0.001$, respectively).

Results of multiple linear regression analysis

All variables with a significant P-value in univariate analysis were entered in the multiple linear regression analysis. Consequently, this analysis was constructed according to BMI, residency, age, sex, marital status, education level, job, income, type of insurance, type of DM, type of treatment, insulin use, co-morbidities, total number of co-morbidities, regular exercise, alcohol intake, and last HbA1c reading. Multiple linear regression models that were estimated to explore associations with the UDI-6 score found that marital state, residency, type of insurance, regular exercise, and alcohol intake were significantly and negatively correlated with the UDI-6 score (p-values: 0.006, 0.038, < 0.001, 0.001, 0.042, respectively). However, sex, insulin use and the presence of co-morbidities were significantly and positively correlated with the UDI-6 score (p-values: 0.042, 0.009, and 0.007, respectively). According to the regression models of the IIQ-7 score, marital state, type of insurance, and regular exercise were significantly and negatively correlated with IIQ-7 (p-values: 0.039, < 0.001, and < 0.001, respectively). However, age and BMI were significantly and positively correlated with the IIQ-7 score (p values: 0.040 and < 0.001, respectively). There was no evidence of multicollinearity between the independent variables (Tables 4 and 5).

Discussion

This study shows that LUTS is a prevalent problem among DM patients with variable presentations. The LUTS has been studied frequently in Palestine among different cohorts but not among DM patients [7, 8, 39]. DM patients represent a special category as LUTS may be attributed to several reasons, such as UTIs, bladder dysfunction, and bladder outlet obstruction [40, 41]. However, in this study, we screened for LUTS, which had no obvious clinically visible reason, such as UTIs or neurological causes. The median UDI-6 score in our study was 5.50, whereas the median of IIQ7 was 5.00. Both scales showed significant correlations with each other. Therefore, the study confirms the direct negative impact of LUTS on diabetic patients' life. This new concept in Palestine shows a compelling need that strategies should be taken at all healthcare levels to identify such problems

Table 4 Multiple linear regression analysis of UDI-6 score

Model	Unstandardized coefficients		Standardized coefficients	p-value*	Collinearity statistics
	B	SE	Beta		VIF
(Constant)	2.370	1.947		0.224	
Age	0.056	0.256	0.018	0.826	3.207
Sex	0.968	0.474	0.116	**0.042**	1.557
BMI	0.305	0.361	0.051	0.400	1.785
Marital status	− 1.249	0.453	− 0.146	**0.006**	1.346
Residency	− 0.649	0.312	− 0.101	**0.038**	1.132
Education level	0.311	0.461	0.037	0.500	1.436
Job	0.026	0.554	0.003	0.963	1.921
Income	0.498	0.284	0.097	0.080	1.459
Type of Insurance	− 1.962	0.432	− 0.222	**< 0.001**	1.142
Type of DM	1.438	1.001	0.137	0.152	4.335
Type of treatment	0.011	0.464	0.001	0.981	1.819
Insulin use	1.479	0.561	0.178	**0.009**	2.175
co-morbidities	2.240	0.829	0.257	**0.007**	4.325
Total number of co-morbidities	− 0.655	0.594	− 0.105	0.271	4.355
Regular exercise	− 1.494	0.456	− − 0.162	**0.001**	1.179
Alcohol intake	− 2.467	1.209	− 0.100	**0.042**	1.147
Last HbA1c reading	0.043	0.139	0.016	0.757	1.222

Table 5 Multiple linear regression analysis of IIQ-7 score

Model	Unstandardized coefficients		Standardized coefficients	p-value*	Collinearity statistics
	B	SE	Beta		VIF
(Constant)	1.002	2.173		0.645	
Age	0.617	0.299	0.159	**0.040**	3.130
Sex	0.117	0.553	0.011	0.832	1.509
BMI	1.515	0.428	0.206	**< 0.001**	1.783
Marital status	− 1.105	0.533	− 0.104	**0.039**	1.327
Residency	− 0.182	0.366	− 0.023	0.619	1.106
Education level	0.255	0.545	0.024	0.640	1.429
Job	− 1.164	0.654	− 0.107	0.076	1.905
Income	− 0.064	0.336	− 0.010	0.848	1.448
Type of Insurance	− 1.800	0.512	− 0.164	**< 0.001**	1.141
Type of DM	− 0.200	1.014	− 0.015	0.844	3.167
Type of treatment	− 0.195	0.455	− 0.021	0.668	1.248
co-morbidities	0.194	0.982	0.018	0.844	4.317
Total number of co-morbidities	0.548	0.704	0.071	0.437	4.353
Regular exercise	− 2.619	0.538	− 0.229	**< 0.001**	1.169
Alcohol intake	− 0.064	1.421	− 0.002	0.964	1.128
Last HbA1c reading	0.287	0.163	0.084	0.079	1.195

at an early stage so avoid physical and mental exhaustion among DM patients.

The results of our study come parallel with international results as high BMI, lack of exercise and co-morbidities increase LUTS severity [33] [42]. Nevertheless, high BMI and lack of physical activity are associated with LUTS regardless of the status of DM [43]. Furthermore, it is evident that weight loss and regular

exercise improve LUTS and treat urinary incontinence among females [44]. Therefore, weight reduction and increased physical activity in a diabetic not only improve DM control and prevent serious complications but also helps DM patients to improve LUTS [45, 46].

Surprisingly, the level of HBA1c and the duration of diabetes are not shown to affect LUTS in our cohort of patients. However, several studies show a positive correlation between the degree of HBA1c and stress and urge urinary incontinence [47, 48]. The high level of HBA1c reflects poorly controlled DM, which is attributed to DM-related complications and end-organ damage, including bladder cystopathy [14, 41, 49]. Thus, we still believe that poorly controlled DM and high HBA1c are related to LUTS, especially since our results show that DM patients taking a combination of medication and insulin are more likely to have LUTS [49].

Females had higher scores on both scales, which indicates that the severity of LUTS is more common among female DM patients. This is compatible with other international studies that showed LUTS are common in women and cause great distress and embarrassment [50–52]. However, it is mandatory to assess for UTI among DM females with LUTS as LUTS, mainly incontinence exacerbates during active UTI, which is a treatable common problem among DM females [53, 54]. However, screening for asymptomatic bacteriuria is not routinely required among DM female patients, and treating asymptomatic bacteriuria does not change LUTS's rate or severity [54]. On the other hand, LUTS among diabetic males creates a challenge to diagnose and treat for several reasons, such as concomitant Benign Prostatic Enlargement in elderly diabetic patients, which may complicate the diagnostic algorithm. Thus, the pressure-flow study is a wise step for elderly diabetic patients to accurately diagnose the underlying problem, especially before potential surgical treatment such as TURP [6].

Taking into consideration all the above facts, LUTS does affect diabetic patients. Several factors may play a role in developing or worsening LUTS. Early identification of LUTS helps DM patients to avoid struggling with such annoying symptoms. Female DM patients should be offered a questionnaire to screen for LUTS. If LUTS is confirmed, appropriate evaluation and management should be followed. DM patients can take several actions to decrease LUTS, such as regular exercise, weight loss, and tight control of DM.

Limitations and strengths

This was the first study in Palestine to examine the prevalence and severity of symptoms of urinary distress in diabetic patients. However, one of the limitations of this study was the cross-sectional design, which prevented us from interpreting the causality of the significant associations in our results. Another limitation is that it took place in only two clinics, which may limit the generalizability of our data to all diabetic patients in Palestine.

Conclusions

LUTS is significant morbidity among DM patients. Several factors, such as age, BMI, and co-morbidities, exacerbate LUTS, which can be modified and controlled. Thus, a screening questionnaire should be offered mainly to DM female patients to address the severity of LUTS and its impact on QoL.

Abbreviations

LUTS: Lower urinary tract symptoms; DM: Diabetis Mellitus; QoL: Quality of life; UDI-6: Urogenital Distress Inventory-6; IIQ-7: Incontinence Impact Questionnaire-7; BMI: Body mass index; UTIs: Urinary tract infections; Hba1c: Hemoglobin A1C; kg: Kilograms; m2: Meters squared; IBM-SPSS: Statistical Package for the Social Sciences.

Acknowledgements

Not applicable.

Author contributions

HQ, MT, SWA, MG, and AA collected the data, reviewed the literature, participated in the study design, and drafted the manuscript. FA participated in the manuscript writing and provided critical input to the results' interpretations. AAK was responsible for the statistical analysis, participated in the manuscript writing, and revised the manuscript critically for important intellectual content. SZ was responsible for the study concept and design, reviewed all parts of the manuscript to enhance the intellectual content, and assisted in the final writing of the manuscript. Then, all authors reviewed and approved the final version.

Funding

No funding was received for this study.

Availability of data and materials

Due to privacy, the datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

Approvals from the Institutional Review Board of An-Najah National University and the Ministry of Health were obtained to carry out the current investigation. Before the interviews, all study aspects were discussed in detail with all patients and we confirmed that their confidentiality is secured. After that, verbal consent was obtained. The ***IRB of An-Najah National University*** approved only verbal consent. Because we did not collect any identifying information during the interview and our study did not pose a major risk to participants, An-Najah National University's IRB waived the requirement for written informed consent. The authors confirmed that all methods were performed following the relevant guidelines and regulations.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Author details

[1]Department of Radiology, An-Najah National University Hospital, Nablus 44839, Palestine. [2]Department of Anaesthesia, An-Najah National University Hospital, Nablus 44839, Palestine. [3]Arab Women Union Hospital,

Nablus 44839, Palestine. [4]UNRWA, Jerusalem, Palestine. [5]Nablus Speciality Hospital, Nablus 44839, Palestine. [6]Department of Medicine, College of Medicine and Health Sciences, An-Najah National University, Nablus 44839, Palestine. [7]Department of Urology, An-Najah National University Hospital, Nablus 44839, Palestine. [8]Division of Clinical Pharmacy, Hematology and Oncology Department, An-Najah National University Hospital, Nablus 44839, Palestine. [9]Department of Clinical and Community Pharmacy, College of Medicine and Health Sciences, An-Najah National University, Nablus 44839, Palestine. [10]Clinical Research Center, An-Najah National University Hospital, Nablus 44839, Palestine. [11]Poison Control and Drug Information Center (PCDIC), College of Medicine and Health Sciences, An-Najah National University, Nablus 44839, Palestine.

Received: 13 June 2022 Accepted: 25 October 2022
Published online: 10 November 2022

References

1. Zimmet PZ, Magliano DJ, Herman WH, Shaw JE. Diabetes: a 21st century challenge. Lancet Diabetes Endocrinol. 2014;2(1):56–64.
2. Narayan B, Nelson-Piercy C. Medical problems in pregnancy. Clin Med (Lond). 2017;17(3):251–7.
3. Fünfstück R, Nicolle LE, Hanefeld M, Naber KG. Urinary tract infection in patients with diabetes mellitus. Clin Nephrol. 2012;77(1):40–8.
4. Lin BB, Huang RH, Lin BL, Hong YK, Lin ME, He XJ. Associations between nephrolithiasis and diabetes mellitus, hypertension and gallstones: a meta-analysis of cohort studies. Nephrology (Carlton). 2020;25(9):691–9.
5. Papaefstathiou E, Moysidis K, Sarafis P, Ioannidis E, Hatzimouratidis K. The impact of Diabetes Mellitus on Lower urinary tract symptoms (LUTS) in both male and female patients. Diabetes Metab Syndr. 2019;13(1):454–7.
6. Derimachkovski G, Yotovski V, Mladenov V, Ianev K, Mladenov D. Men with LUTS and diabetes mellitus. Acta Chir Iugosl. 2014;61(1):91–4.
7. Abushamma F, Nassar N, Najjar SO, Hijaze SM, Koni A, Zyoud SH, Aghbar A, Hanbali R, Hashim H. Lower urinary tract symptoms among females with rheumatoid arthritis: a prospective cross-sectional study. Int J Gen Med. 2021;14:8427–35.
8. Ahmad QT, Saffarini JH, Samara AM, Jabri DS, Safarini ZH, Banijaber YM, Jaradat A, Abushamma F, Zyoud SH. The impact of lower urinary tract symptoms on the quality of life during pregnancy: a cross-sectional study from Palestine. BMC Urol. 2020;20(1):191.
9. Soler R, Averbeck MA, Koyama MAH, Gomes CM. Impact of LUTS on treatment-related behaviors and quality of life: a population-based study in Brazil. Neurourol Urodyn. 2019;38(6):1579–87.
10. Gajewski JB, Drake MJ. Neurological lower urinary tract dysfunction essential terminology. Neurourol Urodyn. 2018;37(S6):S25–31.
11. Stapleton A. Urinary tract infections in patients with diabetes. Am J Med. 2002;113(Suppl 1A):80s–4s.
12. Sewify M, Nair S, Warsame S, Murad M, Alhubail A, Behbehani K, Al-Refaei F, Tiss A. Prevalence of urinary tract infection and antimicrobial susceptibility among diabetic patients with controlled and uncontrolled glycemia in Kuwait. J Diabetes Res. 2016;2016:6573215.
13. Yeshitela B, Gebre-Selassie S, Feleke Y. Asymptomatic bacteriuria and symptomatic urinary tract infections (UTI) in patients with diabetes mellitus in Tikur Anbessa Specialized University Hospital, Addis Ababa, Ethiopia. Ethiop Med J. 2012;50(3):239–49.
14. Gomez CS, Kanagarajah P, Gousse AE. Bladder dysfunction in patients with diabetes. Curr Urol Rep. 2011;12(6):419–26.
15. Hill SR, Fayyad AM, Jones GR. Diabetes mellitus and female lower urinary tract symptoms: a review. Neurourol Urodyn. 2008;27(5):362–7.
16. Sarma AV, Kellogg Parsons J. Diabetes and benign prostatic hyperplasia: emerging clinical connections. Curr Urol Rep. 2009;10(4):267–75.
17. Arya LA, Myers DL, Jackson ND. Dietary caffeine intake and the risk for detrusor instability: a case–control study. Obstet Gynecol. 2000;96(1):85–9.
18. Hashim H, Abrams P. How should patients with an overactive bladder manipulate their fluid intake? BJU Int. 2008;102(1):62–6.
19. Chen CC, Gatmaitan P, Koepp S, Barber MD, Chand B, Schauer PR, Brethauer SA. Obesity is associated with increased prevalence and severity of pelvic floor disorders in women considering bariatric surgery. Surg Obes Relat Dis. 2009;5(4):411–5.
20. Coffey JT, Brandle M, Zhou H, Marriott D, Burke R, Tabaei BP, Engelgau MM, Kaplan RM, Herman WH. Valuing health-related quality of life in diabetes. Diabetes Care. 2002;25(12):2238–43.
21. Redekop WK, Koopmanschap MA, Stolk RP, Rutten GE, Wolffenbuttel BH, Niessen LW. Health-related quality of life and treatment satisfaction in Dutch patients with type 2 diabetes. Diabetes Care. 2002;25(3):458–63.
22. Smith DW. The population perspective on quality of life among Americans with diabetes. Qual Life Res. 2004;13(8):1391–400.
23. Lloyd A, Sawyer W, Hopkinson P. Impact of long-term complications on quality of life in patients with type 2 diabetes not using insulin. Value Health. 2001;4(5):392–400.
24. Batista-Miranda JE, Molinuevo B, Pardo Y. Impact of lower urinary tract symptoms on quality of life using Functional Assessment Cancer Therapy scale. Urology. 2007;69(2):285–8.
25. Rubin RR, Peyrot M. Quality of life and diabetes. Diabetes Metab Res Rev. 1999;15(3):205–18.
26. Göz F, Karaoz S, Goz M, Ekiz S, Cetin I. Effects of the diabetic patients' perceived social support on their quality-of-life. J Clin Nurs. 2007;16(7):1353–60.
27. Engelhardt M, Bruijnen H, Scharmer C, Jezdinsky N, Wolfle K. Improvement of quality of life six months after infrageniculate bypass surgery: diabetic patients benefit less than non-diabetic patients. Eur J Vasc Endovasc Surg. 2006;32(2):182–7.
28. Uebersax JS, Wyman JF, Shumaker SA, McClish DK, Fantl JA. Short forms to assess life quality and symptom distress for urinary incontinence in women: the Incontinence Impact Questionnaire and the Urogenital Distress Inventory. Continence Program for Women Research Group. Neurourol Urodyn. 1995;14(2):131–9.
29. Altaweel W, Seyam R, Mokhtar A, Kumar P, Hanash K. Arabic validation of the short form of Urogenital Distress Inventory (UDI-6) questionnaire. Neurourol Urodyn. 2009;28(4):330–4.
30. Ghroubi S, El Fani N, Elarem S, Alila S, Ben Ayed H, Borgi O, Chmak J, Elleuch MH. Arabic (Tunisian) translation and validation of the Urogenital Distress Inventory short form (UDI-6) and Incontinence Impact Questionnaire short form (IIQ-7). Arab J Urol. 2020;18(1):27–33.
31. Horowitz E, Abadi-Korek I, Shani M, Shemer J. EQ-5D as a generic measure of health-related quality of life in Israel: reliability, validity and responsiveness. Isr Med Assoc J. 2010;12(12):715–20.
32. Larsson D, Lager I, Nilsson PM. Socio-economic characteristics and quality of life in diabetes mellitus–relation to metabolic control. Scand J Public Health. 1999;27(2):101–5.
33. Stojanović M, Cvetanović G, Anđelković Apostolović M, Stojanović D, Rančić N. Impact of socio-demographic characteristics and long-term complications on quality of life in patients with diabetes mellitus. Cent Eur J Public Health. 2018;26(2):104–10.
34. Zyoud SH, Al-Jabi SW, Sweileh WM, Arandi DA, Dabeek SA, Esawi HH, Atyeh RH, Abu-Ali HA, Sleet YI, Abd-Alfatah BM, et al. Relationship of treatment satisfaction to health-related quality of life among Palestinian patients with type 2 diabetes mellitus: findings from a cross-sectional study. J Clin Transl Endocrinol. 2015;2(2):66–71.
35. Klatsky AL, Zhang J, Udaltsova N, Li Y, Tran HN. Body mass index and mortality in a very large cohort: is it really healthier to be overweight? Perm J. 2017;21:16–142.
36. Utomo E, Korfage IJ, Wildhagen MF, Steensma AB, Bangma CH, Blok BF. Validation of the Urogenital Distress Inventory (UDI-6) and Incontinence Impact Questionnaire (IIQ-7) in a Dutch population. Neurourol Urodyn. 2015;34(1):24–31.
37. Nusee Z, Rusly A, Jamalludin AR, Abdulwahab DF, Ismail R. Translation and validation of Bahasa Malaysia version of Urogenital Distress Inventory (UDI-6) and Incontinence Impact Quality of Life Questionnaires (IIQ-7), a cross sectional study. Malays J Med Sci. 2016;23(3):57–63.
38. Lasserre A, Pelat C, Guéroult V, Hanslik T, Chartier-Kastler E, Blanchon T, Ciofu C, Montefiore ED, Alvarez FP, Bloch J. Urinary incontinence in French women: prevalence, risk factors, and impact on quality of life. Eur Urol. 2009;56(1):177–83.
39. Shawahna R, Hijaz H, Jallad K, Abushamma M, Sawafta M. Prevalence of overactive bladder symptoms and their impact on health-related quality of life of medical and dentistry students: a multicenter cross-sectional study. BMC Urol. 2021;21(1):142.

40. Van Den Eeden SK, Ferrara A, Shan J, Jacobsen SJ, Quinn VP, Haque R, Quesenberry CP. Impact of type 2 diabetes on lower urinary tract symptoms in men: a cohort study. BMC Urol. 2013;13:12.
41. Yuan Z, Tang Z, He C, Tang W. Diabetic cystopathy: a review. J Diabetes. 2015;7(4):442–7.
42. Xin C, Fan H, Xie J, Hu J, Sun X, Liu Q. Impact of diabetes mellitus on lower urinary tract symptoms in benign prostatic hyperplasia patients: a meta-analysis. Front Endocrinol (Lausanne). 2021;12: 741748.
43. Hunskaar S. A systematic review of overweight and obesity as risk factors and targets for clinical intervention for urinary incontinence in women. Neurourol Urodyn. 2008;27(8):749–57.
44. Subak LL, Wing R, West DS, Franklin F, Vittinghoff E, Creasman JM, Richter HE, Myers D, Burgio KL, Gorin AA, et al. Weight loss to treat urinary incontinence in overweight and obese women. N Engl J Med. 2009;360(5):481–90.
45. van Dijk JW, van Loon LJ. Exercise strategies to optimize glycemic control in type 2 diabetes: a continuing glucose monitoring perspective. Diabetes Spectr. 2015;28(1):24–31.
46. Rejeski WJ, Ip EH, Bertoni AG, Bray GA, Evans G, Gregg EW, Zhang Q. Lifestyle change and mobility in obese adults with type 2 diabetes. N Engl J Med. 2012;366(13):1209–17.
47. Liu N, Xing L, Mao W, Chen S, Wu J, Xu B, Chen M. Relationship between blood glucose and hemoglobin A1c levels and urinary incontinence in women. Int J Gen Med. 2021;14:4105–16.
48. Ying Y, Xu L, Huang R, Chen T, Wang X, Li K, Tang L. Relationship between blood glucose level and prevalence and frequency of stress urinary incontinence in women. Female Pelvic Med Reconstr Surg. 2021.
49. Chiu AF, Huang MH, Wang CC, Kuo HC. Higher glycosylated hemoglobin levels increase the risk of overactive bladder syndrome in patients with type 2 diabetes mellitus. Int J Urol. 2012;19(11):995–1001.
50. Milsom I, Kaplan SA, Coyne KS, Sexton CC, Kopp ZS. Effect of bothersome overactive bladder symptoms on health-related quality of life, anxiety, depression, and treatment seeking in the United States: results from EpiLUTS. Urology. 2012;80(1):90–6.
51. Felde G, Ebbesen MH, Hunskaar S. Anxiety and depression associated with urinary incontinence. A 10-year follow-up study from the Norwegian HUNT study (EPINCONT). Neurourol Urodyn. 2017;36(2):322–8.
52. Coyne KS, Wein AJ, Tubaro A, Sexton CC, Thompson CL, Kopp ZS, Aiyer LP. The burden of lower urinary tract symptoms: evaluating the effect of LUTS on health-related quality of life, anxiety and depression: EpiLUTS. BJU Int. 2009;103(Suppl 3):4–11.
53. Arinzon Z, Shabat S, Peisakh A, Berner Y. Clinical presentation of urinary tract infection (UTI) differs with aging in women. Arch Gerontol Geriatr. 2012;55(1):145–7.
54. Moore EE, Jackson SL, Boyko EJ, Scholes D, Fihn SD. Urinary incontinence and urinary tract infection: temporal relationships in postmenopausal women. Obstet Gynecol. 2008;111(2 Pt 1):317–23.

Publisher's Note