The Impact of Demographic Factors and Blood Sugar Control on the Incidence of Urinary Tract Infections in Khorramabad in 2013

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Abstract

Background: Diabetes is one of the most serious metabolic disorders to affect different organs in the body. Patients with diabetes are hence at risk of developing other problems. Urinary tract infections (UTI) are one of the problems that occur more commonly in diabetic patients than in others. There are several risk factors that lead to the incidence of UTI in diabetic patients.

Objectives: We conducted this study to determine the effect of different factors on the incidence of UTI in diabetic patients in order to decrease the incidence of this problem.

Patients and Methods: In this cross-sectional study, data concerning 233 patients who were referred to the largest diabetes center in Khorramabad, Lorestan province, Iran, were recorded. The relationships between various factors and the incidence of UTI in these patients were evaluated using SPSS version 16. We used chi-square and logistic regression to analyze the data. A $P < 0.05$ was considered to be statistically significant.

Results: The incidence of UTI increased significantly with increasing age ($P = 0.009$). The incidence of UTI was higher among females than among males, and it was higher among unemployed people than among those in other occupations. The prevalence of UTI among patients who control their diabetes through diet and exercise was lower than that among those undergoing other types of treatment; however, no significant relationship was found between the different types of oral medication and the incidence of UTI. We did not find any relationship between the incidence of UTI in diabetic patients and other factors such as literacy, marital status, BMI, addiction, history of hospitalization, and level of HbA1c.

Conclusions: We found that age, gender, occupation, and the type of medication used are all risk factors for the incidence of UTI in diabetic patients. Other factors such as literacy, marital status, addiction, and history of hospitalization did not have any significant association with the incidence of UTI in diabetic patients.

Keywords: Diabetes Mellitus, Urinary Tract Infections, Risk Factors

1. Background

Diabetes is one of the most common disorders worldwide, and its prevalence is estimated to increase by 122% from 1995 to 2025 (1). Due to the increasing prevalence of diabetes, factors related to diabetes and its complications have become increasingly important (2, 3). Appropriate care, including controlling blood sugar, physical activity, and a suitable diet, can prevent some of the complications typically experienced by diabetic patients (1). People with diabetes are at a higher risk of developing urinary tract infections (UTI) (4-6), especially recurrences of UTI, compared to people without diabetes (5). There are several theories concerning this effect: 1) diabetes increases the risk of infections, of which UTI are one of the most prevalent varieties (7); 2) diabetes causes abnormalities in the host's immune system, which leads to the patients being prone to UTI (8); and 3) diabetic neuropathy causes a defect in urine discharge that results in UTI (9). Some studies have shown that patients who consume oral blood glucose-lowering medications or insulin, people who have had diabetes for more than five years, and diabetic patients with retinopathy are particularly at risk of recurrent UTI (5, 7).

The risk factors for UTI in diabetic patients are not well defined, although several risk factors have been identified: age, metabolic control, duration of morbidity, diabetic cystopathy, sexual activity, macroalbuminuria, presence of diabetic complications, and insulin therapy (7, 10). Kupelian et al. showed that the association between lower urinary tract symptoms (LUTS) and diabetes varies by gender, which indicates different mechanisms of association in men and women (11). Some studies have revealed that sexual intercourse is the most significant risk factor for symptomatic UTI in type 1 diabetic patients, whereas as-

ymptomatic bacteremia (ASB) is the most significant risk factor in type 2 diabetic patients (10). In addition, Renko et al. showed that diabetic subjects who suffer from ASB are at increased risk of albuminuria and UTI (12). Although ASB is associated with an increased risk of hospitalization in diabetic subjects, a study has suggested that its treatment does not reduce the risk of symptomatic UTI (13).

Some studies have revealed that blood glucose control is associated with acute UTI (14), while other studies failed to find a relationship between blood glucose control and acute UTI (7, 8, 10). However, Stapleton showed that blood glucose control can affect diabetes complications and, therefore, it can indirectly control UTI via its impact on bladder dysfunction (8). UTI also have an impact on patients' quality of life (15).

2. Objectives

Due to the significant impact that UTI have on diabetic patients' quality of life, we decided to evaluate the effect of demographic factors and diabetes control on the incidence of UTI in order to help decrease the prevalence of this problem.

3. Patients and Methods

We conducted an inferential cross-sectional descriptive study at a diabetes center in Khorramabad, Lorestan province, Iran, from October 2013 to January 2014. The center used in this study was the largest diabetes center in the city, as well as the only governmental and referral diabetes center in the area. Data concerning 233 patients with type II diabetes who had been actively referred to the center were recorded in this study. Their demographic factors, laboratory tests, and medications were recorded. Some 55 patients were excluded because their laboratory data were not completely recorded in their charts.

The diagnosis of UTI was based on both the laboratory records in their charts and the patients' symptoms such as dysuria and urgent or frequent urination. All clinical variables were measured based on the laboratory criteria and using laboratory equipment. The equipment calibration was regularly performed in the laboratory based on the established rules.

This study complies with the ethical standards of the Helsinki declaration as revised in 2008. The center's ethical review committee approved the final study design. The data collection sheet did not list the names of the participants and, therefore, their privacy was protected.

3.1. Sample Size Consideration

The sample size was calculated as 233 subjects considering α = 5%, a statistical power of 90% (moderate effect size), d = 0.23, and the following Equation:

$$(1) \qquad n = \frac{\left(z_{\frac{\alpha}{2}} + z_{\beta}\right)^2}{d^2} = \frac{10.49}{0.0529} = 198.3\ 198$$

Considering the 18% drop up sample, we added 35 sam-

ples to the optimal sample size and so, in total, we considered 233 samples.

3.2. Data Analyses

The relationships between the demographic factors and the incidence of UTI in diabetes patients were calculated using chi-square. We also calculated the relationships between different oral medications, as well as various laboratory factors, and the incidence of UTI using chi-square and logistic regression. A P < 0.05 was considered to be statistically significant. The odds ratio and confidence interval were recorded. The clinical characteristics of the study population were calculated as either means ± SD or No. (%) using SPSS version 16.

4. Results

4.1. Diabetes Characteristics

The patients' characteristics were collected based on variables that might be associated with diabetes and UTI, including gender, literacy, marital status, occupation, diabetes duration, age, BMI, history of addiction, hospitalization history, diabetes medication, and the most recent measurement of HbA1c (Table 1).

We began this study with 233 patients, of whom 55 patients were excluded. Of the 178 diabetic patients ultimately included in our study, 120 patients had UTI symptoms, while 58 patients did not show any UTI symptoms. The mean ± SD age was 56.09 ± 12.39 years and the mean ± SD duration of diabetes was 80.96 ± 63.27 months.

We calculated the relationship between different demographic factors and the incidence of UTI in diabetic patients. Table 1 shows that the incidence of UTI increased significantly with increasing age (P = 0.009), with the highest prevalence being found among subjects older than 70-years-old. The chi-square test also revealed a strong relationship between gender, occupation, and type of diabetes medication and the incidence of UTI. The prevalence of UTI among females was higher than that among males, and the prevalence was higher among unemployed individuals than it was among those in other occupations. The prevalence of UTI among patients who control their diabetes through diet and exercise was about 6.2%, while in patients who are prescribed oral medication it was about 32.2% and in patients who use insulin it was 46.7%. The prevalence of UTI among patients who take both insulin and oral medication was reported to be 50%; however, no significant relationship was found between the different types of oral medication and the prevalence of UTI (Table 2). We did not find any relationship between the incidence of UTI in diabetic patients and other factors such as literacy, marital status, BMI, addiction, history of hospitalization, and level of HbA1c (Table 1). The serologic factors that are presented as mean ± SD in Table 3 did not have a significant relationship with UTI in diabetic patients.

Table 1. Baseline Characteristics of the Patients[a]

	Patients Without UTI	Patients With UTI	Total	P Value[b]
Patients	120 (67.4)	58 (32.6)	178 (100)	NA
Age, y				0.009
11 - 30	3 (60)	2 (40)	5 (100)	
31 - 50	30 (73.2)	11 (26.8)	41 (100)	
51 - 70	74 (68.5)	34 (31.5)	108 (100)	
≥ 71	4 (26.7)	11 (73.3)	15 (100)	
Unknown	9 (100)	NA	9 (100)	
Literacy				0.701
Illiterate	35 (60.3)	23 (39.7)	58 (100)	
Undergraduate	54 (65.1)	29 (34.9)	83 (100)	
Graduate and above	10 (71.4)	4 (28.6)	14 (100)	
Unknown	21 (91.3)	2 (8.7)	23 (100)	
Gender				0.045
Male	30 (56.6)	23 (43.4)	53 (100)	
Female	90 (72)	35 (28)	125 (100)	
Marital status				0.622
Single	20 (71.4)	8 (28.6)	28 (100)	
Married	100 (66.7)	50 (33.3)	150 (100)	
Occupation				0.038
Unemployed	84 (73.7)	30 (26.3)	114 (100)	
Employee	3 (42.9)	4 (57.1)	7 (100)	
Self-employed	12 (63.2)	7 (36.8)	19 (100)	
Retired	16 (50)	16 (50)	32 (100)	
Unknown	5 (83.33)	1 (16.67)	6 (100)	
Diabetes duration, y				0.765
< 5	52 (69.3)	23 (30.7)	75 (100)	
5 - 10	33 (70.2)	14 (29.8)	47 (100)	
≥ 10	32 (64)	18 (36)	50 (100)	
Unknown	3 (50)	3 (50)	6 (100)	
BMI, kg/m^2				0.745
< 18.5	5 (83.3)	1 (16.7)	6 (100)	
18.5 - 25	26 (63.4)	15 (36.6)	41 (100)	
25 - 30	71 (68.9)	32 (31.1)	103 (100)	
≥ 30	16 (64)	9 (36)	25 (100)	
Unknown	2 (66.66)	1 (33.34)	3 (100)	
Addiction				0.935
No	105 (67.3)	51 (32.7)	156 (100)	
Yes	15 (68.2)	7 (31.8)	22 (100)	
Hospitalization history				0.537
No	89 (77.4)	26 (22.6)	115 (100)	
Yes	12 (70.6)	5 (29.4)	17 (100)	
Unknown	19 (41.3)	27 (58.7)	46 (100)	
Medicine				0.045
Diet and exercise	15 (93.8)	1 (6.2)	16 (100)	
Oral	88 (67.7)	42 (32.3)	130 (100)	
Insulin	16 (53.3)	14 (46.7)	30 (100)	
Oral and insulin	1 (50)	1 (50)	2 (100)	
HbA1c, %				0.220
< 7	24 (82.8)	5 (17.2)	29 (100)	
≥ 7	54 (71.1)	22 (28.9)	76 (100)	
Unknown	42 (57.53)	31 (42.47)	73 (100)	

Abbreviation: NA, not available.
[a]Values are expressed as No. (%).
[b]Chi-square.

Table 2. The Relationship Between Different Oral Medications and the Prevalence of UTI

	Patients Without UTI	Patients With UTI	Total	P Value[a]	Odds Ratio[b]	95% Confidence Interval
Metformin	84 (69.7)	37 (30.6)	121 (100)	0.405	0.462	0.203 - 1.053
Glibenclamide	60 (62.5)	36 (37.5)	96 (100)	0.130	2.437	1.106 - 5.371
Glutazone	3 (75)	1 (25)	4 (100)	0.743	0.720	0.071 - 7.346

[a]Chi-square.
[b]Logistic regression.

Table 3. The Relationship Between Serological Variables and the Prevalence of UTI[a]

	Patients Without UTI	Patients With UTI	Total	P Value[b]	Odds Ratio[c]	95% Confidence Interval
FBS	160.08 ± 55.061	173.37 ± 74.869	164.39 ± 62.26	0.236	1.167	0.763 - 1.786
BS	234.71 ± 82.382	250.17 ± 94.628	239.65 ± 86.46	0.314	1.000	0.988 - 1.012
HbA1c	7.7752 ± 1.43058	8.1630 ± 1.30034	7.87 ± 1.40	0.217	1.000	0.992 - 1.007

[a]Values are expressed as mean ± SD unless otherwise indicated.
[b]Chi-square.
[c]Logistic regression.

5. Discussion

Diabetes is a chronic disease that causes many difficulties for suffers. It affects whole body systems. People who have diabetes are several times more likely to suffer UTI than people who do not have this problem (16). The middle east is estimated to witness the largest increase in the prevalence of diabetes by 2030. More than 1% of the Iranian urban population over 20-years-old develops type 2 diabetes each year (17). The overall findings of this study indicate that the age of diabetic patients has a significant relationship with their likelihood of suffering from UTI. In other studies, such as those by Kojaiibidgoli et al. and Geerlings et al. age has been introduced as a risk factor for UTI in diabetic patients (16, 18). However, other studies, including those by Boroumand et al. and Ishay et al. did not find a significant relationship between age and UTI in diabetic patients (19, 20). Furthermore, Gaymans et al. revealed that age can be a risk factor for ASB, although it was not correlated with the development of UTI during follow-up (21). The fact that a longer duration of diabetes and changes in the host's defense mechanisms were significant predictors of UTI in diabetes patients could explain why a higher age is associated a higher incidence of UTI in this study (22, 23).

Furthermore, we found that medical therapy for diabetics also has a significant relationship with UTI; however, there was no association between different types of oral medication and the incidence of UTI. In a study by Gorter et al. it was found that diabetic patients who take medications (particularly insulin) to reduce their blood glucose are at risk of recurrent UTI (5). A study by Boyko et al. revealed that a significantly higher risk of asymptomatic UTI is related to the type of medication, namely insulin treatment in all multivariable models and oral medication treatment in one model (7). Nevertheless, in a study by Kojaiibidgoli et al. there was no significant relationship found between the type of diabetes treatment and UTI (16).

However, the duration of diabetes is related to insulin administration (24). Similar to our study, some previous studies have shown that the duration of diabetes has no effect on the risk of acute UTI (4, 16). In this regard, Boyko et al. concluded that the risk of UTI is similar in postmenopausal women with a history of diabetes spanning more than ten years and those who have had diabetes for less than ten years (24). In contrast, in a randomized study Boyko et al. showed that the risk of UTI increases with an increasing duration of diabetes (7). Moreover, Gorter et al. showed that women who suffer from diabetes for more than five years are at a high risk of recurrent UTI (5).

In our study, we did not find any relationship between glycemic control and UTI, which is similar to the findings of other studies (4, 5, 7, 25). For instance, in a study conducted by Geerlings et al. no relationship was found between age and HbA1c in diabetic patients with UTI (10). The results of Boroumand et al's study on Iranian women with type II diabetes are consistent with the results of our study (20).

In a study by Yismaw et al. candiduria was found to be increased in women (74.3%) (26). Kupelian et al. showed that the patterns of UTI in males and females are different, which may indicate different mechanisms as well as anatomical differences between the urinary tracts of the two genders (11). A study by Muller et al. revealed that the risk of recurrent UTI increased in women with type I diabetes (14).

We did not find any relationship between BMI and the incidence of UTI; however, in a survey by Geerlings et al. a lower BMI was found to be a risk factor for ASB in those with type II diabetes (25). It is noteworthy that this relationship might be accidental, since the OR was near to 1 (OR = 0.96) and, besides, in the multivariate analysis BMI was not found to be a risk factor (25).

We also found a significant relationship between the patients' occupation and the incidence of UTI. Although we could not identify similar findings in the literature, this may be due to the fact that the association between the incidence of UTI in diabetic patients and the patients' occupations has not been previously investigated. Therefore, it is highly recommended that future studies focus on this issue. Moreover, we have evaluated the association between some other factors, including literacy, marital status, addiction, and history of hospitalization, with the incidence of UTI in diabetic patients, which is another area that has been overlooked in previous studies. The results of our study did not indicate any significant association between these factors and UTI. Hence, in order to verify these results, it is recommended that researchers should also consider these factors in their future studies.

There are various limitations to this study in terms of what it covers and what it leaves out. The lack of data in some patients' records (i.e., occupation, literacy, etc.) should also be mentioned as a weak point of our study. Yet, there are some strengths of our study that deserve to be mentioned. In particular, to the best of our knowledge, this is the first study to examine the management of diabetes and UTI prevalence that has been conducted in Iran.

Acknowledgments

Footnote

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