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ERECTILE DYSFUNCTION IN MEN WITH TYPE 2 DIABETES: IS IT ASSOCIATED WITH POOR GLYCEMIC CONTROL?

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ABSTRACT

Background and Objective

Erectile dysfunction (ED) is a widespread clinical issue with many new cases diagnosed every year. The prevalence of ED in men with type 2 diabetes millitus (T2DM) ranges from 35–90%, depending on patient characteristics and the method used to diagnose it. There is inconsistent evidence about the association between ED and the degree of glycemic control in men with T2DM. Our main objective was to investigate the association between ED in patients with T2DM and poor glycemic control, as well as other factors.

Material and Methods

This is a cross-sectional study based on a self-administrated questionnaire. The study was conducted from July to September 2017at King Saud University-Medical City, Riyadh, Saudi Arabia. Participants in this study were older than 18-years-old. The data from the questionnaire were analyzed using the SPSS program (Armonk, NY, USA).

Results

The prevalence of ED is 80.5%, while a severe degree is seen at 33%. There were several factors significantly associated with it, including age (p-value = 0.01), education level (p-value = 0.01), monthly income (p-value = 0.01), occupation status (p-value = 0.01), duration of diabetes (p-value = 0.01), type of treatment of diabetes (p-value = 0.01), and diabetes status (p-value = 0.01). Increasing age (above 60 years of age), duration, and uncontrolled diabetes were associated with a high risk of developing ED.

Conclusion

ED was highly prevalent in patients with T2DM and poor glycemic control, as well as advanced age and duration of diabetes: each was associated with increased risk of ED.

Keywords: *Erectile dysfunction, diabetes, sexual dysfunction, glycemic control, Saudi Arabia*

Erectile dysfunction (ED) is a widespread clinical issue with many new cases diagnosed every year. ED is defined as "the inability to achieve and/or maintain penile erection sufficient for satisfactory sexual intercourse."[1] ED is correlated with modifiable cardiovascular risk factors such as diabetes mellitus, essential hypertension, lipid disorders, and smoking.[2–4] This could be attributed to the fact that systemic atherosclerosis and endothelial dysfunction affect penile vasculature, in addition to that of the coronary arteries.[5] ED is considered to be a predictor of cardiovascular disease and is found to be related to silent myocardial infarction among patients with type 2 diabetes mellitus (T2DM).[6]

The prevalence of ED in men with T2DM ranges from 35–90%, depending on patient characteristics and the method used to diagnose it.[7,8] It has also been found that the risk of ED in men with diabetes is more than three-fold compared to those without it.[2] In a country like Saudi Arabia, where its occurrence is approximately 24% of the population (and forecast to be higher in the future), ED is becoming a real problem and is often overlooked by health care professionals.[9] In addition, ED has been linked to poor quality of life among men with T2DM.[10]

There are a number of determinants which can increase the risk of ED in men with T2DM. The increased age of men with T2DM is considered to be an independent risk factor.[11,12] Along with that, it has been found that ED is more common among men with diabetes compared to those without it in the same age group.[13] Moreover, many studies indicate that longer duration of diabetes is correlated to increased risk of ED among men with T2DM.[14,15]

There is inconsistent evidence about the association between ED and the degree of glycemic control in men with T2DM. In a US study done by Rome et al., using a sample of men with T2DM, it was found that the hemoglobin A1C (HbA1C) was an independent predictor of ED.[16] Similarly, an Italian study done by Giugliano et al. among men with T2DM found a positive association between poor glycemic control and ED.[17] However, a study conducted in Iran by Ziaei-Rad et al. to assess sexual dysfunction in subjects with diabetes did not find a significant association between ED and glycemic control.[18]

In Saudi Arabia, the literature is lacking studies addressing sexually-related issues. There is a need to conduct more studies on sexual health, as these topics are not at the forefront in a conservative country. After an extensive electronic search, we found few studies addressing the association between the risk of ED and glycemic control, with contrary results. A study done by Almogbel did not find any relation between ED and glycemic control in men with T2DM.[8] Another study done by Al-Turki failed to yield any association between ED and glycemic control in those with T2DM.[19] El-Sakka et al. found a positive association between the risk of ED and poor glycemic control in Saudi men with T2DM.[14]

In this study, our aim was to investigate the association between ED and the level of glycemic control among men with T2DM. We will also explore the relationship between ED and other study variables (i.e., age, number of wives, number of children, monthly income, duration of diabetes, different treatment regimen for diabetes, and other comorbidities).

METHODS

Study Design and Site

The current study used a cross-sectional design, with a self-administered questionnaire to assess the association between the risk of ED and poor glycemic control among men with T2DM. It was conducted in a hospital-based diabetes clinic at King Saud University-Medical City, Riyadh, Saudi Arabia.

Participant Enrollment

Participants were included if they were adults (age > 18 years), married, followed in diabetes clinics for at least one year, have T2DM, and are able to write and read in Arabic. Participants with a past history of prostate disease or surgery, spinal cord injury, or anatomical penile deformities were excluded.

The collection of data was handled by 4 medical students, conducted from July to September 2017. Participants were seen at the diabetes clinic and were asked about inclusion and exclusion criteria. Participants who satisfied enrollment criteria were included in the study, in which the objectives were explained to participants; they were then asked to

sign a written consent form. After receiving permission to participate in the study, confidentiality of the information was assured.

Instrument Development, Study Variables, and Measures

The questionnaire was made up of 16 items separated into 3 sections. The first section collected the background information, which included data on participants' age, highest education level, location, monthly income, current occupation, number of wives, number of children, smoking status, duration of diabetes (years), and types of diabetes treatment. The second part was about self-reported ED, which included yes or no answers. The third section was to diagnose ED among participants by using a validated Arabic translation of the Index of Erectile Function (IIEF-5) questionnaire.[20] IIEF-5 is a concise tool which consists of only 5 questions. It is well-established, and has been used in screening for ED in previous studies: it is a scoring system which categorizes participants after summing the ordinal choices to the 5 items as follows: 22–25 no ED, 17–21 mild ED, 12–16 mild to moderate ED, 8–11 moderate ED, and 5–7 severe ED.[21]

There was a sheet attached to each questionnaire for the data collectors that would remain in the patients' electronic records. It contained 3 sections: the first was about data on height and weight, which were used to calculate body mass index (BMI) by dividing weight into kilograms (kg) by squared height in meters (m^2). The participants were categorized into the following groups: normal weight (BMI = 18.5–24.9), overweight (BMI = 25–29.9), and obese (BMI ≥ 30).[22] The second section included various biomarkers (i.e., HbA1C and a lipid profile). For these biomarkers, we took the most recent results from the last year. The final section contained records about comorbidities, which might affect erectile function; these included hypertension, dyslipidemia, and cardiovascular disease. Hypertension is defined as a systolic blood pressure > 140, diastolic blood pressure > 90, or both, and if the participants are on any antihypertensive medication.[23] Participant blood pressure was calculated from the electronic record during the last clinical visit. Dyslipidemia is considered if serum total cholesterol level is > 6.22 mmol/L, low-density lipoprotein cholesterol concentration is > 4.14 mmol/L, and high-density lipoprotein cholesterol level is < 1.04 mmol/L, or If the participant is using any lipid-lowering agents.[24] The level of glycemic control was assessed by obtaining HbA1C values. Participants were grouped into normal glycemic control (i.e., HbA1C ≤ 7) and poor control (i.e., HbA1C > 7).[25]

Sample Size Calculation

The sample size was calculated based on the average prevalence of ED among men with diabetes in the previous studies, which was about 75%.[7,8] As a result, the required sample was 289 men with T2DM in order to obtain a 95% confidence interval (CI) with a precision of ± 5%. By postulating that 15% of questionnaires will be incomplete, a sample of 340 men with T2DM was needed.

Statistical Analysis

Study participant characteristics were prescribed by using descriptive statistics. The association between ED and other study variables were examined by chi square. Multivariable logistic regression analysis was performed to predict the covariates which could lead to an increased risk of ED. As stated, the software package used was the IBM SPSS Statistics for Windows, version 22.0 to analyze the data. A *p*-value of less than 0.05 would be considered statistically significant for all analyses.

Ethical Consideration

The proposal of the study was submitted and ethically approved by the Institutional Review Board at King Saud University-Medical City.

RESULTS

A total of 340 questionnaires were distributed to men with T2DM, with 293 completed questionnaires collected (response rate 86%). Over half (53.9%) of the participants were less than 60 years of age. The majority (59.4%) had diabetes for less than 10 years and most (68.6%) used tablets for treatment. More than half (55.3%) the participants had uncontrolled diabetes (i.e., > 7) and 53.9% appeared to be obese. The prevalence of ED among participants was 80.5% with around a third (33%) suffering from severe ED. A summary of participant demographics and clinical characteristics is shown in Table 1.

TABLE 1 Participants' Demographics and Clinical Characteristics (N=293)

Participants' demographics and clinical characteristics		n (%)
Age (years)	≤60	158 (53.9)
	>60	135 (46.1)
Highest Education Level	No school attended	31 (10.6)
	Primary school attended	35 (11.9)
	Secondary school attended	41 (14)
	Tertiary school attended	71 (24.2)
	University, college or above	115 (39.3)
Location	Riyadh	228 (77.8)
	Outside Riyadh	65 (22.2)
Monthly Income	<5000 SR	83 (28.4)
	5000–10000 SR	66 (22.5)
	10001–15000 SR	88 (30)
	>15000 SR	56 (19.1)
Current Occupation	Unemployed	12 (4.1)
	Private work	64 (21.8)
	Governmental work	63 (21.5)
	Retired	154 (52.6)
Smoking Status	Never	159 (54.3)
	Current	44 (15)
	Former	90 (30.7)
Number of Wives	One	265 (90.4)
	More than one	28 (9.6)
Body Mass Index	< 25	51 (17.4)
	25–29.9	84 (28.7)
	>=30	158 (53.9)
Duration of Diabetes (years)	≤10	174 (59.4)
	>10	119 (40.6)

TABLE 1 Participants' Demographics and Clinical Characteristics (N=293) (*Continued*)

Participants' demographics and clinical characteristics		n (%)
Type of Diabetes Treatment	Diet only	13 (4.4)
	Tablets only	201 (68.6)
	Insulin only	24 (8.2)
	Tablets and Insulin	55 (18.8)
Diabetes Status	Controlled	131 (44.7)
	Uncontrolled	162 (55.3)
Hypertension	Yes	161 (54.9)
	No	132 (45.1)
Dyslipidemia	Yes	222 (75.8)
	No	71 (24.2)
Coronary Heart Disease	Yes	29 (9.9)
	No	264 (90.1)
Stroke	Yes	6 (2)
	No	287 (98)
Prevalence of ED	ED	236 (80.5)
	No ED	57 (19.5)
Severity of ED	Mild ED	39 (16.5)
	Mild to Moderate ED	70 (29.7)
	Moderate ED	49 (20.8)
	Severe ED	78 (33)

ED = erectile dysfunction; SR = Saudi Riyal.

Table 2 shows the association between ED and participant demographics along with clinical characteristics. ED was associated with 91.9% of participants above 60 years ($p < 0.001$), a lower level of education (i.e., no school or primary school attended) ($p < 0.001$), and low monthly income (< 5000 SR) ($p < 0.001$). Unemployed or retired participants suffered more from ED ($p < 0.001$). Moreover, 91.6% of participants with diabetes for over 10 years had problems with ED ($p < 0.001$). In addition, the use of insulin as a modality for its treatment was associated with ED ($p < 0.001$): 87.7% of participants with uncontrolled diabetes had

ED ($p < 0.001$). As mentioned above, there were no significant association between ED and location, smoking status, number of wives, BMI, hypertension, dyslipidemia, coronary heart disease, or stroke.

Multivariable logistic regression analysis was used to assess the risk factors which can lead to ED among men with T2DM. After adjusting for the highest education level, location, current occupation, smoking status, number of wives, BMI, type of diabetes treatment, hypertension, dyslipidemia, coronary heart disease, and stroke, three demographic and clinical characteristics were associated with an increased risk

TABLE 2 Association between Erectile Dysfunction and Participants' Demographics and Clinical Characteristics

Participants' Demographics and Clinical Characteristics		Erectile Dysfunction		P-value
		Without ED n (%)	With ED n (%)	
Age (years)	≤60	46 (29.1)	112 (70.9)	<0.01
	>60	11 (8.1)	124 (91.9)	
Highest Education Level	No school attended	0 (0)	31 (100)	<0.01
	Primary school attended	2 (5.7)	33 (94.3)	
	Secondary school attended	7 (17.1)	34 (82.9)	
	Tertiary school attended	16 (22.5)	55(77.5)	
	University, college or above	32 (27.8)	83(72.2)	
Location	Riyadh	50 (21.9)	178 (78.1)	0.045
	Outside Riyadh	7 (10.8)	58 (89.2)	
Monthly Income	<5000 SR	7 (8.4)	76 (91.6)	<0.01
	5000-10000 SR	14 (21.2)	52 (78.8)	
	10001-15000 SR	15 (17)	73 (83)	
	>15000 SR	21 (37.5)	35 (62.5)	
Current Occupation	Unemployed	2 (16.7)	10 (83.3)	< 0.01
	Governmental work	21 (33.3)	42 (66.7)	
	Private work	17 (26.6)	47 (73.4)	
	Retired	17 (11)	137 (89)	
Smoking Status	Never	30 (18.9)	129 (81.1)	0.8
	Current	10 (22.7)	34 (77.3)	
	Former	17 (18.9)	73 (81.1)	
Number of Wives	One	53 (20)	212 (80)	0.5
	More than one	4 (14.3)	24 (85.7)	
Body Mass Index	< 25	6 (11.8)	45 (88.2)	0.3
	25-29.9	17 (20.2)	67 (79.8)	
	>= 30	34 (21.5)	124 (78.5)	
Duration of Diabetes (years)	≤10	74 (27)	127 (73)	< 0.01
	>10	10 (8.4)	109 (91.6)	

TABLE 2 Association between Erectile Dysfunction and Participants' Demographics and Clinical Characteristics (*Continued*)

Participants' Demographics and Clinical Characteristics		Erectile Dysfunction		P-value
		Without ED n (%)	With ED n (%)	
Type of Diabetes Treatment	Diet only	6 (46.2)	7 (53.8)	< 0.01
	Tablets only	43 (21.4)	158 (78.6)	
	Insulin only	2 (8.3)	22 (91.7)	
	Tablets and Insulin	6 (10.9)	49 (89.1)	
Diabetes Status	Controlled	37 (28.2)	94 (71.8)	< 0.01
	Uncontrolled	20 (12.3)	142 (87.7)	
Hypertension	Yes	26 (16.1)	135 (83.9)	0.1
	No	31 (23.5)	101 (76.5)	
Dyslipidemia	Yes	44 (19.8)	178 (80.2)	0.9
	No	13 (18.3)	58 (81.7)	
Coronary Heart Disease	Yes	4 (13.8)	25 (86.2)	0.4
	No	53 (20.1)	211(79.9)	
Stroke	Yes	0 (0)	6 (100)	0.6
	No	57 (19.9)	230 (80.1)	

ED = erectile dysfunction; SR = Saudi Riyals.

of ED, while one was associated with a decreased ED risk. Risk was increased by being above 60 (OR 4, 95% CI 1.9 – 8.9), duration of diabetes lasting more than 10 years (OR 3.3, 95% CI 1.5 – 7.5), and uncontrolled diabetes (OR 2.9, 95% CI 1.5 – 5.8). However, higher monthly income was found to be protective against ED (OR 0.2, 95% CI 0.05 – 0.44) (Table 3).

DISCUSSION

The current study examined the association between ED and level of glycemic control among men with T2DM. In addition to what was investigated, there is an association between the presence of ED and other demographic and clinical characteristics of our sample.

The study supports that the prevalence of ED is higher among men with T2DM. We found that 80.5% of surveyed men with T2DM have ED and almost a third of them are suffering with severe ED, which is similar to what has been found by other studies. In a study done in Saudi Arabia by AlMogbel among men with T2DM, the prevalence of ED was 83%.[8] In another study done in Iran, Ziaei-Rad et al. found that the prevalence of sexual dysfunction was 82.5% in men with diabetes.[26] It is worth mentioning that ED prevalence is lower in developed countries. For example, Giugliano et al. found that the prevalence of ED was 60% among Italian men with diabetes[17] while Selvin et al. found that 51.3% of American men with diabetes had ED.[27] A higher prevalence of ED among our sample, compared to other studies done in developed countries, might be related to the high prevalence of a sedentary life and obesity, which plays an important role in diabetes and developing ED.[28,29]

Previous studies stated there were several major factors acting as risk factors for ED, including heart disease, depression, age, smoking, diabetes, and

TABLE 3 Factors Predicting Erectile Dysfunction among Participants with Type 2 Diabetes Mellitus

Adjusted by other variable			
Variable	P-value	OR	95% CI
Age (years)			
≤60 (ref§)	-	-	-
>60	< 0.01	4	1.9–8.9
Duration of Diabetes (years)			
≤10 (ref)	-	-	-
>10	< 0.01	3.3	1.5–7.5
Diabetes Status			
Controlled (reference group)	-	-	-
Uncontrolled	< 0.01	2.9	1.5–5.8
Monthly Income			
<5000 SR (reference group)	-	-	-
5000–10000 SR	0.19	0.5	0.18–1.4
10001–15000 SR	0.31	0.6	0.21–1.6
>15000 SR	< 0.01	0.2	0.05–0.44

CI = confidence interval; OR = odds ratio; SR = Saudi Riyals.

hypertension.[30] It was also reported that ED increased with increasing age.[31] The present study showed that age (> 60) was associated with a greater prevalence of ED: that is, 91.9% in those older than 60. Another Saudi study revealed that the prevalence of ED was 91.5% for those 60–69, and was 100% in patients 70 years and older.[8] In Jordan, one study showed that the prevalence of ED was higher with advanced age[32] In another study in the United States, it was shown that ED increased with age, whereas those between 40–70 years had a probability of developing ED that tripled from 5.1–15%.[33] Regarding education level and monthly income, there were significant associations between lower levels of education and the presence of ED, along with lower monthly income and ED; there was also a significant association between ED and being retired and unemployed. In a previous Saudi study, there was also a significant difference between patients with and without ED in terms of education level, as those with secondary education and higher showed a lower association with ED.[8] In the same study, occupation had a significant correlation, as retired and unemployed patients were more prone to ED. This study revealed that smoking was not a factor that significantly affected ED, with the number of wives and BMI not being significant factors either. Hypertension, dyslipidemia, coronary heart disease, and stroke were not significantly associated with ED in this study as well. In a multicenter cross-sectional study in Saudi Arabia, it was found that 15% of ED patients had hypertension and 56% were smokers.[34] One study[17] showed there was a positive association

between hypertension and ED, while two other studies[15,35] showed there was no association. One Saudi study[14] demonstrated a significant association between smoking and ED, while there were three studies[15,17,36] showing no connection. Several studies found that there was a correlation between ED and BMI.[14,17] Regarding the correlation between ED and dyslipidemia, Giugliano et al.[17] reported a positive association, whereas Lu et al.[35] did not. In our study, the duration of diabetes was significantly higher in patients with ED, where ED was more prevalent in those suffering from diabetes for more than 10 years. Also, uncontrolled diabetes was associated with a higher prevalence of ED. Patients who administrated insulin as the only treatment for diabetes were most affected with ED versus those who administrated other types of treatment. An Iranian study showed that ED increased with increasing duration of diabetes from 25.4% for less than 5 years to 43.5% for 12–30 years.[37] However, the duration of diabetes and presence of ED was not found in a previous Saudi study.[8] There were conflicts between the results of different studies regarding poor glycemic control and ED, with several results[14,16,17] reporting a significant correlation, and others[15,30] showing only a borderline correlation; some[38,39] showed no correlation at all. In an Iranian study, a significant difference was seen regarding type of treatment for diabetes and ED: there were 58.3% with ED receiving insulin, while 58% were administrated both insulin and oral agents.[37]

As stated, this study revealed that the risk of ED was increased by age (> 60), duration of diabetes more than 10 years and uncontrolled diabetes; however, a higher monthly income was found to be protective against ED, which demonstrates that patients with high monthly income can be treated earlier and could also afford the cost of early treatment. One study[40] confirmed a positive association between ED and a patient's age, as well as duration of diabetes; yet another study[16] reported that duration of diabetes and patient age were not correlated to ED.

There were some limitations in the current study. First, the design was cross-sectional, which indicates an association between ED and other study variables, which does not create causation. Second, the data was collected by a questionnaire, which can lead to a recall bias and affect the quality of data collected.

CONCLUSION

There was a high prevalence of ED between patients with type 2 diabetes and several risk factors for developing ED. Duration of diabetes of more than 10 years and uncontrolled diabetes were each associated with increased risk, while other risk factors included lower education level, being unemployed or retired as well as needing insulin treatment; however, higher monthly income was again associated with being less likely to develop ED. Future research should focus on the effect of improving glycemic control of erectile function among patients with diabetes and ED.

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