Prevalence of Complications of Diabetes and Risk Factors Among Patients with Diabetes in the Diabetes Clinic in Southeast of Iran

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Abstract

Objective: Academic health services play an important role in the prevention and control of diabetes mellitus (DM) in Iran. This study aimed at determining the prevalence of DM-related complications and the associated risk factors among patients with DM in a university-affiliated outpatient diabetes clinic of a referral hospital in Southeast of Iran, Zahedan.

Materials and Methods: This cross-sectional study was conducted from January to April 2019 in an academic diabetes clinic. A total of 334 patients with DM, whose characteristics (age, sex, family history of DM, and substance abuse), as well as laboratory and clinical information, were recorded in the baseline forms, were included. The relationship between variables were assessed by Pearson's correlation coefficient at *P*-value< 0.05 and using SPSS version 20.0.

Results: The mean age of the participants was 54.27 (±11.57) years. In these patients, DM type 2 was estimated at 99.1%, and the mean duration of the disease was 8.98 (±6.93) years. The findings showed that 77.2% of the patients had poor glycemic control. Also, 85.4% of the patients had fasting blood sugar (FBS) level >126 mg/dL. There was a significant relationship between insulin-dependent therapy and drug abuse (*P*-value <0.001). The prevalence of hyperlipidemia (68.9%), hypertension (50.6%), retinopathy (29.6%), nephropathy (11.7%), and neuropathy (12.3%) was also determined.

Conclusion: The majority of the patients (77.2%) in this study had poor glycemic control, and 69.9% of them suffered from microvascular complications, macrovascular complications, or both. Therefore, frequent visits accompanied by patient education could help to better diabetes control.

Keywords: Prevalence, Diabetes, Laboratory parameters, Diabetic complication

Introduction

Diabetes mellitus (DM) is a common metabolic disease that shows the phenotype of hyperglycemia. DM is caused by the complex interaction of genetic and environmental factors. The International Diabetes Federation (IDF) estimated that approximately 463 million adults (20-79 years) lived with diabetes in 2019, and this

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number is speculated to rise to 700 million by 2045 (1). The 2019 IDF Diabetes Atlas ranked the Middle East and North Africa as regions with the highest global prevalence of DM (12.2%) (2). According to a systematic review of studies conducted in Iran between 1996 and 2004, the prevalence of type 2 DM (T2DM) was estimated at 24%, which increased by 0.4% each year in people after 20 years of age (3). Approximately five million adult people were living with DM in Iran in 2017, and it is estimated that 9.2 million Iranians will develop DM by 2030 (4).

Currently, one of the most important public health issues is the increasing incidence of DM, linked to increased diabetes complications. The purpose of treatment for DM is to decrease mortality and prevent complications by control of the plasma glucose level (5). In order to manage DM, treatments focus on the control of glycated hemoglobin (A1C), blood pressure, and lipid levels, although there are many other facets of diabetes control and care, which may be also taken into consideration (5).

Estimation of the prevalence of DM complications can be challenging. Generally, complications of diabetes are classified into microvascular (retinopathy, neuropathy, and nephropathy) and macrovascular (stroke, coronary artery disease and peripheral arterial disease) complications. The risk of complications is linked to the duration of DM and the degree of glycemic control (6). However, many of these life-threatening or disabling complications can be preventable with DM care (7).

Since health problems associated with DM are a growing concern in Iran, it is important to investigate the current status of DM-related complications (8). This study aimed at determining the prevalence of DM-related complications and the associated risk factors among patients with DM in a university-affiliated outpatient diabetes clinic of a referral hospital in Southeast of Iran.

Materials and Methods

This cross-sectional study was conducted from January to April 2019 in the diabetes clinic of a university-affiliated hospital in Zahedan, Iran. All patients, who were referred to the diabetes clinic, were selected, and Eligible patients are selected by available sampling method. Some explanations were given to all of the participants about the study, and individuals who were not willing to participate in the study were excluded.

Collecting and recording research data were performed by a trained research assistant, who was blinded to the project. The patients' characteristics (age, sex, type of DM, prescribed drug, family history of DM, and substance abuse), as well as laboratory and clinical information, were recorded in the baseline forms. A medical history related to DM was also taken from the patients upon visiting.

These complications included hypertension, hyperlipidemia, retinopathy, cardiovascular and renal problems based on diagnosis of a specialists in the related field, diabetic foot, and overweight.

In addition, self-report drug abuse, hypertension (systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg), use of antihypertensive drugs, history of complications of DM, and overweight (body mass index ≥25 kg/m^2) were recorded.

Laboratory examinations, including fasting blood sugar (FBS ≥126 mg/dL) (9), blood sugar (BS <200 mg/dL), blood urea nitrogen (BUN <20 mg/dL), creatinine (Cr <1.2 mg/dL), cholesterol (Chol <200 mg/dL), triglyceride (TG <150 mg/dL), high-density lipoprotein (HDL> 45mg/dL), low-density lipoprotein (LDL <100mg/dL), and urinalysis (U/A), were also assessed (chemistry analyzer device BIOTECNICA BT3000+). HbA1c 4 to

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6.4%, 6.5 to 7.5%, and >7.5% levels has been considered as good glycemic control, fair glycemic control, and poor glycemic control respectively (10).

SPSS Statistics version 20.0, was used for statistical analysis. Descriptive statistics (frequency and percentage, mean, standard deviation) were calculated. Also, the relationship between the values of variables was assessed by Pearson's correlation and independent T-test. The statistician was blinded to the study. The level of significance was regarded at 0.05.

Ethical considerations

The local Ethics Committee affiliated with the Zahedan University of Medical Sciences approved this study (Registration code: IR.ZAUMS.REC.1399.087).

All the participants provided their informed written consent for participation in the present study.

Results

In the present study, a total of 334 patients with DM were enrolled. The mean age of the participants was 54.27 (±11.57) years. The majority of the participants were female (62.6% vs. 37.4%). In our sample, DM type 2 was estimated at 99.1%, and the mean duration of the disease was 8.98 (±6.93) years.

The results showed that the mean level of FBS was 213.4 (±86.55) mg/dL, the mean BS was 306.13 (±123.63) mg/dL, and the mean HbA1c was 9.33 (±2.03%). The mean total cholesterol was 169.9 (±49.6) mg/dL, the mean TG level was 181.1 (±103.08) mg/dL, the mean LDL was 87.16 (±36.36) mg/dL, and the mean HDL was 47.18 (±31.9) mg/dL. Moreover, the mean BUN level was 16.64 (±9.89) mg/dL, the mean Cr level was 1.1 (±1.19) mg/dL.

Differences in the characteristics, complications, and biochemical parameters between male and female diabetic patients are shown in Table 1. Regarding gender, female patients with T2DM were significantly more likely to have hypertension than men. The mean BUN level in women with T1DM was significantly higher than that of men with this type of DM. However, the level of BUN was significantly higher in men with T2DM, compared to their female counterparts.

Overall, 77.2% of the patients had poor glycemic control (HbA1c>7.5%). The findings showed that 85.4% of the patients had FBS levels >126 mg/dL. BS was >200 mg/dL in 74.2% of the subjects. Table 2 presents the comparison of parameters between diabetic patients with and without complications. According to this table, there was a significant relationship between age, duration of DM (years), insulin therapy, drug type, and complications. Most people with complications had received insulin-dependent treatments and were more likely to be in the age range of 42-68 years; duration of DM was less than 12 years in these patients. The mean BUN and Cr levels were significantly higher in patients with complications, while the mean cholesterol level was significantly lower in patients with complications.

The present results showed that the prevalence of macrovascular complications (62.3%) was much higher than microvascular complications (33.4%).

Hyperlipidemia was the most common complication reported in 68.9% of the patients, followed by hypertension in 50.6% of the patients. It was found that the prevalence of retinopathy, nephropathy, and neuropathy was 29.6%, 11.7%, and 12.3%, respectively.

Considering the microvascular and macrovascular complications, it was found that 69.9% of the patients suffered from microvascular complications, macrovascular complications, or both.

Based on the results presented in Table 3, there was a significant relationship between the age of individuals and microvascular and macrovascular complications.

There was also a significant relationship between the duration of diabetes, T2DM, type of drug, and macrovascular complications.

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Table 1: Characteristics of the Patients and Complications among them

Parameters	Type 1 diabetes			Type 2 diabetes			*P*-value
	Total N (%)	Female N (%)	Male N (%)	Total N (%)	Female N (%)	Male N (%)	
Age (years)							
≤42	18 (62.1%)	11 (68.6%)	7 (53.8%)	35 (11.7%)	21 (11%)	14 (12.8%)	
42-68	10 (34.5%)	4 (25%)	6 (46.2%)	239 (79.7%)	157 (82.2%)	82 (75.2%)	<0.001*
≥68	1 (3.4%)	1 (6.3%)	0	26 (8.7%)	13 (6.8%)	13 (11.9%)	
Treatment							
Insulin-dependent	23 (79.3%)	12 (92.3%)	11 (91.7%)	141 (47%)	96 (53.6%)	45 (44.6%)	<0.001*
Non-insulin-dependent	2 (6.9%)	1 (7.7%)	1 (8.3%)	139 (46.3%)	83 (46.4%)	56 (55.4%)	
No Drug	4 (13.8%)	3 (18.8%)	1 (7.7%)	14 (4.8%)	9 (4.8%)	5 (4.7%)	
Insulin alone	20 (69%)	11 (68.8%)	9 (69.2%)	65 (22.1%)	45 (23.9%)	20 (18.9%)	<0.001*
Tab. alone	2 (6.9%)	1 (6.3%)	1 (7.7%)	139 (47.3%)	83 (44.1%)	56 (52.1%)	
Insulin with other drugs	3 (10.3%)	1 (6.3%)	2 (15.4%)	76 (25.9%)	5 (27.1%)	25 (23.6%)	
Complications							
None	6 (20.7%)	2 (12.5%)	4 (30.8%)	29 (9.7%)	17 (8.9%)	12 (11%)	0.06
Hypertension (yes)	11 (37.9%)	4 (25)	7 (53.8%)	156 (52%)	110 (57.6%)	46 (42.2%)	0.14
P-value		0.11			0.01*		
Hyperlipidemia (yes)	17 (58.6%)	11 (68.8%)	6 (46.2%)	210 (70%)	141 (73.8%)	69 (63.3%)	0.21
Retinopathy (yes)	13 (44.8%)	7 (43.8%)	6 (46.2%)	83 (27.9%)	51 (26.8%)	32 (29.6%)	0.06
Cardiovascular (yes)	5 (17.2%)	3 (18.8%)	2 (15.4%)	75 (25.1%)	48 (25.3%)	27 (24.8%)	0.35
Renal Problems (yes)	4 (13.8%)	1 (6.3%)	3 (23.1%)	34 (11.4%)	21 (11%)	13 (12%)	0.7
Diabetic Foot (yes)	2 (6.9%)	0	2 (15.4%)	23 (7.7%)	12 (6.3%)	11 (10.2%)	0.88
Overweight (yes)	2 (6.9%)	0	2 (15.4%)	95 (31.7%)	65 (34%)	30 (27.5%)	0.005*
Biochemical assessment [a]							
FBS	228.45 (±88.4)	230.12 (±102.78)	226.38 (±70.8)	210.54 (±86.24	212.32 (±87.08)	207.43 (±85.14)	0.29
BS	311.24 (±112.73)	340.6 (±132.2)	275.07 (±72.3)	302.18 (±124.57)	295.5 (±121.8)	314.08 (±128.9)	0.71
HbA1c	9.5 (±1.44)	9.24 (±1.3)	9.8 (±1.58)	9.5 (±4.2)	9.32 (±2.1)	9.84 (±6.4)	0.98
BUN	15.18 (±7.87)	18.33 (±9.05)	11.55 (±4.13)	16.5 (±8.6)	15.59 (±8.8)	18.13 (±8.2)	0.44
P-value		0.02*			0.01*		
Cr	0.92 (±0.25)	0.88 (±0.32)	0.94 (±0.14)	1.14 (±1.08)	1.06 (±1.02)	1.26 (±1.17)	0.27
Chol	169.7 (±37.35)	170.5 (±37.05)	168.76 (±39.1)	168.62 (±48.67)	170.18 (±50.34)	165.4 (±45.6)	0.91
TG	211.25 (±120.87)	189.35 (±85.07)	234.8 (±150.5)	175.11 (±101.09)	175.4 (±95.9)	174.58 (±109.8)	0.08
HDL	36.22 (±12.5)	39 (±13.8)	33.23 (±10.67)	46.7 (±29.28)	48.23 (±35.68)	44.12 (±11.9)	0.06
LDL	81.33 (±37.5)	79.34 (±33.19)	83.46 (±42.97)	82.8 (±34.28)	85.09 (±33.6)	78.87 (±35.23)	0.83
Rbc (U/A)	4.38 (±7.28)	5.07 (±7.43)	3.69 (±7.37)	2.6 (±3.29)	2.6 (±3.32)	2.59 (±3.24)	0.02*

* Significant (*P*-value <0.05), [a] mean (±SD). Note: Chi-square and independence sample T-test used for remarkable difference analysis between two main groups and subgroups in all variables but statistically significant results were written.

Moreover, the mean BUN and Cr levels were significantly higher in patients with macrovascular complications, compared to those without these complications, whereas the cholesterol level was significantly lower. In patients with microvascular complications, only the mean BUN level was significantly higher than other patients.

Discussion

The majority of patients (n=254; 77.2%) in this study had poor glycemic control, which is comparable to studies conducted in India (74%), Cameroon (78.6%), Saudi Arabia (78%) (11-13), and other parts of the world, especially low- and middle-income countries (12, 14-17). This rate was higher than the rate estimated by the first Nationwide Diabetes Report of National Program for Prevention and Control of Diabetes (NPPCD-2016) in

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Table 2. Comparison of parameters between diabetic patients with and without complications.

Parameters	Diabetic patients with complications	Diabetic patients without complications	*P*-value
Age in years*			
≤42	23 (44.2%)	29 (55.8%)	
42-68	182 (74%)	64 (26%)	<0.001*
≥68	25 (96.2%)	1 (3.8%)	
Duration of Diabetes in years*			
≤12	155 (65.4%)	82 (34.6%)	
12-22	61 (84.7%)	11 (15.3%)	<0.001*
≥22	13 (100%)	0	
Type of diabetes			
Type I	19 (65.5%)	10 (34.5%)	0.49
Type II	211 (71.5%)	84 (28.5%)	
Treatment N (%)			
Insulin-dependent	126 (78.3%)	35 (21.7%)	0.02*
Non-insulin-dependent	92 (66.2%)	47 (33.8%)	
No Drug	6 (33.3%)	12 (66.7%)	
Insulin alone	60 (72.3%)	23 (27.7%)	<0.001*
Tab. alone	92 (66.2%)	47 (33.8%)	
Insulin with other drugs	66 (84.6%)	12 (15.4%)	
Biochemical assessment [a]			
FBS	217.05 (±92.5)	200.07 (±69.73)	0.07
BS	304.3 (±131.3)	300.92 (±103.25)	0.8
HbA1c	9.43 (±2.08)	9.74 (±6.8)	0.54
BUN	17.37 (±9.23)	13.54 (±4.34)	<0.001*
Cr	1.21 (±1.23)	0.89 (±0.14)	<0.001*
Chol	164.87 (±45.9)	177.86 (±50.7)	0.03*
TG	180.7 (±104.96)	175.31 (±100.8)	0.67
HDL	45.6 (±32.93)	46.18 (±12.76)	0.88
LDL	80.4 (±34.39)	87.87 (±33.78)	0.8

* Significant (*P*-value <0.05), [a] mean(±SD). Note: Chi-square and independence sample T-test used for remarkable difference analysis between two main groups and subgroups in all variables but statistically significant results were written.

Iran, which showed poor glycemic control in 55.9% of the patients. Also, the rate of poor glycemic control was higher than the estimates reported from developed countries, which ranged from 25% to 53% (18-20). Moreover, the results of the present study showed that HbA1c >7.5% had a significant relationship with the diabetic foot; this finding can support the results of previous studies (21-23).

A specific phenotype of dyslipidemia is particularly common in patients with DM; high plasma TG concentration, low HDL cholesterol concentration and high LDL cholesterol concentration are the characteristic features of diabetic dyslipidemia (24). The biochemical findings of this study showed that the prevalence of hyperlipidemia was 52.6% among our patients with high TG and 24% in patients with high cholesterol. Our results are consistent with previous studies, which indicated that DM is associated with increased lipolysis, TG synthesis, and free fatty acids uptake by the liver, as well as the accumulation of hepatic TG due to insulin resistance (25-27).

Similarly, our results revealed the high prevalence of hypercholesterolemia and hypertriglyceridemia, which are well-known risk factors for macrovascular complications among patients with DM. The present findings are in line with the results of a previous study, which suggested that the level of total cholesterol is usually normal or near normal if glycemic control is adequate (28).

Hyperglycemia is one of the significant reasons for progressive renal dysfunction. Typically, patients with DM must be investigated periodically for nephropathy and regularly assessed/monitored for serum BUN and Cr. Our results are in agreement with previous studies, which showed that patients with DM had significantly higher levels of BUN and Cr (29,30).

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Table 3. Micro- and Macro vascular complications.

Parameters	Micro vascular complications		Macro vascular complications	
	No	Yes	No	Yes
Gender				
Female	66 (32%)	140 (68%)	73 (35.4%)	133 (64.6%)
Male	44 (36.7%)	76 (63.3%)	49 (40.5%)	72 (59.5%)
P-value	0.39		0.36	
Age in years				
≤42	39 (73.6%)	14 (26.4%)	36 (69.2%)	16 (30.8%)
42-68	167 (67.6%)	80 (32.4%)	82 (33.1%)	166 (66.9%)
≥68	10 (38.5%)	16 (61.5%)	4 (14.8%)	23 (85.2%)
P-value	0.005*		<0.001*	
Duration of Diabetes in years				
≤12	164 (68.6%)	75 (31.4%)	103 (43.3%)	135 (56.7%)
12-22	46 (63.9%)	26 (36.1%)	15 (20.5%)	58 (79.5%)
≥22	5 (38.5%)	8 (61.5%)	2 (14.3%)	12 (85.7%)
P-value	0.07		<0.001*	
Type of diabetes				
Type I	16 (55.2%)	13 (44.8%)	16 (55.2%)	13 (44.8%)
Type II	200 (67.3%)	97 (32.7%)	106 (35.6%)	192 (64.4%)
P-value	0.18		0.04*	
Treatment N (%)				
Insulin-dependent	103 (63.2%)	60 (36.8%)	49 (30.2%)	113 (69.8%)
Non-insulin-dependent	95 (68.3%)	44 (31.7%)	60 (42.6%)	81 (57.4%)
P-value	0.35		0.03*	
No Drug	16 (88.9%)	2 (11.1%)	13 (72.2%)	5 (27.8%)
Insulin alone	49 (58.3%)	35 (41.7%)	31 (36.9%)	53 (63.1%)
Tab. alone	95 (68.3%)	44 (31.7%)	60 (42.6%)	81 (57.4%)
Insulin with other drugs	54 (68.4%)	25 (31.4%)	18 (23.1%)	60 (76.9%)
P-value	0.07		0.001*	
Biochemical assessment [a]				
FBS	212.9 (±84.8)	211 (±90.5)	205.52 (±79.8)	215.7 (±90.3)
BS	305.77 (±115.3)	297.33 (±138.3)	307 (±117.07)	301.18 (±127.4)
HbA1c	9.62 (±4.78)	9.36 (±98)	9.64 (±6)	9.41 (±2.07)
BUN	14.75 (±6.13)	19.6 (±11.5)	14.69 (±6.5)	17.18 (±9)
P-value	<0.001*		0.01*	
Cr	1.05 (±1.06)	1.24 (±1.01)	0.94 (±0.22)	1.22 (±1.290
P-value	0.14		0.02*	
Chol	168.79 (±47.8)	169.15 (±47.9)	176.88 (±49.4)	163.49 (±46.01)
P-value	0.95		0.01*	
TG	176.1 (±107.24)	184.78 (±95.2)	171.9 (±96.9)	182.09 (±107.35)
HDL	45.02 (±14.8)	47.7 (±44.5)	46.99 (±17.44)	44.99 (±33.4)
LDL	88.2 (±33.02)	82.2 (±37.68)	85.3 (±35.9)	80.59 (±33.18)

* Significant (*P*-value <0.05), [a] mean (±SD). Note: Chi-square and independence sample T-test used for remarkable difference analysis between two main groups and subgroups in all variables but statistically significant results were written.

The prevalence of retinopathy (29.6%), nephropathy (11.7%), and neuropathy (12.3%) in the present study were compared with the NPPCD-2016 report from Iran (21.9%, 17.6%, and 28.0%, respectively). However, some local studies have reported various frequencies for some complications, such as diabetic retinopathy (30-40%), diabetic nephropathy (16-87%), and diabetic peripheral neuropathy (10.9-53%) (27). It is suggested that patients with common risk factors, such as aging, longer duration of diabetes, insulin-dependent treatment, poor glycemic control, substance abuse, overweight, and hyperlipidemia, have frequent visits within short intervals (31). In fact, frequent visits may lead to better diabetes control, particularly if accompanied by health education and lifestyle counseling.

There is a limitation in the present study**.** Few patients had completed their files with specialists visits to diagnose the complications of diabetes and as a result, our sample size was small. The strength of this study is that included a large number of variables and

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examined their relationship in the study, which would be difficult to show such results in a report.

Conclusions

DM is recognized as a serious public health problem. However, health education efforts and programs seem to be inadequate for patients regarding the risk of uncontrolled glycemia. Therefore, it is essential to follow-up and control of biochemical parameters carefully in patients with diabetes. Moreover, diabetes self-management education, change of pharmacological therapy, initiation or promotion of blood glucose self-monitoring, frequent visits, and referral to endocrinologists are suggested.

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Conflict of Interest

The authors declare that they have no conflict of interests.

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