

## Original article

# Evaluation of Diabetes Knowledge Level and its Associated Factors in Patients with Type 1 and Type 2 Diabetes Mellitus in Tunisia: A Cross-sectional Study

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A good level of knowledge about diabetes can help patients manage their disease autonomously throughout their lives. The aim of our study was to evaluate the level of knowledge of Tunisian patients with diabetes about their disease and determine its associated factors. **METHODS:** A cross-sectional study was conducted. Type 1 and type 2 patients with diabetes, selected after a systematic random sampling with proportional allocation from hospitals and primary care centers monitoring chronic diseases in the Sousse region, were collected. Data collection lasted 8 months, from January 1 to August 31, 2021. Participants were provided with a self-administered questionnaire in Arabic containing demographic and clinical characteristics, diabetes data, and a validated Arabic version of the "Simplified Diabetes Knowledge Scale". **Results:** In our study, 1007 patients with diabetes were collected. The responses to the questionnaire revealed a low level of knowledge on diabetes in 71.4% of cases. Participants with secondary (adjusted OR = 2.23[1.44-3.44]) and university (adjusted OR = 3.55[2.03-6.21]) education, living in an urban area (adjusted OR = 2.49), with a T2DM (adjusted OR = 4.02[2.11-7.67]), followed therapeutic education sessions (adjusted OR = 1.55[1.6-2.26]), realized their glycemetic self-control (adjusted OR = 2.67[1.74-4.07]) and consulted regularly (adjusted OR = 1.54[1.34-1.87]) had a better level of knowledge about diabetes. Patients with diabetes with a family history of diabetes (adjusted OR = 0.68[0.48-0.98]) and complications of the disease (adjusted OR = 0.28[0.16-0.51]) had a lower level of knowledge on diabetes. **Conclusion:** Treatment education plays a crucial role in acquiring diabetes knowledge. In order to improve the knowledge level of patients with diabetes in Tunisia, educational strategies must be implemented.

**Keywords:** Knowledge; Diabetes; Therapeutic education; Tunisia.

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## 1. Introduction

Cardiovascular disease is by far one of the leading causes of death worldwide, diabetes is one of its major risk factors, and its incidence is steadily increasing [1]. In a sample of 12,000 adults aged 25-75 years, the national prevalence of diabetes was 18.2% [1]. This prevalence is underestimated because more than half of adults are unaware that they have diabetes [2]. According to the latest report of the International Diabetes Federation (IDF), there are 349,900 adults aged 20-79 in Tunisia with undiagnosed diabetes [3]. The medical costs of the disease and its complications are expensive and have serious economic and social implications. According to the latest IDF report, the average diabetes-related expenditure in Tunisia is 1887 Tunisian dinars per affected person [3]. In addition to these economic aspects, the quality of life of those affected also changes [4].

Being well-informed about diabetes is essential for treating the disease efficiently. Diabetes is a chronic disease that needs continuing management and, if not effectively controlled, can have major health effects [5]. Patients can take steps to control their illness and avoid complications by being aware of the disease, its symptoms, causes, and risk factors.

This includes understanding how to monitor blood glucose levels, make healthy food choices, engage in regular physical activity, and take medication as prescribed [5]. Having good knowledge about diabetes can help patients recognize when they need to seek medical attention and communicate effectively with healthcare providers [5]. Overall, being informed about diabetes is essential for living well with the disease and minimizing its impact on health and quality of life [5]. Several studies highlighted that poor understanding of diabetes, denial or downplaying, and resistance to lifestyle changes can worsen the quality of life of patients with diabetes [6-8].

A recent Tunisian study [6] showed that impaired quality of life of patients with type 1 (T1DM) and type 2 (T2DM) diabetes, using the "Diabetes Health Profile-18" was predicted by a low level of knowledge about diabetes. Factors associated with acquiring good diabetes knowledge can help tailor treatment strategies and improve patient engagement [9]. This process must be accompanied by high-quality therapeutic education so that patients can cope with their disease and implement changes in their daily lives [9]. The aim of this study was to evaluate the level of knowledge of Tunisian patients with diabetes about their disease and determine its associated factors.

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## 2. Patients and methods

### Study design period, and setting

A cross-sectional study was conducted. Data collection began on January 1 and ended on August 31, 2021. It took place at the diabetes departments of Sahloul and Farhat Hached university hospitals and primary care centers in the Sousse region (Tunisia).

### Study population and sampling

Patients with diabetes were recruited after a systematic random sampling with proportional allocation from hospitals and primary care centers managing chronic diseases in the Sousse region. A total of three hospital departments and six primary care centers were randomly selected (Fig. 1.).

Patients with diabetes with an age of 18 years and older, with T1DM or T2DM, whose disease is evolving for at least one year and able to read and understand an Arabic language newspaper were included. In case of patient's disability (visual impairment or motor disability), the investigator of the work completed the questionnaire under the participant's dictation.

The minimum sample size was calculated according to the Cochran formula ( $n = za/22 p (1 - p) / i^2$ ). For a proportion (p) of 59% of Tunisian patients with diabetes with good knowledge on the disease [10], a level of confidence (z) equal to 1.96 and a margin of error (i) of 5%, the size sample of patients with diabetes (n) was estimated at 372. The number was expanded to 447 patients with diabetes, considering a non-response rate of 20%.

### Data collection

A questionnaire written in Arabic was self-administered to study participants. The time required to complete the questionnaire was 15 minutes. The first section was designed to collect the demographic and clinical characteristics of the participants (age, gender, marital status, education level, socioeconomic status, habitat, Body Mass Index (BMI) [11], smoking and sedentary lifestyle). Diabetes data were also noted (type of diabetes, its age, family history of diabetes, therapeutic modalities, diabetes complications, glycemic

control with reference to the most recent measurement of glycated hemoglobin (HbA1c), previous therapeutic education sessions, glycemic self-control, foot protection and regularity of medical follow-up).

An HbA1c value below 7% and without hypoglycemia is a good indicator of glycemic control. Glycemic control is acceptable when HbA1c was between 7% and 8% (without hypoglycemia) and poor when HbA1c was above 8% [12].

The second section contained the Arabic version of the "Simplified Diabetes Knowledge Scale" (SDKS) [13]. Among the few instruments that measure the knowledge of patients with diabetes about their disease, the SDKS, in its Arabic version, met the criteria of content, conciseness, simplicity, reliability and validity. It includes the facts a patient with diabetes needs to know without overlooking the brief time needed to finish it [13].

This questionnaire contains 20 items, 18 of which are general and two are specific to insulin-treated patients with diabetes. It aims to obtain a general assessment of the patients 'knowledge on diabetes and its care. The items cover diet, exercise, glycemic control, foot care, follow-up, and complications of diabetes. Responses are in a "True/False/Don't Know" format [13].

The SDKS score [13] is represented by the proportion of correct answers: the maximum score is 18 for non-insulin treated patients with diabetes and 20 for insulin treated ones. Patients with diabetes who answered more than 65% of the questions correctly (i.e., 13/20 or 12/18 correct answers) are considered to have a good knowledge on diabetes mellitus.

### Statistical analysis

Our data analysis and statistical processing were carried out using SPSS version 21.0 software. The categorical variables were expressed in terms of number (n) and relative frequency (%). Quantitative variables were summarized by measures of central tendency (Mean: M), dispersion (Standard Deviation: SD), Minimum (Min) and Maximum (Max), after checking the normality of the variables by the Kolmogorov-Smirnov test. The crossing of two categorical variables, satisfying the condition of a theoretical number  $\geq 5$ , was carried out using the Pearson chi-square test. The significance level was set at 5% for all tests.

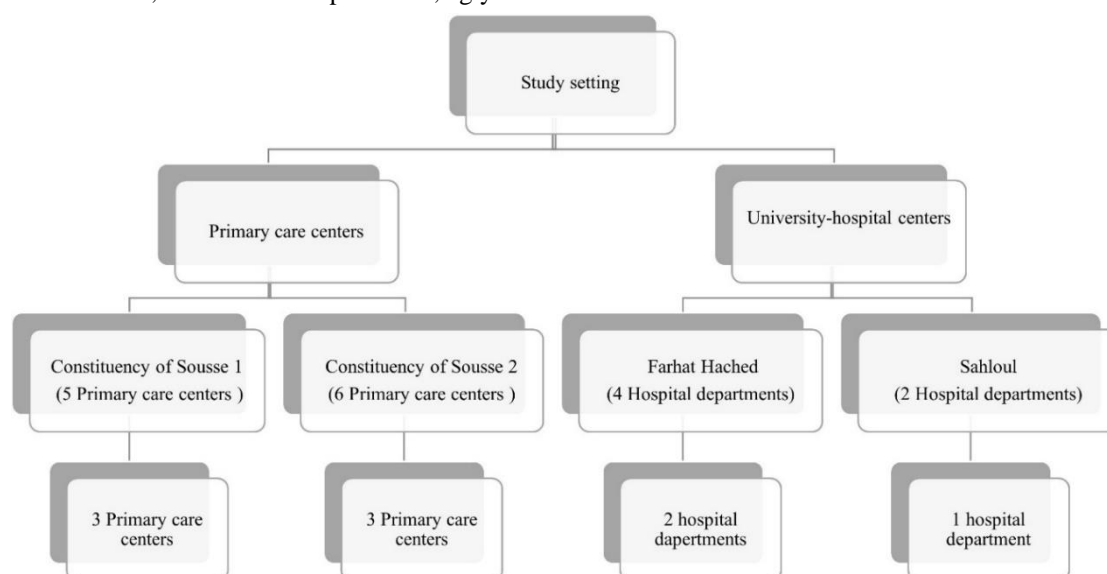


Fig. 1. Study setting after a systematic random sampling with proportional allocation from hospitals and primary care centers managing chronic diseases in the Sousse region.

To perform the multivariate analysis, variables significant at  $p \leq 0.2$  were retained. A binary logistic regression was carried out according to the "Backward: Wald" method, based on the lower reference modality, to obtain a model identifying factors associated to the level of knowledge on diabetes of patients. Some variables were forced into the initial model after studying their theoretical importance in the literature. Odds ratios (OR), adjusted OR, 95% confidence intervals (95% CI), and p-value were determined.

*Ethical considerations*

This study obtained the approval of the Human Research Ethics Committee of the Faculty of Medicine of Sousse on July 27, 2020, under the reference CEFMS 54 / 2020. Participants were asked to read and sign a consent form written in Arabic, validated by the same Ethics Committee.

**3. Results**

*Demographic and clinical characteristics of patients with diabetes*

In our study, 1007 subjects, whose age is greater than or equal to 40 years in 85.9 % of cases, were recruited. The sex ratio (male/female) was 1.26 (44.2% female versus 55.8% male). They were married in 72.9 % of cases. They had a primary education in 39.2% of cases. Secondary or higher education was found in 37.2% and 23.6% respectively. An average socioeconomic status was found in 65.1% of cases and urban areas were lived in 80.5% of cases. In 53.5% of the cases, patients with diabetes were not working. They were overweight or obese in 51.9% of cases. Smoking and sedentary lifestyle were reported in 37.8% and 87.4% of cases respectively.

*Diabetes data description*

In our study, 81.5% of the patients were T2DM. A family history of diabetes was noted in 74.6% of cases. The age of the disease was less than 10 years in 53.3% of cases. Insulin was injected by 55.3% of patients with diabetes (Table 1).

Only 38.2% of patients with diabetes had diabetic complications of which 13.8% had at least three organs affected. Glycemic control was poor (HbA1c>8%) in 40.5% of patients. Almost half of them (42.8%) had already received therapeutic education sessions.

Self-glycemic control was practiced in 45.9% of patients. Regular medical follow-up was found in 55.6% of them. Only 9.6% were wearing preventive foot protection devices.

*Knowledge level of Tunisian patients with diabetes about their disease, measured by the SDKS*

Patients with diabetes (71.4%) had a low level of knowledge about their disease, regardless of the treatment received (mean diabetes knowledge score  $\leq 0.65$ ) (Table 2).

*Level of knowledge on diabetes in the health structures of the Sousse region*

Patients with diabetes who consulted in primary care centers had a significantly lower level of knowledge on diabetes compared to those who consulted in university hospital

centers ( $p < 10^{-3}$ ) (Table 3).

Table 1. Diabetes data description in the study participants (n=1007)

Diabetes data		n	%	
Type of diabetes	Type 1	186	18.5	
	Type 2	821	81.5	
Family history of diabetes	No	256	25.4	
	Yes	751	74.6	
Duration of diabetes	<10 years	537	53.3	
	$\geq 10$ years	470	46.7	
Therapeutic modalities	Lifestyle and dietary measures only	30	3.0	
	Anti-diabetic drugs	420	41.7	
	Insulin	557	55.3	
	Complications of diabetes	No	622	61.8
	Yes	Heart	53	5.3
		Eye	92	9.1
		Kidney	28	2.8
		Foot	72	7.2
		$\geq 3$ Organs	139	13.8
		Total	385	38.2
	Glycemic control	HbA1c >8%	408	40.5
HbA1c of 7 to 8%		443	44.0	
HbA1c <7%		156	15.5	
Therapeutic education	No	576	57.2	
	Yes	431	42.8	
Glycemic self-control	No	545	54.1	
	Yes	462	45.9	
Foot protection	No	910	90.4	
	Yes	97	9.6	
Regular medical follow-up	No	447	44.4	
	Yes	560	55.6	

%: relative frequency; HbA1c: glycated hemoglobin; n: number

Table 2. Description of the responses to the SDKS items on the level of knowledge of patients with diabetes (n=1007)

Items	False answer		Correct answer	
	n	%	n	%
SDKS1	303	30.1	704	69.6
SDKS2	539	53.5	468	46.5
SDKS3	485	48.2	522	51.8
SDKS4	479	47.6	528	52.4
SDKS5	627	62.3	380	37.7
SDKS6	417	41.4	590	58.6
SDKS7	594	59.0	413	41.0
SDKS8	303	30.4	704	69.6
SDKS9	219	21.7	788	78.3
SDKS10	405	40.2	602	59.8
SDKS11	310	30.8	697	69.2
SDKS12	842	83.6	165	16.4
SDKS13	197	19.6	810	80.4
SDKS14	654	64.9	353	35.1
SDKS15	802	79.6	20	2.0
SDKS16	413	41.0	594	59.0
SDKS17	303	30.4	704	70.0
(n=557)				
SDKS18	204	36.6	353	63.4
(n=557)				
SDKS19	67	6.7	940	93.3
SDKS20	861	85.5	146	14.5
Scores du SDKS	M (SD) [Min; Max]			
Score of knowledge of patients with diabetes treated with insulin	0,52(0,17) [0,05; 0,90]			
Score of knowledge of patients with diabetes not treated with insulin	0,55(0,17) [0,11; 0,89]			
Overall diabetes knowledge score for patients with diabetes	0,53(0,17) [0,05; 0,90]			

%: relative frequency; M: mean; Max: maximum; Min: minimum; n: number; SD: standard deviation; SDKS= Simplified Diabetes Knowledge Scale

Table 3: Description of the level of knowledge on diabetes in the health structures of the Sousse region (n=1007)

Health structures	Low level of knowledge		Good level of knowledge	
	n	%	n	%
Primary care centers (n=637)	502	78.8	135	21.2
University hospital centers (n=370)	217	58.6	135	41.4

%; relative frequency; n: number

#### *Level of knowledge on diabetes based on demographic and clinical characteristics in Tunisian patients with diabetes*

Level of knowledge on diabetes varied significantly with level of education ( $p < 10^{-3}$ ), socioeconomic status ( $p < 10^{-3}$ ), habitat ( $p < 10^{-3}$ ), sedentary lifestyle ( $p < 10^{-3}$ ), glycemic control ( $p < 10^{-3}$ ), therapeutic education ( $p < 10^{-3}$ ), glycemic self-control ( $p < 10^{-3}$ ), foot protection ( $p = 0.002$ ) and regular medical follow-up ( $p < 10^{-3}$ ) (Table 4).

#### *Level of knowledge' associated factors in Tunisian patients with diabetes*

Participants with secondary (adjusted OR = 2.23[1.44-3.44]) and university (adjusted OR = 3.55[2.03-6.21]) education, living in an urban area (adjusted OR = 2.49), with a T2DM (adjusted OR = 4.02[2.11-7.67]), followed therapeutic education sessions (adjusted OR = 1.55[1.6-2.26]), realized their glycemic self-control (adjusted OR = 2.67[1.74-4.07]) and consulted regularly (adjusted OR = 1.54[1.34-1.87]) had a better level of knowledge about diabetes. Patients with diabetes with a family history of diabetes (adjusted OR = 0.68[0.48-0.98]) and complications of the disease (adjusted OR = 0.28[0.16-0.51]) had a lower level of knowledge on diabetes (Table 5).

## 4. Discussion

Our results showed that the knowledge level of patients with diabetes was low in 71.4% of cases. This result is inconsistent with other studies in Tunisia. In a study of 404 T2DM patients, 59% were satisfied with their knowledge level (measured by the study authors using a self-designed questionnaire) [10]. Our results are also not consistent with studies conducted in other Arab countries. A Moroccan study of 300 patients with T2DM showed that the general knowledge level of diabetic patients was good after administrating a self-designed questionnaire [14]. In Saudi Arabia, the responses of 942 T1DM and T2DM patients to the Diabetes Knowledge Test-2 showed an average level of knowledge on diabetes in 66% of the patients, a poor level in 29.2% and a good one in 4.7% of the patients [15]. Using the SDKS and to achieve the same objective, the results of another Saudi study showed an acceptable level of knowledge on diabetes in 191 T2D [16]. This discrepancy between our results and those of the literature could be related to the questionnaires used to assess knowledge.

A good level of knowledge on diabetes was associated with level of education, habitat, type of diabetes, family history of diabetes, complications of diabetes, therapeutic education, glycemic self-monitoring, and the regularity of the follow-up (Table 5). A family history of diabetes and

complications of the disease were associated to a lower level of knowledge on diabetes (Table 4). The level of education of patients with diabetes can have a strong impact on the disease management because it influences the acquisition of basic health and disease knowledge. Several studies confirmed that diabetes knowledge increases with education level [17,18]. They have demonstrated that the higher the level of education, the better the patient's self-management of the disease, with the main outcome being the avoidance or delay of complications [17,18]. Medical care for diabetes is expensive [3]. Patients with diabetes living in rural areas have less access to medical resources and are less familiar with new diabetes treatment technologies compared to those who are living in urban areas [19].

T2DM is typically diagnosed later in life. Many patients can manage it with lifestyle modifications or oral medications, without the need for insulin injections [20]. Since it is often associated with lifestyle factors such as diet and physical activity, patients may have more control over their diabetes management, which can empower them to learn more about the disease and take an active role in their care [20]. In contrast, patients with T1DM are typically diagnosed at a younger age and require insulin injections to manage the condition [21]. They may have less control over their blood sugar levels compared to those with T2DM [20]. T1DM is an autoimmune disease, and its management may be less straightforward and require more specialized knowledge [21].

Several authors, such as Solanki et al. [22], have demonstrated the close relationship between glycemic control, level of knowledge and complications of diabetes. According to these authors, a better knowledge of the chronic nature of the disease and the attitudes to adopt to prevent complications can help to improve glycemic control in diabetic patients [22].

Therapeutic education is particularly relevant in the adoption of a healthy lifestyle to prevent the complications of diabetes [9]. The following of hygienic and dietary rules, the practice of physical activity and the cessation of smoking are actions required by the patient. Therapeutic education provides patients with the necessary tools to acquire knowledge about their disease and treatment and to learn technical gestures such as glycemic self-control to have better manage their diabetes [23,24]. The medical follow-up, in turn, allows supporting the patient's efforts, to motivate him/her and to adapt the teaching to his/her needs. Non-compliance with appointments and education sessions will be a barrier to achieve the therapeutic goals of diabetic patients [23].

Patients with family members who have diabetes may observe their relatives' management practices, including dietary choices, physical activity, and medication adherence [23]. If the family members with diabetes demonstrate good self-care practices and knowledge, it can positively influence other family members. However, if the family lacks knowledge or follows unhealthy habits, it may perpetuate misconceptions or poor management practices [23].

A bad level of knowledge about diabetes can be associated with an increased risk of complications in patients with diabetes. A lack of knowledge about these essential aspects of the disease can result in poor self-care practices and lead to uncontrolled blood glucose levels, which over time can contribute to complications such as cardiovascular disease, nerve damage, kidney problems, or eye issues [14].



Table 4. Level of knowledge on diabetes based on demographic and clinical characteristics in Tunisian patients with diabetes (n=1007).

Variables		Level of knowledge about diabetes		p
Demographic characteristics		Low	Good	
		n (%)	n (%)	
Gender	Female	327 (73.5)	118 (26.5)	0.193
	Male	392 (69.8)	170 (30.2)	
Age (Years)	<40	103 (72.5)	39 (27.5)	0.702
	≥ 40	616 (71.2)	249 (28.8)	
Marital status	Single	104 (69.6)	45 (30.2)	0.133
	Married	516 (70.3)	218 (28.7)	
	Divorced	23 (74.2)	8 (30.2)	
	Widow(er)	76 (81.7)	17 (18.3)	
Level of education	Primary	341 (86.3)	54 (13.7)	< 10 <sup>-3</sup>
	Secondary	263 (70.3)	111 (29.7)	
	University	115 (48.3)	123 (51.7)	
Socioeconomic status	Low	210 (87.1)	31 (12.9)	< 10 <sup>-3</sup>
	Middle	445 (67.8)	211 (32.2)	
	Decent	64 (58.2)	46 (41.8)	
Habitat	Rural	176 (89.8)	20 (10.2)	< 10 <sup>-3</sup>
	Urban	543 (67.0)	268 (33.0)	
<b>Clinical characteristics</b>				
BMI	Thin	10 (71.4)	4 (28.6)	-
	Normal	322 (70.9)	132 (29.1)	
	Overweight	336 (72.1)	130 (27.9)	
	Obese	51 (69.9)	22 (30.1)	
Smoking	No	438 (70.0)	188 (30.0)	0.179
	Yes	281 (73.8)	100 (26.2)	
Sedentary lifestyle	No	73 (57.5)	54 (42.5)	<10 <sup>-3</sup>
	Yes	646 (73.4)	234 (26.6)	
<b>Diabetes Data</b>				
Type of diabetes	Type 1	137 (73.3)	49 (26.3)	0.451
	Type 2	582 (70.9)	239 (29.1)	
Duration of diabetes (years)	< 10	383 (71.3)	154 (28.7)	0.953
	≥ 10	336 (71.5)	134 (28.5)	
Family history of diabetes	No	173 (67.6)	83 (32.4)	0.117
	Yes	546 (72.7)	205 (27.3)	
Therapeutic modalities	Lifestyle and dietary measures only	12 (40.0)	18 (60.0)	0.09
	Anti-diabetic drugs	312 (74.3)	108 (25.7)	
	Insulin	395 (70.9)	162 (29.1)	
Complications of diabetes	No	426 (68.5)	196 (31.5)	0.009
	Yes	293 (76.1)	92 (23.9)	
Glycemic control	HbA1c > 8%	325 (79.7)	83 (20.3)	< 10 <sup>-3</sup>
	HbA1c of 7 to 8%	312 (70.4)	131 (29.6)	
	HbA1c < 7%	82 (52.6)	74 (47.4)	
Therapeutic education	No	459 (79.7)	117 (20.3)	< 10 <sup>-3</sup>
	Yes	260 (60.3)	171 (39.7)	
Glycemic self-control	No	455 (83.5)	90 (16.5)	< 10 <sup>-3</sup>
	Yes	264 (57.1)	198 (42.9)	
Foot protection	No	663 (72.9)	247 (27.1)	0.002
	Yes	56 (57.7)	41 (42.3)	
Regular medical follow-up	No	350 (78.3)	97 (21.7)	< 10 <sup>-3</sup>
	Yes	369 (65.9)	191 (34.1)	

%; relative frequency, BMI: body mass index, HbA1c: glycated hemoglobin, n: number, p≤ 5%; -: test not applicable

Table 5. Level of knowledge 'associated factors in Tunisian patients with diabetes (n=1007).

Variables		Adjusted OR [CI at 95%]	p		SE
<b>Demographic characteristics</b>					
Level of education	Primary	1			
	Secondary	2.23 [1.44-3.44]	<10 <sup>-3</sup>	<10 <sup>-3</sup>	0.216
	University	3.55 [2.03-6.21]	<10 <sup>-3</sup>		0.273
Habitat	Rural	1		0.003	
	Urban	2.49 [1.36-4.56]			0.300
<b>Clinical characteristics</b>					
Type of diabetes	Type 1	1		<10 <sup>-3</sup>	
	Type 2	4.02 [2.11-7.67]			0.221
Family history of diabetes	No	1		0.041	
	Yes	0.68 [0.48-0.98]			0.179
Complications of diabetes	No	1		<10 <sup>-3</sup>	
	Yes	0.28 [0.16-0.51]			0.227
Therapeutic education	No	1		0.021	
	Yes	1.55 [1.6-2.26]			0.185
Glycemic self-control	No	1		<10 <sup>-3</sup>	
	Yes	2.67 [1.74-4.07]			0.211
Regular medical follow-up	No	1		0.011	
	Yes	1.54 [1.34-1.87]			0.230

CI: confidence interval, p: signification level, SE: standard error

Our study results highlighted that managing the level of knowledge about diabetes involves providing comprehensive education, supporting self-management strategies, providing regular check-ups, promoting support systems, and encouraging continued learning. These strategies can help patients take an active role in their diabetes management and improve their overall health outcomes. Our study has some limitations that we could not escape; the self-administration of the questionnaire to patients with diabetes was likely to include self-report bias.

In conclusion, diabetes is a chronic condition that requires ongoing management, and it can have serious health consequences if not properly controlled. Having good knowledge about the disease is crucial for effectively managing it. Our study assessed the knowledge level of 1007 patients with T1DM or T2DM using the SDKS and analyzed its associated factors. The results showed that the knowledge level of patients with diabetes was low.

Understanding the level of knowledge that patients have about diabetes can help healthcare providers tailor education and support to their patients' specific needs. It can help, also, identify areas where education and support may be lacking, and inform the development of effective diabetes education programs.

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### Conflict of Interest Disclosures

All authors declare that they have no conflict of interest.

### Authors' contributions

All authors have read and agreed to the published version of the manuscript.

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