Adherence Behavior of Type-2 Diabetic Patients to Medication, Nutrition, and Physical Activity in a Population of the City of Nador North-East Morocco

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Abstract

Diabetes is a persistent condition characterized by high blood sugar levels when the body fails to regulate glucose according to its requirements. The aim of our study is to measure patients' awareness of drug treatments, insulin therapy and diet in the city of Nador. The results of the study found that the average age of the participants was 59.07±.50 years, and that 73.1% of them were women. 74.82% were overweight or obese. The medication used consists of sulfonamides and biguamides. 94.69% of patients were aware of medical nutritional therapy and the role of physical activity in reducing high blood sugar levels. A large proportion of T2DM patients follow the instructions suggested by their treating doctors, and this can help them avoid severe complications, especially cardiovascular complications. The study suggests that competent authorities make efforts to provide care for individuals with type 2 diabetes, especially those residing in rural areas. That is, there is a need to expand and enhance available health care services and resources to ensure that individuals with type 2 diabetes, regardless of their geographic location, receive appropriate care and support. This expansion could include measures such as increasing health care infrastructure, improving outreach programs, and designing services to meet the specific needs of rural communities.

Keywords: Diabetes type II, medication, insulin., diet, physical activity, Overweight-Obesity

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1. Introduction

Diabetes is a chronic disease, defined as hyperglycemia when the body is unable to regulate blood sugar levels to the body's needs[1]. The World Health Organization (WHO.) anticipates that by 2030, diabetes will rank as the 7th leading cause of global mortality[2]. Between 2000 and 2019, there was a 3% increase in mortality rates due to diabetes across different age groups. In the same year, diabetes and diabetes-related kidney diseases accounted for approximately 2 million deaths[3]. As per the WHO's 2017 data, 425 million individuals worldwide are affected by diabetes, a number that is projected to reach 629 million by 2045[4]. In 2021, over 537 million people globally, or 1 in 10 individuals, are expected to be impacted by diabetes, with 61 million cases in Europ[5].

As reported by the Ministry of Health in Morocco on World Diabetes Day in 2018, there are over 2 million individuals aged 18 and above who have diabetes[6]. Consequently, the Ministry allocates an annual budget of 156,700,000 dirhams for insulin procurement and an additional 15 million dirhams for metabolic monitoring of diabetic individuals. Notably, type 2 diabetes disrupts the body's utilization of sugar (glucose) as an energy source. The body develops resistance to insulin or fails to produce an adequate amount of insulin to fulfill its requirements, potentially resulting in elevated blood sugar levels if not properly addressed. Type 2 diabetes (T2DM) heightens the body's vulnerability to cardiovascular (CV) complications, such as coronary heart disease (CHD) leading to severe outcomes like myocardial infarction (MI) and ischemic stroke. The incidence of all diabetes types is rising, with type 2 diabetes anticipated to nearly double by the year 2035. Type 2 diabetes (T2DM) is a persistent condition, currently afflicting 4.5% of the population in France[7].

In 2017, the estimated prevalence in Tunisia for the population aged 20 to 79 was 9.8%. In Algeria and Morocco, it reached 14.4% and 10.6%, respectively, in 2018 for the population aged 18 to 79[8]. The main risk factors are

heredity, a sedentary lifestyle, modern eating habits and excess weight. In Morocco, a country in the midst of a demographic, nutritional and epidemiological transition, dietetics plays an essential role in the treatment of type 2 diabetes (T2D), alongside drug therapy and physical activity[9]. This practice ensures a balanced nutritional intake, reduces glycemic variations and delays the onset of vascular complications[10]. The aim of our work is to develop compliance with drug and dietary treatment programs and physical activity prescribed by the attending physician in a group of patients with type 2 diabetes in the city of Nador (north-east Morocco).

2. Materials and Methods
2.1. Study area

Nador is a town in northeastern Morocco, located in the Eastern Rif region, it is , the 19th largest city in Morocco, serves as the capital of Nador Province in the Oriental Region of northern Morocco. Situated on the Mediterranean coastline along the Sebkha Bou Areq lagoon, the city extends along the coast. It is positioned about 75 km (47 mi) west of the Algerian border, 10 km (6.2 mi) south of the Spanish enclave of Melilla, and 380 km (240 mi) east of the Moroccan capital, Rabat[11] (Figure 1).

2.2. Participants

This epidemiological study was conducted in a private medical analysis laboratory located in NADOR for a duration of one year, spanning from October 1, 2018, to October 1, 2019. The study included 830 male and female participants aged 18 and above, all residing in the city of NADOR. Our initial step involved applying for an internship at a private medical analysis laboratory in NADOR. Upon obtaining approval, we communicated the study's objectives to the biologist in charge. The subjects recruited were type 2 diabetic patients who came to the laboratory to check their blood glucose levels. Their blood glucose was ≥ 1.26g/l (7 mmol/l) on two occasions [12].With the help of the laboratory's reception and sampling team, consisting of three secretaries and two nurses, we explained the aim of the study, and they volunteered to sign the consent form and were then surveyed. We collected socio-demographic information: age, marital status, level of education and employment, as well as clinical information from the 830 subjects, and used equipment to perform the necessary anthropometric measurements and biological assays. The measurements were conducted in a designated space specifically allocated for these individuals. Their confidentiality and privacy were diligently upheld.
Inclusion Criteria:
- All individuals diagnosed with Type 2 diabetes, whether or not they have degenerative complications, and irrespective of the duration of diabetes.
- Patients aged 18 years or older.
- Both male and female participants.
- Individuals residing in the city of Nador.
Exclusion Criteria:
- Pregnant or breastfeeding women.
- Children.
- Individuals with Type 1 diabetes or gestational diabetes.
- Non-residents of Nador

2.3. Statistical Analysis

The collected data were entered on Excel, after filtration and coding we transmitted them on a statistical exploitation support SPSS (Statistical Package for Social Sciences) version 23.0. Quantitative variables were expressed as means ± standard deviation, and qualitative variables as frequencies and percentages. The hypothesis tests applied to compare the means and proportions are respectively T Student and the Chi-2 test of independence. Data are collected from data sheets including clinical characteristics (age, sex, duration of diabetes, marital status, educational level, body mass index (BMI), as well as questions related to drug treatment, insulin therapy and diet, and a question on sensation. Data are collected from data sheets including clinical characteristics (age, sex, duration of diabetes, marital status, educational level, body mass index (BMI), as well as questions related to drug treatment, insulin therapy and diet, and a question on sensation.

3. Results
3.1. Sociodemographic and anthropometric characteristics of patients

Table (1) shows the results of the patients' socio-demographic characteristics. Indeed, 74.49% (n=549) of patients are over 40 years of age, and 90.24% (n=749) of patients are functionless, the majority of whom are women (over 75%). However, the distribution of type 2 diabetic patients according to BMI category shows that 2.77% (n=23), including 20 women, were underweight, while 22.41% (n=186) were of normal build. Furthermore, 27.23% were overweight, 69.91% (n=158) of whom were female, and 47.59% were obese, 76.96% (n=304) of whom were female. The mean duration of diabetes is 7.50±0.138 years, extended by 21 -1 years=20 years, of which 50.48% have a diabetes age between 5 and 10 years (Table 1).

3.2. Assessment of risk factors

Age is a major risk factor for the onset of T2DM, with an average age in our sample of 59.07±.50 years. Obesity is a risk factor influencing glycemic control in type 2 diabetes (T2D). In our sample, 74.82% of T2DM patients were either overweight or obese. Furthermore, 78.31% (n=650) of T2DM patients reported having had a family history, including 78.75% of women and 77.13% of men [Odds ratio=1.1; 95% CI: 0.76-1.59]. Studies have shown a relationship between smoking and insulin resistance, and between smoking and type 2 diabetes mellitus. However, the results in our sample show a strong relationship between smoking and alcohol consumption as a function of gender (chi2= 163, 35; p<0.000). Indeed, 10% of T2DM patients reported using tobacco or alcohol or both, including 71 men and 12 women.

3.3. Assessment of dietary factors

The aim of medical nutrition therapy in type 2 diabetic patients is to achieve optimal metabolic control of blood glucose levels. Compliance with medical prescriptions is a major concern for physicians and public health professionals. The questions below concern the patient's diet and constraints. Although the chi2 test showed no significant relationship between dieting and gender, 94.69% (n=786) answered "dieting", including 32 women and 12 men, while 5.3% (n=44) answered "no".
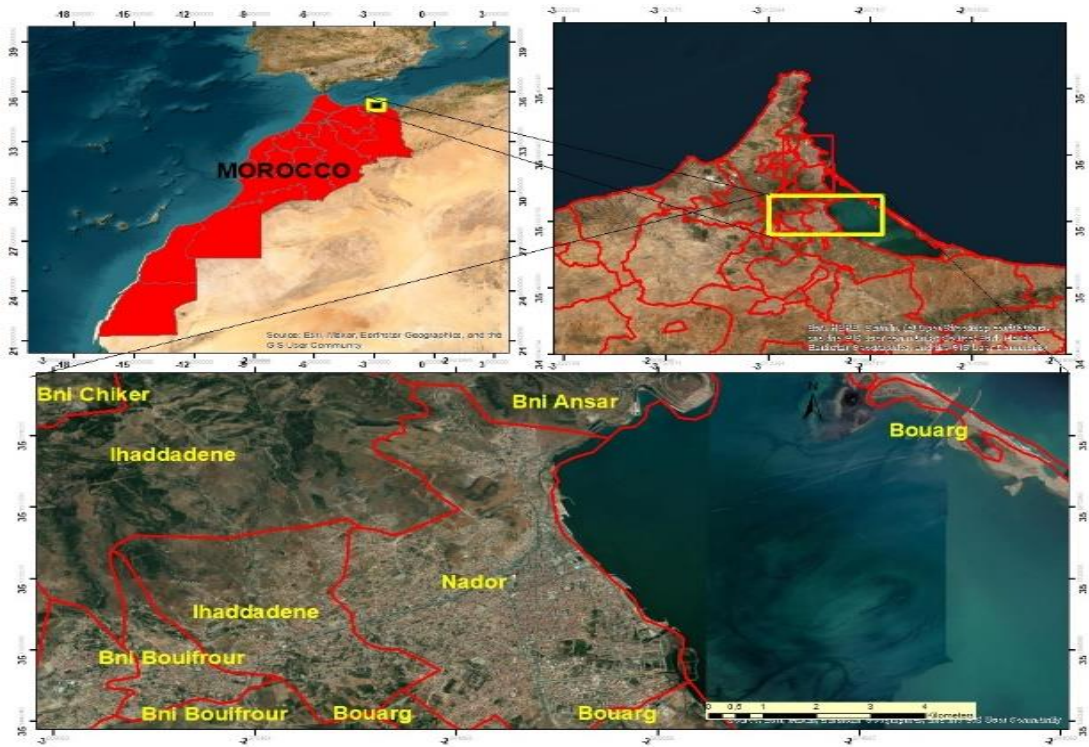
Figure 1. Study area

Table 1. Socio-demographic characteristics of respondents

Variable	modality	Men 26,9% (n=223)	Women 73,1% (n=607)	Total
Age(Years)	<25 ans	5	16	21
	Between 25 and 40 years	30	42	72
	Between 40 and 55 years	50	150	200
	Between 55 and 70 years	86	279	365
	> 70 years	52	120	172
professional situation	Without function	184	565	749
	With function	39	42	81
school level	Out of school	178	521	699
	Primary	8	29	37
	Secondary	13	21	34
	Higher	24	36	60
Marital status	Single	45	68	113
	Married	178	539	717
Average duration of diabetes	<5 years	69	190	259
	Between 5 and 10 years	114	305	419
	>10 years	39	111	150
BMI	underweight	3	20	23
	normal weight	61	125	186
	Overweight	68	158	226
	Obese	91	304	395

Table 2. Distribution of T2DM patients according to Diet variables and gender

Variable	modality	Women	Men		khi2
Diet	No	32	12	44	Khi2=0,004 (p<0,95)(ns)
	Yes	575	211	786	
Who prescribed this Diet	No answer	574	211	785	5,73 (p<0,22)(ns)
	General practitioner	2	0	2	
	Nutritionist/Dietician	0	1	1	
	Endocrinologist	22	5	27	
	Other :	9	6	15	
what this diet consists of	Without diet	575	211	786	0,51 (p<0,94)(ns)
	Eat everything in moderation	10	4	14	
	Eliminate white sugar	6	2	8	
	Eliminate red meat	5	1	6	
	Eliminate certain foods	11	5	16	
Ramadan fasting	Yes	549	208	757	1,63 (p<0,2)(ns)
	No	58	15	73	

Table 3. Distribution of patients according to how they feel about the requested diet

	Women		Men		Total		P Value
	N	(%)	N	(%)	N	(%)	
Hunger	3	0,36	2	0,24	5	0,6	0,454
Blood sugar imbalanc	11	1,32	3	0,36	14	1,68	
Financial constraints	4	0,49	3	0,36	7	0,84	
Time constraints	7	0,84	1	0,12	8	0,96	
Bad mental state	6	0,72	4	0,49	10	1,20	

Table 4. Clinical and biological characteristics and Treatments

			Women		Men		P.Totale		P *Sig.*
			N	%	N	%	N	%	
Gly(g/l)			2.34±0.81g		2.25±0.71		2.32±0.78		**0,61**
HbA1c (%)	**HbA1c <7%**		60	7,2	29	3,5	89	10,7	**0,528**
	7%>HbA1C<8%		133	16	53	6,4	186	22,4	
	8%>HbA1c<9%		116	14	43	5,2	159	19,2	
	HbA1c>9%		296	35,7	100	12	396	47,7	
Treatments	**OAD**	**Biguanides**	399	48,07	147	17,71	546	65,78	**0,459**
		Sulfonamides	4	0,48	4	0,48	8	1	
	Insulin therapy	**Transient Insulin**	165	19,87	65	7,83	230	27,71	
		Definitive insulin	9	1,08	2	0,24	11	1,3	
	OAD+Insulin		28	3,37	7	0,84	35	4,21	

OAD: Oral Anti Diabetic

With regard to the knowledge of patients who said "no" to the question "What does the RA consist of?", the results show that 1.68% replied "Eat everything in moderation", 0.9% said "Eliminate white sugar", 0.7% saw the solution as being to eliminate red meat and 1.93% said to eliminate certain foods. For the question "Who prescribed the AR to you?" among this category of patients who answered "no", the answers were as follows: 2 patients said it was the GP, 1 patient said it was the Nutritionist/Dietician, 27 T2DM patients confirmed that they followed the advice of the Endocrinologist. Diabetes can be seen as a real burden, preventing them from fasting during Ramadan. In our sample, 91.1% answered that they fasted during the holy month, of which 90.44% were women versus 93.27% men (Table 2).

However, the requested change in eating behavior can be socially costly, especially in the eyes of other eaters. In fact, the figure below shows the results of the distribution of patients according to the sensation of eating behaviour requested by the doctor or by themselves. Among women, 57.33% answered the "hunger" question, compared with 59.64% among men, followed by financial reasons and the problem of glycemic imbalance, with a rate of over 12.5% for both sexes (Table 3). Type 2 diabetes patients are called upon to lead a healthy, balanced diet. They should ensure sources of low-glycemic carbohydrates such as fiber, and should consume fruit and vegetables every day, unsaturated vegetable oils, vegetable proteins (pulses, nuts) or fish.

3.4. Antihyperglycemic treatment of type 2 diabetes

For this type of diabetes, treatment is generally either oral antidiabetic medication or insulin therapy, or both at the same time. The glycated hemoglobin level (HbA1c) remains the central element for assessing glycemic control in diabetics, and thus for deducing the effectiveness of prescribed treatments. Choosing the most appropriate treatment for each patient can be complex, as T2DM is a heterogeneous disease, which may or may not be associated with target organ damage and comorbidities. Nutritional therapy (NT) and regular physical activity (150 minutes a week) play a key role in diabetes management. Oral antidiabetic therapy remained the most common treatment modality (93.49%), followed by insulin therapy alone (2.29%) and the biotherapeutic combination of insulin and oral antidiabetic drugs (4.22%). Furthermore, the two pharmacological classes, biguanides and hypoglycemic sulfonamides, remain the two most prescribed oral treatments for type 2 diabetes, with 65.78% using sulfonamides and 27.71% using biguanides. Insulin is often the treatment of last resort. In fact, 8 patients underwent transient insulin therapy and 11 patients underwent definitive insulin therapy. On the other hand, the distribution of patients using insulin injections per day shows that 48.15% of patients use 3 injections per day, 33.33% use 2 injections per day and 16.67% use 4 injections per day (Table 4).

Many patients use medicinal plants to balance their diabetes. Morocco is endowed with a considerable biodiversity of plants that merit exploration in the search for hypoglycemic molecules. In our sample, 94.5% said they

used plants to lower blood sugar levels, 93.90% of whom were women and 95.96% men. Physical activity not only contributes to weight loss, it also increases insulin sensitivity and reduces abdominal fat, even in the absence of weight loss. The current recommendation is 150 minutes of physical activity per week (e.g. 30 minutes/d 5 x per week). The chi2 test shows a strong association between physical activity and gender (chi2=7.48; p<0.006). In our sample, 95% of patients responded that they were physically active, with 95.88% of female patients being physically active, compared with 91.03% of male patients [odds ratio=0.44 and 95% CI: 0.24-0.81] (Table 4).

4. Discussion

Diabetes is a chronic and intricate condition that subjects patients to various complications, serving as a risk factor for cardiovascular diseases. Renal failure represents one of the most severe outcomes of diabetes, and several studies have indicated that effective blood pressure management can decelerate the decline in renal function[13].

Based on these findings, even though a significant number of patients adhere to their general practitioner's recommendations, they are required to adhere to specific limitations aimed at enhancing carbohydrate and lipid parameters as well as vascular outcome[14]. Promoting the intake of foods with a low glycemic index, endorsing the consumption of omega-3 fatty acid-rich fish, and minimizing the consumption of animal proteins in favor of plant-based proteins are recommended[3, 13, 15, 16].

Additionally, collaborating with healthcare professionals, such as physicians or diabetes-specialized dietitians, is crucial. This approach aims to address risk factors like hypertension, hyperlipidemia, smoking, obesity, and sedentary lifestyle, ultimately preventing the onset of severe complications associated with Type 2 Diabetes (T2D)[17]. Thus, the implementation of educational programs and the monitoring of hygienic-dietary measures as part of organized diabetes management will effectively reduce the intensity and severity of complications associated with T2DM. In this context, the role of nutrition education and raising awareness among type 2 diabetic patients and their families of the seriousness of the disease are essential for maintaining glycemic control and reducing metabolic and vascular risks. This is why diabetes education should rightly be considered as one of the most important pillars of the treatment and management of diabetes in general, and T2DM in particular, in our country.

5. Conclusions

The objective of our study is to assess patients' understanding of drug treatments, insulin therapy, and dietary practices in the city of Nador. The study revealed that the average age of participants was 59.07±0.50 years, with 73.1% being women. Additionally, 74.82% were identified as overweight or obese. The predominant medications used were sulfonamides and biguanides. Impressively, 94.69% of patients demonstrated awareness of medical nutritional therapy and the significance of physical activity in managing elevated blood sugar levels. A substantial portion of Type 2 Diabetes (T2DM) patients adheres to the instructions provided by their treating physicians, potentially mitigating the risk of severe complications, particularly cardiovascular issues. The study highlights the necessity for competent authorities to extend healthcare services to individuals with Type 2 Diabetes, particularly those residing in rural areas. This entails the expansion and enhancement of existing healthcare infrastructure and resources to ensure individuals with T2DM receive appropriate care and support, regardless of their geographic location. Potential measures include increasing healthcare facilities, improving outreach programs, and tailoring services to meet the unique needs of rural communities.

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