



## EPIDEMIOLOGICAL ASPECTS AND FACTORS ASSOCIATED WITH COMPLICATIONS IN A GROUP OF MOROCCAN DIABETIC PATIENTS

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### Abstract

**Background:** In Morocco, diabetes is considered as one of the major public health issues, and considered the second cause of death. Increased risk for diabetes is primarily associated with age, ethnicity, family history of diabetes, obesity, and physical inactivity. The demographic, socio-economic and cultural environment in which the patient lives influences his lifestyle and management of the disease. **Methods:** A cross-sectional survey was conducted with 298 type-2 diabetic patients in Essaouira province attended health center and Mogador association for diabetes. **Results:** 43% of participants are aged between 40 and 60 Y, rate illiteracy is 58.8%, only 12% have reached higher education and 70% are an employed during the study. Mean duration of diabetes is 12.23Y. Many significant associated factors are linked to complications in our context: recruitment place, matrimonial status, age; instruction level, family history, age of onset of diabetes, and balanced diabetes. Only 41.4% of participants had unbalanced diabetes and 31.5% of patients had complications such as decreased visual acuity (the main complication 14%), hypertension (8,3%), kidney failure and cardio vascular diseases (9,2%). **Conclusion:** Need-based diabetes awareness, management, and control policy such as patient education, improving socio economic conditions, early diagnosis, and life-style modification; specialized health professionals for better control and care in diabetic patients.

**Keywords:** Diabetes, complications, associated factors, Essaouira, Morocco.

### 1. INTRODUCTION

Nowadays the global prevalence of diabetes is increasing hastily. It has become one of the major public health problems [1]. 382 million was the number of patients who were diagnosed with diabetes in worldwide. This number is anticipated to increase to 592 million by the year 2035 [2]. Moreover, the future predictions found out that by 2030: 1 in 10 people in the world is expected to have this disease [3]. The global prevalence of diabetes among adults over 18 years of age has approximately doubled between 1980 and 2014, moving from 4.7% to 8.5% [4]. There are some variations from one region to another; in the US the prevalence is 9.4% [5] 9.1% in Europe; 8.1% in south-east Asia, 3.1% in Africa and 9.2% in MENA region [6].

In Morocco as everywhere else in the world, diabetes is considered as one of the major public health issues. There are 1,5 million Moroccan diabetics, which places the country in the fourth rank among Arab countries according to a study released by Nature Middle East magazine in 2014. [7]. In 2017 the estimated prevalence of diabetes is 7.1% [8]. According to the World Health Organization (WHO), diabetes is the second cause of death in Morocco [9].

Even though significant regional variability exists is noticeable that most people (about 80%) suffering from diabetes are living in countries with low and middle-income. Nevertheless urbanization, unhealthy diets, especially fast food, and sedentary lifestyles are also implicated in causing this disease [10].

Type 2 diabetes mellitus (T2DM) accounts for 90% to 95% of all cases of diabetes. It is developed when there is an abnormal increased resistance to the action of insulin and the body cannot produce enough insulin to overcome the resistance [11]. Increased risk for diabetes is primarily associated with age, ethnicity, family history of diabetes, smoking,

obesity, and physical inactivity. Diabetes-related complications—including cardiovascular disease, kidney disease, neuropathy, blindness, and lower-extremity amputation—are a significant cause of increased morbidity and mortality among people with diabetes [12].

Persons with diabetes require life-long personal care to the occurrence of long-term complications. Good knowledge about the risk factors of diabetes including age, gender, educational level, the area of residence, BMI, and obesity, family history, and inactive life-style, plays an essential role in prevention and treatment [13]. There are few evidences claiming that medical care has been effective in preventing the onset of type II diabetes [14]. On the other hand, medical care plays an essential role in controlling diabetes, preventing the complications, improving the quality of life, and reducing the mortality associated with the disease [15].

Some studies have shown that T2DM can be prevented or postponed by practicing the recommended healthy behaviors. For example, diabetes prevention programs in the USA and Finland have contributed to reducing the incidence rates by 58% [16]. From the standpoint of diabetes related health education, the fundamental practices entailed by “improving healthy behaviors and self-management of patients” have been repeatedly emphasized by experts. Although favorable health behaviors for patients with T2DM have been suggested in many studies [17].

## Objective

The main objective of the present paper is to study epidemiological aspects and factors associated with complications in a group of Moroccan T2DM patient.

## 2. Materials and Methods

### 2.1. Study Design

A cross-sectional survey was conducted with 298 type-2 diabetic patients aged between 25 to 80 years in Essaouira province, Morocco, in 2017.

### 2.2. Context of the Study

Essaouira province is located in the west of Morocco, with a total area of 6335 km<sup>2</sup> and a population of 449133 inhabitants; with 50.20% males and 49.80% female. 57% of the population is aged between 15 and 59-year-old. The illiteracy rate is 49.9% most of them are women (60.1%). The activity rate in women is 11.7% against 79.8% in males; almost half of them (41.4%) are independent workers, while only 1.8% are employers. The vulnerability rate is 25.8% [18]. the aforementioned numbers indicate that the population has a precarious socio-economic level.

The number of diabetic patients in 2016 was 10321 which 61% are women, and 81% are aged more than 40-year-old [19]. It was 8904 in 2015 and 6256 In 2014, which indicates that the number of diabetics is constantly increasing in the province (approximately 2000 new cases every year), which explains the choice of this region in the present study.

### 2.3. Study Participants and Recruitment

The population in this study consisted of type 2 diabetic patients attending the health care centers (61.7%) and Mogador association of Diabetes (38.3%) (Mogador Association specialized in diabetes), it provides health education: about diabetes complications, risk factors, hygienic measures, healthy food and the importance of physical activity as a secondary and tertiary prevention. The sampling included diabetic patients who were received during the study period. After briefing the patients about the study and getting their individual informed consent, they were submitted to a structured interview that includes demographic Socio economic and cultural information (such as sex, age, education level, and marital status, profession, economic status) and diabetes information (age of onset, medical care, treatments, family history of the disease, diabetic balance, complications, etc.). Data were completed by consulting medical reports of the patients, in which fasting blood glucose and glycated hemoglobin were documented. To determine associated factors to diabetes complication, we realized a bi bivariate analysis and performed a binary logistic regression including significant factors to assess the most important factor that affect complication.

## 2.5. Statistical Analysis

Statistic Package for Social Science software release 10 (SPSS) was used for data analyses. All the categorical variables were described and presented as proportions.

SPSS software is used for data entry, percentages, uni and bi variate analysis, chi square test. To determine the weight of factors associated with complications, we performed a binary logistic regression analysis.

**2.6. Informed consent:** Informed consent was obtained from all individual participants included in the study.

## 3. RESULTS

A total of 298 participants were administered the questionnaire, 32.9% male and 67.1% female. 76.2% are married. The average age of this group is 50,5Y (SD=12.7Y; minimum=25Y; maximum 80Y).

22.8% of participants belongs to Age group <40 Y, 43% (36.7% are male and 46% are female) are aged between 40 and 60 Y. whereas 34.2% (43.9% male and 29.5% women) their age is higher than 60 Y. the age group 40-60 was the most represented in women, while higher than 60 Y for male, with statistically significant difference ( $p < 0.05$ ).

Rate illiteracy among participants is 58.4% (54.1% male et 60.5%female), and only 12% have reached higher levels in their studies, without statistically significant difference between male and women. 70% of participants were not employed during the study: the majority of them were women (91.1%) and 28.6% are male with significant statistical difference ( $p < 0,01$ ). Almost all of the participants (93.1%) were from the poor social class.

71,4% of patients have non-insulin dependent diabetes. The mean age for diabetes diagnosis was 38.7 years (41.2 years for male; SD  $\pm 9.9$  et 37.4 years; for women SD $\pm 9.2$ ) with a statistically significant difference between sex ( $P < 0.01$ ). Mean duration of diabetes was 12.23 years. Polyuria and polydipsia are the main symptoms indicated the diagnosis of diabetes (73.3% of those cases). 29% is the proportion of comorbid conditions among the participants: 21.7% of patients are hypertensive. Asthma, kidney failure and cardio-vascular diseases are the other form of co-morbidities.

62.6% of participants have positive family history for diabetes nearly half of them (44.1%) are their parents, while brothers and sisters represent only 10.6%. The medical care is provided for all participants (97.4%), most of them are in public facilities (90.7%) and only few of them (4%) are followed up by a nutritionist.

The Average of Fasting blood glucose level of participants is 1.7g/l (SD $\pm 0.56$ , min 0.88 and max 4), while the Average of glycated hemoglobin is 8% (SD $\pm 1.7$ , min 5 and max 14) without a statistically significant difference between sex. Only 41.4% (34.1% male and 45.2% women) of participants had un balanced diabetes (glycated hemoglobin  $\leq 7\%$ ). Due to the un balanced diabetes 31.5% of patients had complications such as decreased visual acuity (the main complication 14%), hypertension (8.3%), kidney failure and cardio vascular diseases (9.2%).

According to table 1, many factors are linked to complications in our context: recruitment place, matrimonial status, age; instruction level, family history, age of onset of diabetes, and balanced diabetes. On one hand patients who attended the association, married, aged less than 60 Year old with higher education level, balanced diabetes with a familial history of diabetes, with the age of onset of diabetes less than 40 Years old presented less complications compared to patients who attended health centers, and were unmarried, with age superior than 60 Y, illiterate or low education level without a family history of diabetes, unbalanced diabetes and the age of onset of diabetes superior than 40 Years old. On the other hand, the study showed that patients with diabetes complications have important significant fasting blood glucose level and glycated hemoglobin average than patients without complications (table1).

**Table 1:** Comparison of diabetic patient complicated or non-complicated according to biodemographic, socio-economic, cultural and biologic characteristics

Variables	Modalities	Effective	Complicated Diabetes n (%)	Non-complicated diabetes n (%)	Chi-square
<b>Place of investigation</b>	Mogador association	114		89(43.6)	7.9* *
	Health Centers	184	25(26.6) 69(73.4)	115(56.4)	
<b>Sex</b>	Male	98	34(36.2)	64(31.4)	0.6ns
	Women	200	60(63.8)	140(68.6)	
<b>Matrimonial status</b>	Married	227	62(66)	165(80.9)	7.8* *
	Not Married	71	32(34)	39(19.1)	
<b>Age groups</b>	<=40 (Y)	68	4(4.3)	64(31.4)	50.6 ***
	40-60 (Y)	128	33(35.1)	95(46.6)	
	>60 (Y)	102	57(60.6)	45(22.1)	
<b>Education status</b>	Illiterate	174		109(53.4)	7.03 *
	Primary school	87	65(69.1)	65(31.9)	
	Secondary school and above	37	22(23.4) 7(7.4)	30(14.7)	
<b>Activity</b>	Active	87	26(28.9)	61(30.8)	0.1ns
	Inactive	203	64(71.1)	137(69.2)	
<b>Socio Economic Status</b>	With low income (1)	270	6(6.7)	14(7.1)	0.01 ns
	With high-income (2)	20	84(93.3)	184(92.9)	
<b>Age of onset of diabetes</b>	<40 years	191	47(50)	144(70.6)	11.8 **
	>40 years	107	47(50)	60 (29.4)	
<b>Family history for diabetes</b>	Yes	188	52(59.1)	136(73.9)	6.1* *
	No	84	36(40.9)	48 (26.1)	
<b>Balanced Diabetes</b>	Yes	104	20(22.2)	84(52.2)	21.3 ***
	No	147	70(77.8)	77(47.8)	
<b>Average of Fasting blood glucose level</b>		1.86	2.13 (SD=0.63)	1.6 (SD=0.44)	t=7.6 ***
<b>Average of glycated haemoglobin</b>		8.18	8.82 (SD=1.63)	7.54 (SD=1.61)	t=6.0 1***

*SD: standard deviation. \*: p<0.05; \*\*p<0.01; \*\*\*P<0.001; ns: non significant.*

The binary logistic regression model (table2) took as explicative variables: place of study, age, instruction level, matrimonial status, age of onset of diabetes, family history and balanced glycemia. In step 0 of analysis; all variables were significantly different between patients with complications and without complications. In step 1 of analysis: complications were negatively correlated to all tested variables, while according to Odd ratio it is the balanced glycemia that represented the higher score, followed by age, and relatively instruction level. In the studied population, the onset of complication is associated with balanced glycemia; age and relatively patients instruction level.

**Table 2:** Binary logistic regression model : factor associated to diabetes complications.

Variables	A	X2	OR	IC
<b>Age</b>	-1.185**	10.951	.306	0.15- 0.62
<b>Instruction</b>	-.645*	3.737	.525	0.27-1.01
<b>Matrimonial status</b>	-.083	.055	.920	0.46-1.84
<b>age of onset of diabetes</b>	-.156	.188	.855	0.42-1.73
<b>family history for diabetes</b>	-.520	2.351	.595	0.31-1.16
<b>Balanced Diabetes</b>	-1.219***	13.153	.296	0.15-0.57
<b>Place of investigation</b>	-.476	2.035	.621	0.32-1.19

*A: constante; X2: Wald; OR: Odds-Ratio; IC : Confidence interval; OR (95% CI); \* p<0.05 \*\*p<0.01; \*\*\* p< 0.001*

## 4. DISCUSSION

Type 2 diabetes is a chronic disease that is associated with several demographic, socioeconomic, health and lifestyle factors. Female gender, age group of 40 and over, illiteracy, work inactivity and low socioeconomic status are the most important determinants of diabetes in our sample. These results are confirmed in the literature by the study of Diez Roux et al, where they confirmed that among diabetic patients, long term outcome is worse for those with low Socio-Economic status (SES) [20].

In addition, statistics about the prevalence of diabetes in Essaouira (retrieved from provincial delegation of Essaouira 2016) confirm that the most common categories of diabetic patients were women (63.3%) and patients aged 40 years old and more (81.3%). The same result was found by Deshpande and collaborators [12], and Reeves & Rafferty Ahmed [15]. It's associated with SES: illiteracy level, precariousness and vulnerability rates, that are very high in the province (women's illiteracy rate is 60.1%. The activity rate in women is 11.7%. The vulnerability rate is 25.8% [18].

Lower individual levels of education and income and lower levels of SES were independently associated with an increased risk of type 2 diabetes, the same finding was revealed by different studies in the USA [21].

Socioeconomic inequalities in health have been attributed to different factors, including unhealthy behaviors, inadequate access to health care, nutritional inadequacies and other inequalities in material circumstances, and psychologic stress. Most of these factors are at least plausible intermediate risk factors for type 2 diabetes [22]. Another possible link between low SES and type 2 diabetes is depression, which is associated with both [23]. Depression is also much more prevalent among women than men, [24] which may explain the finding that SES is strongly associated with type 2 diabetes among women but not men.

The study showed that for patients with T2DM, the risk of complications is associated with hyperglycemia and high rate of HbA1C. those results are confirmed by the UK prospective diabetes study, where they recommended the reduction in HbA1c to reduce the risk of complications [25]. Moreover, the duration of diabetes is considered also as an associated factor to complications which is shown by this some studies in different countries such as Italy, Saudi Arabia, Mexico and the United Kingdom [26].

The risk of developing chronic complications in patients treated in Mogador Association of Diabetes where doctors and nurses are trained in diabetes care, is less as compared to those receiving treatment from General Practitioners in different health centers, who have less time and lesser experience to provide treatment, motivation and encouragement. This is on par with the observations of a Pakistani study [27]. Which showed that the majority of T2DM are non-insulin independent, complications can be prevented or delayed by specialized health education.

The chronicity of the disease induces some more or less serious complications according to each individual and his environment. In our study 21% of diabetic patients are hypertensive, the risk of hypertension is very high. This result confirms the findings of the studies on the high incidences of Hyper tension in diabetic patients and vice versa, either in Morocco [28], or in the world [9-25], but according to Shahin and collaborators (2014) they have found a very high proportion of comorbidity 69% [29].

Age, the place of recruitment, matrimonial status, age of onset of diabetes, and diabetic balance are the factors that are mostly associated with the onset of complications, especially age, which is considered as a co-factor that affects other characteristics, such as the onset of diabetes, the duration of the disease as well as chronic complications. The same results are confirmed by different studies [30].

The demographic, socio-economic and cultural environment in which the patient lives influences his lifestyle and management of the disease. The marital status and level of education in this study indicates that married and middle-level to high-educated individuals develop fewer complications related to diabetes. Indeed, a married person enjoys a certain family and emotional stability that could have a positive effect on the control of the disease. The balanced diet and healthy lifestyle, where differences were found between groups (with complications and without complications) such as poverty (93.1%) and illiteracy (58.4%) These results are also consistent with other studies: Azevedo, et Alla, (2008) conducted in some African countries (Kenya, Mali, Mozambique, Nigeria, South Africa and Zambia) [31].

In the group of patients with complications there were lower levels of income, and lower levels of education. These findings may be connected with a lower level of health education and a different assessment of the quality of life [32], while high level of education would allow good compliance with drugs and good monitoring of the disease.

Patients who attended the association presented less complications compared to those who attended health centers, which may be explained by the health education offered by the association.

It is known that achieving and maintaining glycated hemoglobin levels < 7% is difficult in patients with a longer duration of diabetes mellitus and the average diabetes duration in our study 12.23 years may be an alternative explanation [33]. As confirmed by another study in Jordan in 2010 by Khattab et al, the majority of participants who had a duration of diabetes superior that 7 Years have a glycated hemoglobin  $\geq 7\%$ .

There is a significant effect of family history of T2DM on individuals (95% positive family history) these results are also consistent with other studies [34]. The family history of specific diseases reflects the consequences of genetic susceptibility, shared environment and common behaviors.

In this study, 41.4% of patients have controlled diabetes, which show an increasing rate in Morocco compared to the statistics of 2013, where there was only 24% with controlled diabetes as shown by the study conducted by Ramdani et al 2013. Vulnerable population must have had more access to care and specialized human resources (in our study only 4% are cared by nutritionist). Early diagnosis and treatment of diabetes are essential in reducing and preventing the long term complications [35]. These results are also consistent with our findings about long term complications.

## 5. CONCLUSION

Many most important conclusion emerging from our study is that the complications of diabetes can be delayed if we act on associated factors. Also we insist on importance of sensibilization and information. They allow good taking care and Changing life-style for controlling diabetes. While sometimes diabetes is an inevitable disease, the onset of complications can be slowed down. As diabetes is an amendable disease, different management guidelines can be produced based on our findings. In morocco need-based diabetes awareness, management, and control policy such as patient education, improving socio economic conditions, early diagnosis, and life-style modification; specialized health professionals for better control and care in patients with diabetes.

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**7. Conflict of Interest:** The authors undertake that there is no conflict of interest, whatsoever with anyone.

**8. Ethical approval:** All procedures performed in this study were in accordance with the ethical standards of national and local research committee. In absence of the local ethics committee, this study is authorized by the provincial delegation of health in Essaouira.

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## ANEX

### Questionnaire

No. of the card:

1. Location of the investigation:
2. Date of the investigation:
3. Gender: 1-male 2-female
4. Date of birth:
5. Place of residence: 1-city 2-suburban 3-rural
6. Level of Education: 1- None, 2- Quranic, 3- Primary, 4- Secondary, 5- Superior
7. Profession:
8. Marital Status: 1-Married, 2-Divorced, 3-widowed, 4-Single

9. Diabetes since when (= how old were you when you have detected diabetes):
10. Type of diabetes: 1-Type1, 2-Type 2, 3-IDDM, 4-NIDDM, 5-type 3 (specify) ( type 1 = IDDM) ( type 2 = NIDDM)
11. Blood glucose level today:
12. Average blood glucose level over 3 months:
13. Balanced diabetes 1: yes 2: no
14. treatments used : 1-insulin 2-oral antidiabetic 3-Diet- 4-traditional measures (specify)
15. Medical care : 1-public 2-private
16. Dietary management by a dietitian: 1-yes 2-no
17. Dietary management in: 1-public 2-private
18. Family history of diabetes:
19. Do you have diabetes complications: 1-yes 2-no
20. What are the complications of diabetes that you have?
21. Diabetes detected how?
22. Diabetes detected by who?
23. Have you changed your eating habits since you were diagnosed ? 1-yes 2-no
24. What did you do?