

ORIGINAL PAPER

Prevalence and Risk Factors for Diabetic Complications: 8-Year Retrospective Report from a Single Regional Diabetes Center to the Eastern Region of Morocco

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Abstract

Objective: This study aims to investigate the risk factors of diabetes and its complications in the eastern region. Design: This is a retrospective study conducted on diabetic patients followed at the regional center of diabetology and chronic diseases in Oujda for the period 2012-2019.

Materials and Methods: Clinical, biological, therapeutic and anthropometric data were collected from patient records.

Result: A total of 3.976 patients participated in the study. The frequency of complications is around 1/3. One diabetic out of four has at least one modifiable cardiovascular risk factor: arterial hypertension at 25.35%, dyslipidemia at 12.67%, overweight and obesity at 35.48% and 27.8%. The most discriminating factors in the pathogenesis of diabetic complications in order of importance are age of diabetes, hypertension, HbA1c and dyslipidemia, statistically significant associations were found with p 0.0082, 0.0001, 0.002, 0.0001 respectively). Then a multifactorial analysis coupled with a hierarchical ascending classification in birth data to two large groups of diabetics with complications and those without complications.

Discussion: The age of trend T2DM has fallen to less than 40 years, so that the first characteristics of an epidemiological and nutritional transition are being established in our region. In addition, blood pressure and glycemic imbalance in diabetics reflect a problem of medical and therapeutic management that needs to be resolved.

Conclusion: The pathogenesis of diabetic complications is multifactorial. However, medical care must be taken to reduce the risk of degenerative complications.

Keywords: diabetes, risk factors, complications, Eastern region of Morocco.

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INTRODUCTION

Non-communicable diseases (NCDs) are becoming major health challenges with increasing burdens. Diabetes mellitus is one of the major segments of chronic non-communicable diseases¹. It has become a major public healthcare problem due to its increased prevalence and socio-economic impact². According to WHO estimates³, more than 356 million people worldwide have diabetes, a figure that is likely to double by 2030. Many of these increases will occur in developing countries where the burden of diabetes and its complications is greater³. As announced by the International Diabetes Federation (IDF), approximately 75-80% of people with diabetes die from complications, mostly cardiovascular³.

The sedentary lifestyles combined with the growth of urbanization cultures and processed diets are identified as factors responsible for this pandemic, which is likely to affect young populations in the next 25 years as well^{1,3}.

Morocco has suffered by this scourge in recent decades, an epidemiological transition marked by the evolution of non-communicable diseases (NCDs) and the

decline of communicable diseases; NCDs are currently the main sources of mortality, including diabetes⁴.

Hence its prevalence increased from 6.6% in 2000 to 10.6% and 10.4% was in pre-diabetes in 2018.

The burden of diabetes on the global economy has been steadily increasing over the past decade, with IDF estimates that by 2019, annual global health spending on diabetes will reach US\$760 billion. These direct costs will rise to US\$825 billion by 2030 and US\$845 billion by 2045⁵.

In this respect, the report drawn up by the National Health Insurance Agency (NHIA), reports that 49.3% of the fund's total expenditure is generated by long-term illnesses (ALD) and diabetes accounts for 10.2% of this expenditure⁶.

In the eastern region of Morocco where our study was conducted, the prevalence of diabetes was estimated at 10%⁷. Thus, the search for the factors inducing this frequency appeared relevant as a research axis. In this sense, the objective of our study is to describe the clinical and biological socio-demographic profile of the diabetics followed at the RCDMC between 2012 and 2019 in order to compare trends and raise new or persistent risk factors specific to the Eastern region popu-

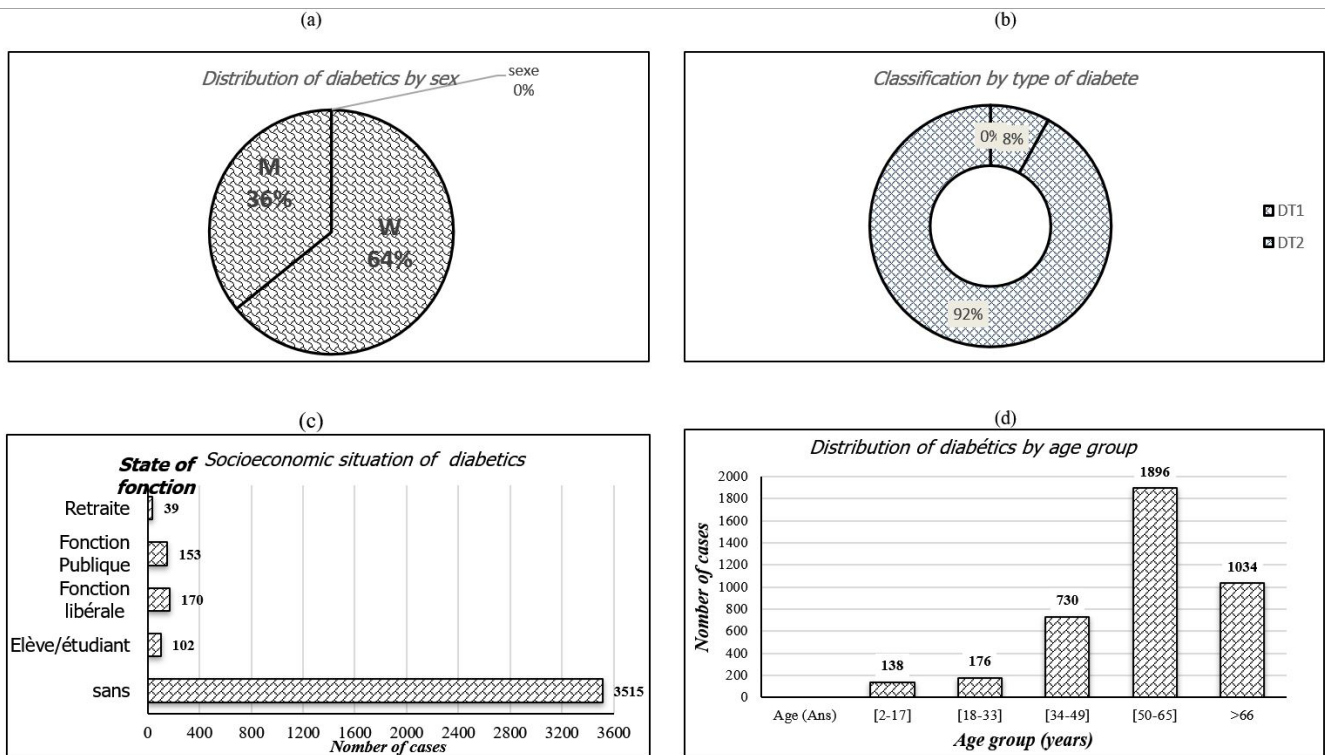


Figure 1. Sociodemographic characteristics of diabetics (a) sex, (b) type of diabetes, (c) socioeconomic status, (d) age group.

lation. Indeed, our approach to risk factor analysis differs from other studies carried out in the same context, by its multifactorial statistical analysis methodology and the hierarchical bottom up CAH classification to answer the following questions:

- What are the risk factors implicated in the pathogenesis of complications?
- What links exist between the different risk factors in diabetics?

Knowledge of the epidemiological profile reveals of paramount importance to enable decision-makers to develop prevention strategies based on empirical results that focus on the study of modifiable risk factors.

METHODOLOGY

SITE OF STUDY:

The Regional Centre for Diabetes and Chronic Diseases (RCDMC) is a public center with a regional vocation created on July 31, 2005. Its main objective is the management of diabetes and its complications. Primary health care facilities throughout the region refer people with diabetes to this center, either at the time of initial diagnosis or in the event of a glycemic imbalance, for possible management by specialists.

STUDY TYPE AND SAMPLE:

This is a retrospective study conducted on diabetic patients followed at the RCDMC for the period 2012-2019. All diabetic patients of all ages, insulin-dependent or not, were included in this study. Our sample size was estimated at 3.976 records (patients) after eliminating incomplete records and/or those with gestational diabetes and those lost to the study.

INCLUSION AND EXCLUSION CRITERIA:

In this study all diabetics of all ages, insulin-dependent or not, were included. Only gestational diabetes and lost to follow-up were excluded from the study.

The variables collected from the patients' medical records are as follows:

- ✓ **Socio-demographic variables:** age, gender, socio-economic status, medical insurance.
- ✓ **Clinical variables:** type of diabetes, duration of diabetes, treatment of diabetes, history of hypertension, systolic pressure (SBP), diastolic pressure (DBP), body weight, height, BMI, complications including cardiovascular disease, diabetic foot complications, nephropathy, retinopathy, gout, and family history of diabetes.

✓ **Biological variables:** Total Cholesterol (TC), Triglycerides (TG), Fasting Blood Glucose and Glycated Hemoglobin (HbA1c)

- Body mass index (BMI) was calculated by dividing weight (kg) by height squared (kg/m^2) and classified according to World Health Organization criteria: underweight ($< 18.5\text{kg}/\text{m}^2$), normal corpulence ($18.5-24.9\text{kg}/\text{m}^2$), overweight ($25-29.9\text{kg}/\text{m}^2$) and obesity $>30\text{kg}/\text{m}^2$ ⁸.

- A hypertensive patient is considered hypertensive if he/she has a systolic blood pressure PAS $>140\text{mmHg}$ and/or a diastolic blood pressure PAD >9 , according to the Seventh National Joint Committee on the Prevention, Detection, Evaluation and Treatment of Hypertension ⁹.

- Glycated hemoglobin (HbA1c) was defined as good glycemic control if HbA1c $<7\%$ and poor glycemic control if HbA1c $>7\%$ ¹⁰.

STATISTICAL ANALYSIS

In this study, quantitative variables were expressed as mean \pm standard deviation and qualitative variables were expressed as frequency or percentage. The chi-square test was used to compare the qualitative variables. Univariate and multivariate logistic regression was studied, with the occurrence of complications as the dependent variable, and age, duration of diabetes, hypertension, and other risk factors as independent variables. A multiple correspondence factorial analysis was performed by MCFA (Multiple Correspondence Factor Analysis) supported by a hierarchical classification of HCA classes.

Cronbach's coefficient for measuring internal consistency between variables > 0.7 is considered satisfactory. The Euclidean method was applied to group diabetics into dendrogram at the CAH level. A P value <0.05 was considered statistically significant. All statistical analysis was performed using SPSS 22 software. Correlations were determined by the Pearson test.

ETHICAL CONSIDERATIONS

This study was conducted in accordance with the Declaration of Helsinki and local legislation, without the need for ethics committee approval because it does not directly involve patients.

Nevertheless, authorizations were requested from the Regional Health Directorate at the Eastern Region of the Ministry of Health.

RESULTS

The attached Table 1 contains sociodemographic and clinical data for 3976 diabetic patients. Of these diabetic patients, 65% are women. The sex ratio (males / females) was 0.55.

It can be observed that half of the people, 47.66% precisely with diabetes, are over the age of 50. While 88.61% of diabetics are from urban areas, with only 5.17% of consultants are from rural areas and the remaining 6.28% are from other provinces in the region.

Almost 89% of these diabetics were unemployed (88.36%) and 92.90% were Ramedistes (a medical coverage for the economically weak), compared to 7.79 of the mutualists (Table 1). By type of diabetes, 92.2% are type 2 and 7.8% are type 1. In addition, 3096 cases (77.14%) had duration of diabetes of less than 9 years.

Of the 3,976 diabetes cases studied, 3,668 (92%) had type 2 diabetes (T2DM) while 310 (8%) had type 1 diabetes (T1DM). In addition, 3096 cases (77.14%) had a duration of diabetes between 0 and 9 years.

For the treatment of diabetes, 74.68% were taking oral antidiabetic drugs (OADs), 20.58% were taking insulin alone versus 1% a combination of insulin and OADs and 3.56 were on a hypoglycemic diet.

The incidence of patients with a family history of diabetes was 36.75%. The mean duration of diabetes was 5.80 with a standard deviation of 6.82.

One third (29.28%) of our sample had a degenerative complication with diabetic retinopathy (DR) at the top of the list (13.78%) followed by diabetic nephropathy (ND) 12.74%, and heart disease with only 3.79%. (Figure 3i).

In the overall sample, 35.47% were overweight versus 27.80% obese. As for the glycemic control of our patients measured for glycated hemoglobin 62.77% had a rate greater than 7 and 32.32% had a systolic pressure >14.

The classification by type of diabetes shows a predominance of females in T2DM without significant difference with T1DM $P < 0.084$. The young age of T1DM in contrast to T2DM where their age is over

Figure 2.

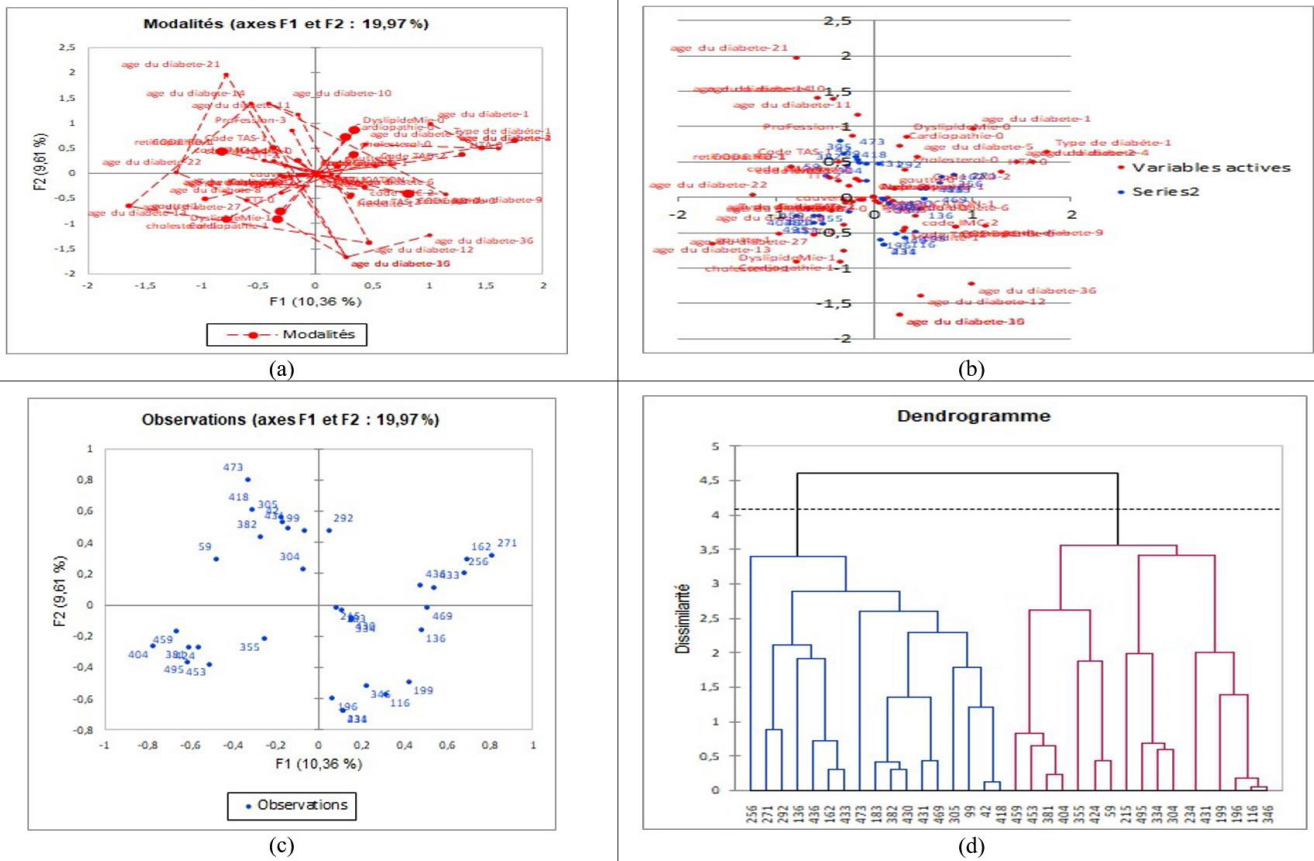


Figure 3. ACM analysis (a),(b),(c) and CAH (d).

Table 1. Sociodemographic and Clinical Characteristics of Diabetic

| SOCIO-DEMOGRAPHIC CRITERIA | NUMBER | POURCENTAGE % |
|-------------------------------------|--------|---------------|
| GENDER | | |
| W | 2554 | 64.2 |
| M | 1424 | 35.8 |
| AGE (YEARS) | | |
| 2-17 | 138 | 3.46 |
| 18-33 | 176 | 4.42 |
| 34-49 | 730 | 18.35 |
| 50-65 | 1896 | 47.66 |
| >66 | 1034 | 25.99 |
| PROFESSION | | |
| PUPIL/STUDENT | 102 | 2.56 |
| LIBERAL FUNCTION | 170 | 4.27 |
| PUBLIC SERVICE | 153 | 3.84 |
| RETIRED | 39 | 0.98 |
| WITHOUT | 3515 | 88.36 |
| INSURANCE COVERAGE | | |
| MEDICAL INSURANCE | 310 | 7.79 |
| RAMED | 3668 | 92.20 |
| RESIDENCY | | |
| URBAN | 3525 | 88.61 |
| RURAL | 206 | 5.17 |
| OUTSIDE THE REGION | 245 | 6.16 |
| CLINICAL CRITERIA | NUMBER | % |
| DIABETES TYPE | | |
| DT1 | 316 | 7.94 |
| DT2 | 3654 | 91.85 |
| TRAITEMENT | | |
| INSULINE | 819 | 20.58 |
| INSULINE/ORAL | 39 | 0.98 |
| ORAL | 2971 | 74.68 |
| REGIME | 142 | 3.56 |
| DURATION OF DIABETES (YEARS) | | |
| 0-9 | 3096 | 77.14 |
| 10-19 | 687 | 17.26 |
| 20-29 | 145 | 3.64 |
| >30 | 50 | 1.25 |
| COMPLICATIONS | | |
| YES | 1165 | 29.28 |
| TYPE OF COMPLICATION | | |
| CARDIOPATHY | 151 | |
| MI | 2 | 3.79 |
| TOTAL | 153 | |
| NEPHROPATHY | 109 | 2.74 |
| RÉTINOPATHY | 548 | |
| BLINDNESS | 2 | 13.78 |
| TOTAL | 550 | |
| AMPUTATION | 12 | 0.32 |
| LOWER LIMB | 1 | |
| UPPER LIMB | 11 | |
| THE DROP | 30 | 1 |
| OTHER RELATED MORBIDITY | 122 | 3.06 |
| HBP | 998 | |
| CVA | 10 | 25.35 |
| TOTAL | 1008 | |
| DYSLIPIDEMIA | 504 | |
| TRIGLYCERIDE | 224 | 12,67 |
| CHOLESTEROL | 280 | |
| HERÉDITY | 1462 | 36.75 |
| BMI | | |
| OVERWEIGHT | 1411 | 35.48 |
| OBESITY | 1106 | 27.80 |
| GLYCEMIC EQUILIBRIUM | | |
| GLYÉMIA >1.26 | 1628 | 40.92 |
| HBAC >7 | 2497 | 62.77 |
| TENTION BALANCE | 1286 | 32.32 |
| TAS>14 | 493 | 12.39 |
| TAD>9 | | |

50 years in 50% of cases, however the most surprising thing is that it has been noticed that the age of T2DM has begun to decline thus reaching a younger population in active phase with about 19.74% their age is between 30 and 49 years.

The frequency of overweight and obesity was more significant in the DT2 group (33.57%, 26.30%) in contrast to the DT1 group (1.71% and 1.30%). The Pearson correlation coefficients are highly significant ($P < 0.005$); between type of diabetes and gender ($r = 0.7$) and between type of diabetes and BMI ($r = 0.3$) and glycated hemoglobin values ($r = 0.3$).

Our sample included a rate of 29.28% of diabetics with a degenerative complication for which hypertension is the primary cardiovascular factor frequently associated with diabetes 86.52% and 1% have already had a stroke (Table 3).

The female sex appears to be more affected by the degenerative disease with a rate of 70.64%, these complications appear in patients over 50 years old (48.24%) and whose diabetes duration does not exceed 9 years in 72.78%. The genetic factor represented by heredity seems to have an effect in 34.67 of our patients who have a family history of diabetes.

Overweight and obesity increases the frequency of complications with 40% and 32%. Lipid status was dominated by dyslipidemia in 33.39% of cases.

The study of the relationship between risk factors and onset of complications showed a highly significant

relationship with the following dependent variables with a $p < 0.0001$ (heredity, age of diabetes, Hb1ac, hypertension and dyslipidemia) (Table 3).

Therefore, besides gender, the main risk factors for diabetes complications in the population of eastern Morocco are duration of diabetes, heredity related to genetic factor, the patient's cardiovascular factors: hypertension, highly responsive dyslipidemia and Hb1ac values (Figure 2).

The CMA, based on 21 variables, led to the projection of a factorial plane (AxeF1, AxeF2). F1 X F2 with a total inertia of 20%. The Cronbach's & coefficient measuring the internal reliability between the variables was 0.864.

The first F1 axis separates patients with dyslipidemia and complications on the left from patients without these characteristics on the right (Figure 3 (a)).

The most discriminating variables on the F1 axis are age of diabetes and dyslipidemia. It can therefore be concluded that Axis 1 addresses "the risk factors responsible for complications".

On the other hand, the F2 axis separates, on the one hand, diabetics with high blood pressure and glycemic imbalance and, on the other hand, those without hypertension and more or less glycemic balance. It is an HTA and HbA1c axis.

The projection of individuals on the factorial plane F1 x F2 confirms the analyses given above (Figure 3 (c)).

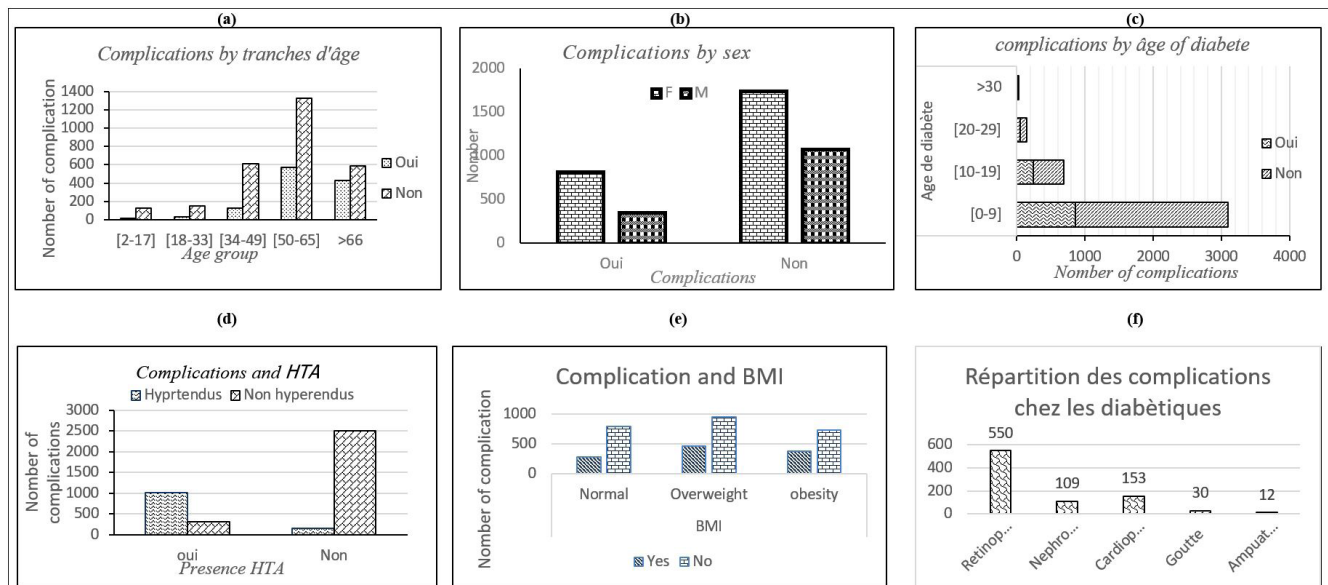


Figure 3. Distribution of risk factors for diabetic complications.

Table 2. Patient characteristics by type of diabetes and correlation with risk factors.

| Variables | DT1 | DT2 | P value | IC [95%] |
|----------------------|-----|------|---------|--------------------|
| GENDER | 159 | 2384 | 0.084 | 0.724[0.502-1.045] |
| F | | | | |
| M | 155 | 1270 | | |
| Age (YEARS) | | | | |
| 2-17 | 130 | 0 | 0.0001 | 2.383[1.418-4.005] |
| 18-33 | 87 | 99 | 0.001 | 1.083[0.661-1.744] |
| 34-49 | 53 | 686 | 0.751 | |
| 50-65 | 37 | 1859 | | |
| >66 | 19 | 1002 | | |
| Complication YES | 19 | 986 | 0.104 | 1.819[0.855-3.740] |
| Type of complication | | | | |
| DIBETIC RETIN | 9 | 540 | 0.0001 | 0,193[0,101-0,370] |
| DIABETIC NEPH | 9 | 150 | NS | |
| Cardiopathy | 5 | 148 | 0.09 | |
| Dyslipidemia | 22 | 471 | 0.032 | 0,54[0,290-1,008] |
| Amputation | 2 | 11 | 0.018 | |
| BMI | 68 | 1335 | 0.366 | 1.260[0.764-2.078] |
| OVERWEIGHT | 52 | 1046 | 0.391 | 1.229[0.768-1.966] |
| OBESITY | | | | |
| HBP | 19 | 986 | 0.082 | 0.493[0.222-1.093] |
| Hbac >7 | 214 | 2266 | 0.155 | 0.678[0.397-1.158] |

Table 3. Relationship between risk factors and onset of complications

| DEPENDENT VARIABLES | Complications (N=1165) | 29.28 | P value | Odds Ratio [IC 95%] |
|------------------------------|------------------------|-------|---------|----------------------|
| | N | % | | |
| GENDER | | | | |
| Women | 823 | 70.64 | 0.565 | 1.917[0.681-1.233] |
| Men | 342 | 29.35 | | |
| Age (YEARS) | | | | |
| 2-17 | 6 | | 0.209 | 0.509[0.177-1.460] |
| 18-33 | 21 | 10.01 | 0.626 | 1.196[0.582-2.460] |
| 34-49 | 117 | 48.24 | 0.297 | 0.785[0.498-1.237] |
| 50-65 | 562 | | 0.699 | 1.071[0.755-1.520] |
| >66 | 453 | | | |
| DURATION OF DIABETES (YEARS) | | | | |
| 0-9 | 848 | 72,78 | 0.082 | 1.514[0.239-1.580] |
| 10-19 | 245 | 21.03 | | |
| 20-29 | 57 | 4.89 | | |
| >30 | 15 | 1.28 | | |
| Heredity | | | 0.022 | 0.701 [0.517-0.949] |
| yes | 404 | 34.67 | | |
| BMI | | | | |
| Normal | 285 | 24.46 | 0.124 | 0.617[0.344-1.141] |
| OVERWEIGHT | 463 | 39.74 | 0.97 | 0.993[0.675-1.459] |
| Obesity | 372 | 31.93 | 0.281 | 1.213[0.854-1.729] |
| HBP | | | | |
| CVA | 10 | 0.85 | 0.0001 | 0.0007 [0.005-0.009] |
| YES | 997 | 85.57 | | |
| Dyslipidemia | 389 | | 0.0001 | 0.017[0.008-0.037] |
| TG | 223 | 33.39 | | |
| Cholesterol | 166 | | | |
| HBAC | | | | |
| <7 | 361 | 30.98 | 0.003 | 0.512[0.328-0.799] |
| >7 | 804 | 69.01 | | |

An analysis by hierarchical ascending classification (AHC) in dendrogram (Figure 3 (d)) showed the partition of diabetics into two distinct groups at a distance of 4.1, these 2 groups are homogeneous and share common and similar characteristics:

Group A: 64% of female diabetic patients are in the three age groups [34-49], [50-65] and >66 years old, with 23%, 42% and 31% respectively.

The sociodemographic level of these diabetics is very low, 94% have no occupation, compared with 6% who have regular or temporary work. Almost all of them belong to the urban environment, with a young diabetes developed in less than 9 years.

This group of diabetics presents degenerative complications in 33% of cases and condenses an agglomeration of cardiovascular risk factors: arterial hypertension, overweight, obesity and dyslipidemia.

Complications that appear in this group are DR, DN and some cases of heart disease.

In addition, a glycemic and blood pressure imbalance has been observed in the majority of diabetics in this group. This same group is formed by three distinct subgroups.

Group B: Diabetics in this group are female of all ages. They have a low socioeconomic status, benefiting from a social medical coverage plan dedicated to the economically weak (RAMED). However, this group has few risk factors and therefore fewer degenerative complications despite the $HbA1c > 7$ glycemic imbalances.

This group is composed of four subgroups: two are on the same side and the other two are on the opposite side. Subgroups three and four on the right have hypertension and body fat status, while subgroups one and two on the left have no complications or risk factors. This group represents diabetics without complications.

This distinction between the two groups is largely due to the age factor of diabetes plus or minus 9 years and the absence of the risk factors associated with diabetes in group B that are responsible for the development of degenerative complications.

The hypertensive diabetics under treatment are female in 71.03% with type 2 diabetes in 96.82%. Glycemic control in this category was poor with only 24.5% of diabetics with $Hb1c < 7\%$ and 68.55% with $Hb1c > 7\%$. This study also revealed that systolic blood pressure was >14 in 54.66% and 28.76% had a PAD >9 despite taking hypertensive therapy (Table 4). As a result, these diabetics have a very high cardiovascular

risk, and the corollary is that they need to adapt and intensify hypoglycemic and hypotension treatment to balance the values.

Diabetic retinopathy was the complication most associated with diabetes and hypertension in 50.49% of cases followed by cardiovascular disease in 9.82% (two cases of myocardial infarction recorded) and nephropathy in 7.53% of patients (Table 4).

DISCUSSION

Diabetes is a serious disease, a source of increased risk for various complications leading to frequent and long-term disability. It reduces life expectancy and generates high medical costs¹¹.

In our study, we note a predominance of the female sex in the diabetic population, i.e., a representativeness of 65%. This result is in total agreement with the study by Nadjib et al¹². This feminine tendency has been explained by authors, whether it is related to relatively high sex hormones (estrogen and progesterone), both of which can reduce the sensitivity of the whole body to insulin¹³.

In the same context, the distribution of diabetes complications according to gender shows an overall female predominance (70.64%) probably related to women's predisposition to the different risk factors for obesity leading to complications¹⁴.

Similarly, 47.66% of diabetics are over the age of 50. This explains why 92% of our sample have T2DM. Indeed, it is common to consider that the prevalence of diabetes increases with age because the human body accumulates risk factors for diabetes over time¹⁵.

On the other hand, our results showed that the age of type 2 diabetics has a tendency to fall back to catch people under 50 years old between 33 and 49 years old with a frequency of 19.74%. The correlation between age and complications was significant in our sample with p value = 0.0001. This finding may be the consequence of a nutritional transition resulting from changes in eating habits and lifestyle due to over-consumption of carbohydrates and animal fats, low fiber consumption and a severe sedentary lifestyle¹⁶.

The majority of our diabetics come from urban areas, with a percentage of 88.6%. The location of the center within the prefecture of Oujda facilitates access to its urban population which represents (65.41%) against the rural (34.5%). A highly significant relationship was found between place of residence and diabetes P value < 0.001 .

Table 4. Characteristics of hypertensive diabetics under treatment

| RISK FACTORS | HBP 86.52 (N=1008) | | P value | OR | [IC 95%] |
|------------------------------|--------------------|-----|---------|------|---------------|
| | HBP | CVA | | | |
| GENDER | | | | | |
| W | 716 | 6 | <0.0001 | 1.48 | [1.266-1,734] |
| M | 281 | 4 | | | |
| TYPE OF DIABETES | | | | | |
| 1 | 19 | 0 | <0.0001 | 0.25 | [0.168-0.382] |
| 2 | 976 | 10 | | | |
| DURATION OF DIABETES (YEARS) | | | | | |
| 0-9 | 710 | 7 | <0.090 | 0.53 | [0.250-1.104] |
| 10-19 | 221 | 3 | <0.606 | 0.82 | [0.385-1.746] |
| 20-29 | 53 | 0 | <0.818 | 0.91 | [0.401-2.058] |
| >30 | 13 | 0 | | | |
| Hb1ac | | | | | |
| <7 | 306 | 5 | <0.205 | 1.5 | [0.778-2.907] |
| >7 | 691 | 5 | | | |
| GLYCEMIA | | | | | [1.197-1.611] |
| <1.26 | 646 | 7 | <0.0001 | 1.39 | R2=0.005 |
| >1.26 | 351 | 3 | | | |
| SAT | | | | | |
| <14 | 446 | 5 | <0.0001 | 0.61 | [0.516-0.720] |
| >14 | 551 | 5 | | | |
| DAT | 707 | 7 | | | |
| <9 | 290 | 3 | <0.001 | 0.68 | [0.548-0.841] |
| >9 | | | | | |
| BMI | | | | | |
| 1 | 255 | 1 | <0.0001 | 1.46 | [0.854-2.480] |
| 2 | 406 | 1 | | | |
| 3 | 336 | 8 | | | |
| COMPLICATIONS | | | | | [0.976-1.030] |
| RETINOPATHY | 509 | 6 | <0.0001 | 1.52 | R2= 0.5 |
| NEPHROPATHY | 76 | 3 | | | |
| CARDIOPATHY | 99 | 0 | | | |
| IDM | 2 | 0 | | | |

SAT: Systolic Arterial Tension, DAT: Diastolic Arterial Tension, CVA: CerebralVascular Accident, HBP: High Blood Pressure, MI: Myocardial Infarction,HBAC: Glycated Hemoglobin, BMI: Body Mass Index

The economic recession and the unemployment rate recorded in the Eastern region, 15.7%¹⁷, encourage 88.36% of unemployed diabetics to seek medical follow-up at the MDRCMC. Moreover, 92.9% have RAMEd medical coverage. Since this center is a non-profit public institution, it does not require any payment. Thus, the influx of this social class category to this structure is justified. Nevertheless, socio-economic status has an impact on the presence of diabetes itself¹⁸. Not to mention the cost generated by the prescrip-

tion, which impoverishes these patients; this has been demonstrated by a study by the American Diabetes Association, which concluded that people with a diagnosis of diabetes have on average 2.3 times more medical expenses than they would have had in the absence of diabetes¹⁹.

Depending on the type of diabetes, T2DM accounts for 92% of our sample, as reported in the literature, this type is the most common form worldwide, with a prevalence of 90-95%. With a rate of 8% of DMT1, we are

approaching the 5-10% found worldwide². Our results indicate that 77% of the diabetics had duration of diabetes of less than 9 years.

This finding is similar to that found by Sow et al. in Dakar, who found that 55.6% of diabetics had a duration of diabetes of less than 5 years²⁰. However, this rate diverges from another study carried out between 2005 and 2011 in the eastern region, which showed that the duration of diabetes exceeded 10 years in more than 50% of cases.

Concerning this parameter, its effect is proven on the appearance of complications, i.e., once the age of diabetes is advanced, the risk of complications increases with a significant relationship $p < 0.0001$ in our sample. Our results are corollary with another research in this sense that has demonstrated the effect of the duration of diabetes on the onset of complications²¹.

Oral antidiabetic drugs (OADs) were prescribed in 74.68% of our patients compared to 20.58 on insulin therapy. This result is directly related to the high rate of type 2 diabetics (92%), as OADs represent the treatment used in the majority of cases to treat type 2 diabetics called non-insulin-dependent diabetes mellitus. Whereas, for T1D called insulin-dependent diabetes mellitus, patients must be treated with daily insulin²².

On the other hand, 3.5% of patients are under hygieno-dietary rules alone, and this could be explained by the fact that in the majority of cases, the diabetic consults the RCDMC in a state of chronic hyperglycemia for adaptation of hygieno-dietary rules.

As for the inbreeding factor, 36.75% of patients reported the presence of diabetes in their family. It is more frequently found in non-insulin-dependent diabetes (25%) than in insulin-dependent diabetes (18%), in accordance with the data in the literature²³.

The literature discusses the impact of obesity on the health of diabetics called (diabesity), it includes long-term, reduced health-related functioning, reduced quality of life and reduced overall life expectancy. Long-term complications include myocardial infarction, stroke and end-stage renal disease. In addition, recent advances have shown an association between chronic stress, depression, and sleep disorders and diabetes and obesity²⁴.

According to a Canadian study conducted in 2017, interventions that affect 5% body weight loss would reduce health care costs by \$2.03 billion²⁵.

In Morocco, the burden of obesity seems to be linked to changes in lifestyle, particularly diet, where 53% are overweight and 20% are obese¹¹. Our sample

includes 35.48% overweight and 27.80% obese.

In this study, the impact of BMI is very clear on complications 39.74% are overweight and 31.93% are obese with a higher average BMI in women than men are. The MCA results showed the clustering of overweight and/or obese diabetics with the presence of complications (group A). In addition, the regression test shows a highly significant correlation with a P value = 0.0001 (OR = 1.213; 95% CI: [0.854-1.729]).

The pathogenesis of diabetes complications is not fully understood and there is controversy as to why they occur in some patients and not in others.

In this study, data on complications are presented in Table 3, which shows that their frequency is 29.80%, which corroborates the frequency found by HAMMOUDI et al. 31% in the eastern region²⁶. Nevertheless, this rate is lower than in other studies (63.8% in Morocco (Fez), 60% in Algeria, 68.7% in Libya and 86% in Oman)²⁶. This difference in the frequency of diabetic complications can be largely explained by the specificity of our research approach (retrospective and mono-centric) and the characteristics of the sample (age, sex....).

In this sense, diabetic retinopathy remains the most frequent of all the above-mentioned complications with 13.78%, this association was very significant with a p value = 0.0001. It affects more the T2Ds with a risk of RR=5.89. Other studies have observed a higher prevalence of retinopathy among diabetic patients ranging from 16.8% to 69.4%²⁷. Furthermore, DR in Eastern Mediterranean countries has been estimated to be between 10 and 64%²⁶.

The second most common complication in this study was diabetic nephropathy (ND) with 12.8% of cases. ND results from the same pathological mechanisms as DR, the discovery of one of these complications must necessarily lead to the search for the other. The prevalence of this microvascular pathology differs from one country to another: those close to ours are 10.8% in Arabia²⁸, and 57.4% proliferative diabetic retinopathy in eastern Morocco²⁹.

The rate of cardiovascular disease is 3.4%, lower than the rate found by the International Diabetes Management Practices Study (IDMPS) in Morocco 45.85% and other Arab countries where macrovascular complications could range from 1.3%, 5.6 to 50.8% in people with diabetes²⁵.

From a co-morbidity point of view, it turns out that hypertension in addition to diabetes makes the progno-

sis of patients very critical. The 1/4 (25.35%) represents this associative character which is close to the results of the Moroccan Ministry of Health which found a frequency of 29%.

In a study conducted by Ziyat et al⁷ in Eastern Morocco, the frequency of hypertension was 31.7% higher in a population aged 40 years and older, and a very high frequency (69.9%) in diabetic subjects from the same population.

Similarly, other studies have published a frequency of hypertension ranging from 49.3% to 70.4% in patients with type 2 diabetes in different regions of Morocco²⁷.

These alarming rates of hypertension confirm that this disease has become a health scourge in our study area as in all regions of Morocco, our diabetics were 3.06 times more likely to be hypertensive with a OR (95% CI) = 3.06 [2.11, 4.45] (Table 3).

A meta-analysis of 102 prospective studies published in 2010 shows a relative risk (RR) of 2.0 (95% CI, 1.8-2.2) for any coronary heart disease, and 2.3 (95% CI, 2.1-2.6) for death due to coronary heart disease.

The risk of several stroke subtypes is also increased, ranging from an RR of 2.3 (2.0-2.7) for ischemic stroke to 1.6 (1.2-2.1) for hemorrhagic stroke¹.

This specific population of diabetics, in addition to hypertension and heart disease, presents other risk factors such as obesity 40.27%, overweight 33.33%, and dyslipidemia, which affects their glycemic balance, which is higher than 7% in 68.55% of cases.

Dyslipidemia is present in our sample with a frequency of 12.67% in diabetic patients; its presence is frequent in diabetic patients, especially type 2 according to the literature: it affects nearly 50% of diabetic patients and aggravates the risk of cardiovascular pathologies in these patients who are already at high cardiovascular risk³⁰.

This result is justified since our sample includes more women who are obese whereas the character of dyslipidemia is often accompanied with the notion of obesity.

Our results corroborate those of a study conducted in Burkina Faso that found a rate of metabolic syndrome equivalent to 48.9% in diabetics. The literature has already demonstrated this high prevalence in the general population and in diabetics in particular⁴.

Our patients' blood glucose control values measured by Hb1ac are above the acceptable limit (7%) in 62.77% of patients. For fasting capillary blood glucose, 64.08% had a value greater than 1.26 g/l. similar results were

endorsed by the study of Ben el Mostafa et al. in 2019, which worked on T2DM, where 84% had an Hb1ac value > 7 and 28% had a value greater than >10³¹.

Our analysis showed that age, duration of diabetes and hypertension, dyslipidemia and BMI were the main risk factors associated with the development of diabetes complications. These same results were found in the MCA analysis where the most discriminating factors are identical.

These results are consistent with other reports showing that the risk of developing these complications is positively associated with these variables²⁶.

Pearson's correlation coefficients are highly significant (P = 0.000); on the one hand between complications and BMI (r = 0.5) and on the other hand between complications and glycosylated hemoglobin values (r = 0.4); this result can be explained by the fact that overweight can lead in the majority of cases to poorly controlled diabetes.

Understanding the relationship between risk factors and the occurrence of complications could be a good starting point for monitoring and preventing complications.

A 30% reduction in risk factors, through interventions for those at higher risk of developing complications (i.e., the top 10% of the highest risk group) would result in savings of \$1.48 million²⁴.

CONCLUSION

Through this single-center study, limited to the population of diabetics from the eastern region, we have made an inventory of the risk factors and complications arising from this pathology. Our data are consistent with those found by local researchers and others on a larger scale. This report highlights the extent of diabetes and its complications in the Eastern region.

The most relevant results show that one in four people with diabetes has at least one modifiable risk factor such as corpulence, dyslipidemia, and uncontrolled hypertension.

In this respect, a national program declined at the regional level for the reduction of environmental risk factors must be considered in the short term.

Priority will be given to the urban environment, and to populations at risk: women and young people especially.

This program must include the implementation of

measures to prevent risk factors and complications, promote therapeutic education, and improve the management of diabetics (nutritional, therapeutic and physical).

In the long term, this pattern will undoubtedly reduce the exponential incidence of complications, which will have a positive impact on the direct cost of care and on the quality of life of diabetics.

Compliance with ethics requirements: The authors declare no conflict of interest regarding this article. The authors declare that all the procedures and experiments of this study respect the ethical standards in the Helsinki Declaration of 1975, as revised in 2008(5), as well as the national law. Informed consent was obtained from all the patients included in the study.

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