

# Macroangiopathy and Associated Factors in Outpatients with Type 2 Diabetes Attending the Antidiabetic Center of Abidjan in Ivory Coast

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**Abstract:** Diabetes constitutes a major public health concern, especially in developing countries, due to its frequency and severity related to the macroangiopathy complications. This study aimed at estimating the prevalence of macroangiopathy in type 2 diabetic outpatients attending the Antidiabetic Center of Abidjan (ADCA) and identifying the associated factors. It was a retrospective and analytic study that was conducted in 2014 at the ADCA. In total, 377 diabetic outpatients were included in the study. Patients had a mean age of 61.3 (SD: 8.9) years and were suffering diabetes for a mean duration of 11.8 years (SD: 5.6). In 95.5% of the cases, at least one cardiovascular disease risk factor was associated to diabetes. It was high level of cholesterol (37.1%), high level of Low Density Lipoprotein (LDL) cholesterol (72.4%), low level of High Density Lipoprotein (HDL) cholesterol (20.9%), high level of triglycerides (10.3%), hypertension (67.4%), and obesity (18.8%). Macroangiopathy was diagnosed in 62 out of 377 patients, meaning 16.4%. It was a coronary disease (44/377 meaning 11.7%), vascular cerebral accident (11/377 meaning 2.9%) and peripheral arterial disease of the lower limbs (10/377 meaning 2.7%). Diabetic patients with hypertension were more likely to have a macroangiopathy as compared to those without hypertension ( $p = 0.024$ ; OR2.57, IC = [1.13-5.85]). In addition, patients presenting a low level of HDL cholesterol were likely to have a coronary heart disease as compared to those with a normal level of HDL cholesterol ( $p = 0.008$ ; OR = 2.72, IC [1.28-5.76]). With regard to the severity of macroangiopathy complications, it is tremendous to reinforce the medical management of cardiovascular disease risk factors in type 2 diabetes patients in Ivory Coast.

**Keywords:** Type 2 Diabetes, Macroangiopathy, Associated Factors, Ivory Coast

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## 1. Introduction

In contrast to a former opinion that was considering diabetes mellitus as a disease of developed countries, it has more and more become a major health concern in developing countries. In fact, the recent global estimates of the International Federation of Diabetes (IFD) reveal that 8.3%

of adults, meaning 382 million people are affected with diabetes worldwide, type 2 diabetes being the leading condition [1]. These figures are expected to increase beyond 592 million in less than 25 years. Moreover, 80% of the total number of people affected with this disease live in poor and middle income countries such as Cote d'Ivoire where the epidemic is growing at an alarming pace, along with its related complications, representing a heavy social and

economic burden [1].

Among the complications, macroangiopathy with regards to its frequency and severity, represents a major concern. According to several epidemiologic studies, macroangiopathy accounts for more than half the deaths observed in the diabetic population [2]. In the United States of America (USA), this coronary heart disease brings about 70% of deaths in type 2 diabetes patients while it is only responsible of one-third of deaths in non-diabetic patients [2]. In France, it is usually estimated that 20-30% of type 2 diabetes patients are affected with an ischemic coronary heart disease. In addition, diabetic patients are 4 to 6 times likely to suffer a peripheral arterial disease (PAD) of the lower limbs as compared to non-diabetic patients [1]. This frequency of macroangiopathy is explained by the steady presence of cardiovascular disease risk factors among type 2 diabetic patients, hypertension being the leading risk factor with 60% to 70% of patients concerned [3]. Hence, a noticeable number of deaths could be avoided in the diabetic population by decreasing their risk level of cardiovascular disease.

In Ivory Coast, the estimate prevalence of macroangiopathy in 2002 was 23.15% [4]. Except this study, there is a scarcity of recent data on the prevalence of macroangiopathy in diabetic patients, and above all, little is known on the associated risk factors. This study has been conducted with the aim of filling such a gap. The objectives were to estimate the prevalence of macroangiopathy in type 2 diabetic patients followed in the Antidiabetic Center of Abidjan (ADCA) and to identify its related risk factors.

## 2. Methodology

### 2.1. Study Site

The study site was the Antidiabetic Center of Abidjan (ADCA) located at the National Institute of Public Health (NIPH) is the national reference center specialized in the management of diabetic outpatients (both type 1 and type 2). Each year, this center receives about 1500 new cases and follows up the management of 10.000 consulting of diabetes. The majority of patients, meaning 93.4% are type 2 diabetes patients.

The ADCA offers a comprehensive medical management of the diabetic population. It is organized so as to offer in the same venue, a minimum annual package of care including medical and nutritional care as well as exams related to the follow up and checkup (biology, ECG) for 55 000 FCFA, meaning about 90 USD considering the current cost of 1 USD= 607 FCFA). The medical care are provided by a team made of 8 doctors, 3 nurses, and one social worker.

### 2.2. Type of Study

It was a retrospective descriptive and analytic study. The study was conducted during the month of November 2014.

### 2.3. Study Population and Sampling Strategy

The study population was made of type 2 diabetes patients

attending the ADCA. Any patient respecting the following criteria was included:

- (a) attended the ADCA in 2014;
- (b) with a diabetes duration of 5 years and more;
- (c) benefited a screening for macroangiopathy related complications.

The sample size was calculated based on the formula below:

$$n = \frac{\varepsilon^2 pq}{i^2} = 377 \quad (1)$$

p is the expected proportion of macroangiopathy 56.86% [5]

q = 1-p

ε is the standard normal variate at the risk α (type 1 error) of 5% = 1.96

i is the precision used to estimate the frequency of macroangiopathy = 5%.

The minimum number of subjects to include in the study was 377. Patients were retrospectively included, going from the beginning date of the survey, until the desired sample size was reached. Thus, they were retrospectively included based on their order in the registration files.

### 2.4. Data Collected

Sources of data were the medical records of the patients. Data were collected through a questionnaire and were related to sociodemographic characteristics (age, sex, profession, nationality, ethnicity, marital status, place of residency), diabetes history (diagnosis circumstances, family history of diabetes, diabetes duration, duration of ADCA attendance, current treatment, the most recent blood sugar measure, HBA1c), associated cardiovascular disease risk factors (hypertension, dyslipidemia, obesity, overweight, smoking, micro or macro albuminuria), macroangiopathy related complications (coronary heart disease, cerebral vascular disease, peripheral arterial disease of the lower limbs) and other complications (microangiopathy, metabolic and infectious complications).

### 2.5. Definition of Mains Variables

*Coronary heart disease:* Coronary heart disease diagnosis was made in front of electrocardiogram abnormalities revealing an ischemia, a lesion or a necrosis.

*Cerebral Vascular Disease (CVD):* CVD diagnosis was made when intracranial computed tomography scans were showing typical images of stroke or in front of sequelae of stroke such as motor deficiency (hemiparesis and hemiplegia).

*Peripheral Arterial Disease of the lower limbs (PAD of the lower limbs):* Diagnosis of PAD of the lower limbs was made in front of typical clinical symptoms (absence of one or several pulses at the palpation of lower limbs arteries, intermittent claudication, rest pain, skin discoloration / gangrene) and/or typical results of the duplex Doppler of the lower limbs.

*Hypertension:* Hypertension was defined as systolic blood

pressure superior or equal to 140 mmHg and/or diastolic blood pressure less or equal to 90 mmHg.

**Dyslipidemia:** Dyslipidemia was diagnosed in presence of at least one of the following abnormality, total cholesterol superior or equal to 2.0g/l or Low Density Lipoprotein (LDL) cholesterol superior to 1.0g/l; High Density Lipoprotein (HDL) cholesterol < 0.4g/l for men and 0.5g/l for women; Triglycerides superior to 1.5g/l.

**Glycemic balance:** Glycemic balance was defined by a level of HbA1c less than or equal to 7%.

**Obesity:** the patient was considered obese when his Body Mass Index (BMI) was superior or equal to 30kg/ m<sup>2</sup>.

## 2.6. Data Management

Data were entered and analyzed using Epidata 3.1, SPSS 18.0 and Excel 2007. Quantitative variables were described by the mean, the standard deviation and the extremes. Qualitative variables were described by the proportions. In order to identify the correlates factors of macroangiopathy, we've first conducted a bivariate analysis with the test of chi 2. Then, variables showing a significant association with the dependent variable as well as those described in the literature as potential predictors of macroangiopathy related complications were included in the model for the multivariate logistic regression.

In the final model, adjusted Odds Ratio (OR) and their Confidence Interval (CI) at 95% were computed. The statistics tests were realized at the significant statistic level of 5%.

## 2.7. Ethical Considerations

We have obtained an authorization of the direction of NIPH that has allowed us to conduct this survey in the ADCA. We have respected the anonymity of the questionnaires and confidentiality during data collection.

# 3. Results

## 3.1. General Characteristics of the Study Population

General characteristics of the study population are described in table 1. The majority of patients were female (62.1%) with a sex ratio of 0.61. The mean age was 61.27 [ $\pm$  8.9] years and the majority was Ivorian (91.8%). About one quarter (24.1%) of the study population were either retired or unemployed and more than 2-third were married (71.9%) and were living in Abidjan (70.9%). Diabetes was discovered in a context of cardinal symptoms (78.8%), with a mean duration of 11.78 [ $\pm$  5.6] years. Family history of diabetes was found in 35.8% of cases and was mainly concerned with ascendants (52.3%) and siblings (45.7%).

The mean duration of attendance to the ADCA was 10.01 [ $\pm$  6.2] years. Patients' treatment was mainly based on Oral Anti-diabetic (50.9%) and insulin only (34.2%). The last 3 months' glycemic balance (HbA1c  $\leq$  7%) was satisfying in 56.8% of patients.

In 95.5% of the cases, at least one cardiovascular disease risk factor was associated to diabetes. It was high level of cholesterol (37.1%), high level of LDL cholesterol (72.4%),

low level of HDL cholesterol (20.9%), high level of triglycerides (10.3%), hypertension (67.4%), and obesity (18.8%). More than 2-thirds of patients were presenting a dyslipidemia (70.5%)

**Table 1.** General Description of diabetic patients, ADCA, 2014.

Variables	Frequency	%
Sex		
Male	143	37.9
Female	234	62.1
Age (years)		
40 – 49	32	8.5
50 – 59	136	36.1
60 – 69	149	39.5
$\geq$ 70	60	15.9
Place of residency		
Abidjan	267	70.9
Out of Abidjan	110	29.1
Circumstances of diagnosis		
Cardinal symptoms	297	78.8
Fortuitous discovery	71	18.8
Complications	9	2.4
Diabetes duration (years)		
<10	158	41.9
$\geq$ 10	219	58.1
Current anti-diabetic treatment		
Oral Anti Diabetic drugs (OAD)	192	50.9
Insuline	129	34.2
OAD + insuline	37	9.8
Nutritional Education Measures	19	5.1
Obesity <sup>1</sup>		
Absent	294	81.2
Present	68	18.8
Hypertension		
Absent	123	32.6
Present	254	67.4
HbA1c <sup>2</sup>		
< 7%	197	54.6
$\geq$ 7%	164	45.4
Total Cholesterol <sup>3</sup>		
< 2.0 g/l	215	62.9
$\geq$ 2.0 g/l	127	37.1
LDL Cholesterol <sup>4</sup>		
< 1.0 g/l	94	27.6
$\geq$ 1.0 g/l	246	72.4
HDL Cholesterol <sup>4</sup>		
< 0.40 g/l	71	20.9
$\geq$ 0.40 g/l	269	79.1
Triglycerides <sup>5</sup>		
< 1.50 g/l	306	89.7
$\geq$ 1.50 g/l	35	10.3

<sup>1</sup>n=362 <sup>2</sup>n=361 <sup>3</sup>n=342 <sup>4</sup>n=340 <sup>5</sup>n=341

## 3.2. Macroangiopathy and Associated Risk Factors

Macroangiopathy was diagnosed in 62 out of 377 patients, meaning 16.4%. It was, in a ranking order, coronary heart disease (44 meaning 11.7%), cerebral vascular disease (11 meaning 2.9%), and peripheral arterial disease of the lower limbs (10 meaning 2.7%). Most of the macroangiopathy related complications (75.8%) occurred after 5 years of diabetes duration. Macroangiopathy was more frequent in patients aged 65 years and more (p = 0.003), those with more than 10 years of diabetes duration (p = 0.025), and those with

an associated hypertension (0.006) (Table 2).

**Table 2.** Macroangiopathy according to diabetic patients' characteristics, ADCA, 2014.

Variables	Frequency	%	p
Sex			
Male	24	16.8%	0.89
Female	38	16.2%	
Age			
< 65	30	12.3%	0.003
≥ 65	32	24.1%	
Diabetes duration (years)			
<10	18	11.4%	0.025
≥10	44	20.1%	
HbA1c			
< 7%	35	17.8%	0.744
≥ 7%	27	16.5%	
Hypertension			
Yes	51	20.1%	0.006
No	11	8.9%	
LDL Cholesterol			
< 1.0 g/l	17	18.1%	0.433
≥ 1.0 g/l	36	14.6%	
HDL Cholesterol			
< 0.40 g/l	16	22.5%	0.070
≥ 0.40 g/l	37	13.8%	
Triglycerides			
< 1.50 g/l	45	14.7%	0.207
≥ 1.50 g/l	8	22.9%	
Obesity			
Yes	14	20.6%	0.32
No	46	15.7%	

After adjusting for age, diabetes duration and the levels of LDL cholesterol, HDL cholesterol and triglycerides, there was a significant association between macroangiopathy and hypertension ( $p = 0.024$ ; OR 2.573, IC = [1.132-5.846]). Diabetic patients with hypertension were 2 times more likely to suffer from macroangiopathy as compared to those without hypertension (Table 3).

**Table 3.** Factors associated with macroangiopathy ( $n=377$ ; number of cases macroangiopathy = 62).

Variables	OR	IC 95%	p value
Age (years)			
< 65	1	---	0.118
≥ 65	0.605	[0.322–1.136]	
Hypertension			
Absent	1	---	0.034
Present	2.421	[1.071–5.473]	
Diabetes duration (years)			
< 10	1	---	0.140
≥ 10	0.601	[0.306–1.181]	
HbA1c			
< 7%	1	---	0.822
≥ 7%	0.932	[0.503–1.725]	
LDL Cholesterol			
< 1.0 g/l	1	---	0.542
≥ 1.0 g/l	1.231	[0.631–2.401]	
HDL Cholesterol			
< 0.40 g/l	0.518	[0.262–1.024]	0.058
≥ 0.40 g/l	1	---	
Triglycerides			
< 1.49 g/l	1	---	0.455
≥ 1.50 g/l	0.701	[0.277–1.777]	

**Table 4.** Coronary heart disease according to diabetic patients' characteristic, ADCA, 2014.

Variables	Effectif	%	p
Sex			
Male	18	12.6%	0.66
Female	26	11.1%	
Age (years)			
< 65	21	8.6%	0.012
≥ 65	23	17.3%	
Diabetes duration (years)			
< 10	13	8.2%	0.077
≥ 10	31	14.2%	
HbA1c			
< 7%	24	11.8%	0.779
≥ 7%	20	12.7%	
Hypertension			
Absent	9	7.3%	0.067
Present	35	13.8%	
LDL Cholesterol			
< 1.0 g/l	11	11.7%	0.764
≥ 1.0 g/l	26	10.6%	
HDL Cholesterol			
< 0.40 g/l	14	19.7%	0.007
≥ 0.40 g/l	23	8.6%	
Triglycerides			
< 1.49 g/l	30	9.8%	0.066
≥ 1.50 g/l	7	20.0%	
Obesity			
Yes	12	17.6%	0.084
No	30	10.2%	

Coronary heart disease was associated with age ( $p=0.012$ ) and level of HDL cholesterol ( $p = 0.007$ ) in the bivariate analysis (Table 4). After adjusting for age, diabetes duration, hypertension, level of LDL cholesterol, and level of triglycerides, we found that level of HDL cholesterol was significantly associated with coronary heart disease ( $p = 0.008$ ); OR = 2.720, IC [1.284-5.762] (Table 5). Patients with low level of HDL cholesterol (< 0.40 g/l) were about 3 times more likely to suffer from coronary heart disease.

**Table 5.** Factors associated to coronary heart disease ( $n=377$ ; cases of coronary heart disease=44).

Variables	OR	IC	p value
Age (years)			
< 65	1	---	0.189
≥ 65	1.640	[0.784 – 3.433]	
Diabetes duration (years)			
< 10	1	---	0.352
≥ 10	1.448	[0.664 – 3.154]	
Hypertension			
Absent	1	---	0.243
Present	0.587	[0.240 – 1.436]	
HbA1c			
< 7%	1	---	0.301
≥ 7%	1.460	[0.713 – 2.989]	
LDL Cholesterol			
< 1.0 g/l	1	---	0.997
≥ 1.0 g/l	0.992	[0.449 – 2.211]	
HDL Cholesterol ( $n=340$ )			
< 0.40 g/l	2.879	[1.362 – 6.089]	0.006
≥ 0.40 g/l	1	---	
Triglycerides ( $n=341$ )			
< 1.49 g/l	1	---	0.188
≥ 1.50 g/l	1.965	[0.720 – 5.364]	

## 4. Discussion

This study realized in ADCA, the national reference center for management of diabetes outpatients, aimed at estimating the prevalence of macroangiopathy in type 2 diabetes patients, as well as identifying the associated risk factors of macroangiopathy in type 2 diabetes patients.

This study showed some limitations. Some paraclinical exams that could help in exploring and confirming some complications were not systematically prescribed to or realized by patients.

In addition, some information related to macroangiopathy and its risk factors were lacking in some medical records. This may have influenced the prevalence of some macroangiopathy related complications and may have limited data analysis. In spite of these limitations, the study has revealed some sound results that can help in decision making at the local level.

In the study, patients presented at least one associated Cardiovascular Disease Risk Factor (CVDRF) such as hypertension (67.4%), dyslipidemia (70.5%) and obesity (18.8%).

These results are similar to those found in the literature, revealing that hypertension is present in 20% to 80% of diabetic patients [2] and dyslipidemia in 54% [2, 6]. The frequency of CVDRF in diabetic patients can be explained by the fact that type 2 diabetes generally occurs in a context of several metabolic abnormalities or metabolic syndrome due to insulin resistance.

These cardiovascular risk factors expose diabetic patients to the occurrence of macroangiopathy related complications, explaining all the severity of this condition. In the study, 16.4% of patients presented macroangiopathy related complications. The results are different from those of past studies realized in type 2 diabetes patients in Ivory Coast.

Studies realized at the teaching Hospital of Treichville in 1993, 1999 and 2002 respectively found prevalence of macroangiopathy of 56.86% [5], 34.33% [7], et 23.15% [4].

These results show a reduction in the prevalence of macroangiopathy throughout the years. In contrast, ABODO, in a study conducted in a peripheral hospital of Abidjan, found a prevalence of 5.1% [8]. This low prevalence may be explained by the fact that this facility did not have a specialized technical plateau, and was therefore referring patient to more specialized structures such as ADCA and the unit of diabetology of the teaching hospital. The current study showed that coronary heart disease (11.7%) was the most frequent complication. These findings are similar to those of study conducted by Allechi in Ivory Coast and Ouedraogo in Burkina Faso with respective prevalence of 20.78% and 32.2% [5, 9, 10].

In Morocco, FILALI in 2009, in a study on type 2 diabetes patients at the teaching Hospital of Marrakech, showed a proportion of «coronary» complications of 24.5% [11]. In France, the ENTRED study in 2007 showed a prevalence of coronary heart disease of 15.5% in the general population [12].

The prevalence of coronary heart disease in diabetic patient is as higher as other CVDRF are present and it is higher than 50% when two other risk factors are associated to diabetes [13, 14]. Vascular cerebral disease and PAD of the lower limbs were present in the study population at some relatively low prevalence, respectively of 2.9% and 2.7%.

KONIN, in a prospective study conducted in 2012 in diabetic patients coming from 3 diabetes management centers in Abidjan, found a prevalence of PAD of the lower limbs higher than ours (22.07%) [15].

In Morocco, FILALI in his study revealed some proportions of vascular cerebral disease and PAD of the lower limbs at 22.1% and 13.9% respectively [11]. In this study, the diagnosis of PAD of the lower limbs was essentially clinically made. Paraclinical exams such as Duplex Doppler of the lower limbs were barely prescribed or realized, explaining this low proportion. According to the results, hypertension was significantly associated with macroangiopathy related complications. Henceforth, diabetic patients with hypertension were 2.4 more likely to suffer some macroangiopathy related complication as compared to diabetic patients without hypertension.

According to the literature, hypertension is a major risk factor of coronary heart disease in diabetic patients: an increase in systolic blood pressure of 10 mmHg is associated to a 15% increase in risk of coronary heart disease [16]. Hypertension is responsible of 49% of cardiovascular ischemic disease and 62% of vascular cerebral disease [17].

With regards to coronary heart disease, there is a significant association with the risk factor HDL Cholesterol. Low level of HDL cholesterol in a diabetic patient increases 2.8 times the risk of suffering a coronary heart disease. In 1993, the National Cholesterol Education Program (NCEP) Adult Treatment Panel II (ATP II) recognized HDL cholesterol as a risk factor of independent ischemic cardiovascular disease and recommended its dosage along with that of total cholesterol during the initial screening [18]. High level of cholesterol is responsible of 18% of vascular cerebral diseases and 56% of ischemic cardiovascular diseases [16].

## 5. Conclusion

Hypertension and low level of HDL cholesterol were identified as predictors of macroangiopathy in diabetic patients attending the ADCA. More than 2 thirds were suffering from hypertension and had low level of HDL cholesterol. With regards to the severity of macroangiopathy complications, it appears tremendous to reinforce the medical management of diabetic patients. This will require to prevent the onset of cardiovascular disease risk factors by the educational and hygienic strategies or to radically treat them once they are already set. In addition, all cardiovascular complications should be systematically and efficiently looked after in diabetic patients so as to ensure an early management.

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