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Prevalence, Morbidity and Mortality of Diabetes Mellitus in 9009 Adult Patients over 12 Years in the Internal Medicine Department of the Bouaké University Hospital

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Abstract

Introduction: Diabetes mellitus, which is steadily increasing in sub-Saharan Africa, leads to disabling complications and premature death. We conducted a study in African hospitals with the aim of investigating the morbidity and mortality of diabetes in terms of its prevalence and associated factors. **Methods:** This was a cross-sectional, analytical study conducted in the Internal Medicine Department of Bouake University Hospital from January 2010 to December 2021 (12 years), covering 9009 diabetic patient records (aged 16 and over) in consultation and hospitalization. The diagnosis of diabetes was based on criteria from the American Diabetes Association (ADA 2024). The variables included sociodemographic data, comorbidities, cardiovascular risk factors, diabetes characteristics, complications, therapeutic and outcome parameters, and mortality analysis (only in hospitalized patients). We used EPI INFO 7 software for data analysis ($p < 0.05$). **Results:** The average age was 47.27 ± 11.8 years (28 - 42), the sex ratio was 0.83, and the average blood glucose level was 2.5 g/l (0.35 - 9.13). The prevalence in hospitalization was 10.1% and 29% in consultation. Familial diabetes was noted in 17% of cases, unknown in 54.2% of cases, and mainly type 2 (78.7%). Prevalence curves gener-

ally declined over 12 years. The main factor associated was hypertension (34.7%). Complications were metabolic (85%), dominated by ketoacidosis (94.7%), infectious such as pneumonia (26.5%) and diabetic foot (26.4%). There were also macroangiopathies (16%) such as strokes (52%), silent myocardial ischemia (28%), and microangiopathies (11.1%). Diabetes was fatal in 10.5% of cases, with diabetes-related mortality at 5.8% and diabetes-specific in-hospital mortality at 1.1%. Mortality had been increasing since 2018 and was associated with factors such as age over 50 (50 - 59 years: p: 0.0018; OR: 1.8 [1.26 - 2.6] and ≥60 years: p: 0.006; OR: 1.76 [1.19 - 2.6]), hypertension (p: 0.03; OR: 1.79 [1.07 - 3]), smoking ($p < 0.001$; OR: 3.74 [2 - 7]), dyslipidemia (p: 0.04; OR: 1.56 [1.04 - 2.34]), infections (p: 0.047; OR: 2.44 [1.05 - 5.6]), macroangiopathy ($p < 0.001$; OR: 4.7 [2.94 - 7.5]) and microangiopathy ($p < 0.001$; OR: 5.44). Women were associated with death (OR: 2.34). **Conclusion:** The prevalence and mortality of diabetes were high and increasing. Factors associated with mortality included infections, macroangiopathies, and microangiopathies, Hence the importance of targeted screening of people at risk, adult members of the families of each diabetic patient, and finally multidisciplinary care, especially preventive care for diabetic patients.

Keywords

Diabetes Mellitus, Complications, Mortality, Internal Medicine, Côte d'Ivoire

1. Introduction

Diabetes mellitus is a global public health problem due to its increasing prevalence and morbidity and mortality rates. Its global mortality rate, all causes combined, has risen from 6.8% to 12.2% in recent years, with atherosclerotic cardiovascular disease being the leading cause [1]-[3]. It contributes to chronic kidney disease (CKD: 25 - 30%), amputations (26% in Côte d'Ivoire), and blindness [4]-[6]. Epidemiological predictions for this pandemic are on the rise for the coming years. In fact, in 2025, the International Diabetes Federation (IDF) estimated that the number of diabetics worldwide will increase by 51% from 2019 to 2045, with a 143% increase in Africa [4]. The same federation estimated that the highest proportion of underdiagnosed diabetes was in Africa in 2021 (53.6%) and in 2025 (72.6%) [4] [7] [8]. In Côte d'Ivoire, Yao found a 15-year hospital mortality rate of 8.9%, with anemia and sepsis as the leading causes of death [9]. Limited data on this mortality and morbidity is available in the center of the country, particularly at the Bouake University Hospital, which serves a cosmopolitan population and is a referral center. Are there any specific characteristics in the Internal Medicine Department of the Bouake University Hospital? This question sparked our interest in this study. The objective was to study morbidity and mortality due to diabetes in the Internal Medicine Department of Bouake University Hospital, both in terms of prevalence and associated factors.

2. Patients and Methods

Patients

Our study was conducted in the Internal Medicine Department of the Bouake University Hospital Center (CHU) from January 2010 to December 2021. It included the records of adult patients aged 16 years and older with diabetes mellitus, regardless of the reason for admission, or in whom diabetes mellitus was discovered during consultation or hospitalization (Figure 1). The records of patients who met the age criteria but were unusable were not included, nor were diabetic patients who were transferred from the emergency department to another department such as infectious diseases (e.g., COVID-19), cardiology, or neurology. We recorded patients by file number to avoid duplication within each unit (outpatient and inpatient) and for patients who had stayed in both units.

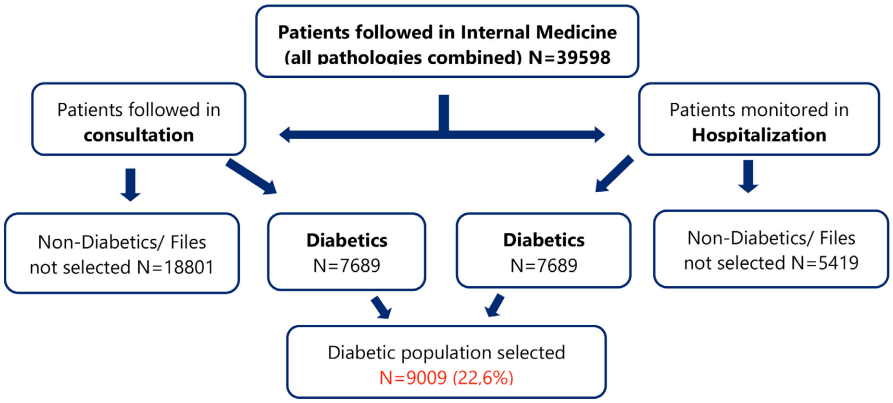

Figure 1. Patient selection scheme and prevalence of diabetes in patients hospitalized and consulted in Internal Medicine from 2010 to 2021.

Methods

This was a cross-sectional, analytical study. The first group of variables studied included sociodemographic data (age, gender, occupation), comorbidities, and cardiovascular risk factors (CVRF) (high blood pressure (HBP), diabetes mellitus, dyslipidemia, alcohol consumption, tobacco use, sedentary lifestyle, overweight and obesity according to body mass index). The reasons for hospitalization and consultation, the characteristics of diabetes (type, status known or not), the biological parameters (glycemia, HbA1c, HDL and Total cholesterolemia; level of triglycerides and LDL calculated according to the formula: calculated LDL = Total cholesterol – HDL (triglycerides/5) in g/l). The diagnosis of diabetes was based on three criteria from the American Diabetes Association (ADA 2024), namely: fasting blood glucose ≥ 1.26 g/L (7.00 mmol/L) on two occasions, the presence of diabetes symptoms with random blood glucose ≥ 2 g/L (11.1 mmol/L), or HbA1c ≥ 6.5% [10]. However, in all patients with venous blood glucose levels above 1 g/l (5.5 mmol/l), HbA1c was measured to diagnose diabetes. Then the variables were metabolic complications according to blood sugar levels, ketonuria and physical signs of acidosis (ketoacidosis, hyperglycemic hyperosmolar syndrome, hypoglycemia,

lactic acidosis), infectious (whatever the organ). Complications also included macroangiopathies (strokes based on brain imaging, peripheral arterial occlusive disease based on Systolic Pressure Index (SPI) results, and coronary artery disease based on electrocardiogram and cardiac enzyme abnormalities) and microangiopathies (retinopathy on fundus examination, nephropathy based on albuminuria and glomerular filtration rate data, neuropathy based on peripheral motor disorders and abnormal monofilament test results). Finally, the therapeutic and evolutionary parameters (length of hospitalization, outcome), the calculation and analysis of mortality (only in hospitalized patients) were discussed by the following reports:

- **Overall hospital mortality:** Number of deaths (all pathologies)/Number of hospitalizations.
- **Proportional mortality due to diabetes:** Number of deaths due to diabetes/Number of deaths.
- **In-hospital specific mortality due to diabetes:** Number of deaths due to diabetes/Number of hospitalizations.
- **In-hospital case fatality from diabetes:** Number of deaths due to diabetes/Number of diabetics.
- **Factors associated with deaths:** We used the chi-square test to examine the relationship between several factors and the occurrence of deaths.

The analysis was conducted using EPI INFO 7 software and a statistical significance threshold of $p < 0.05$.

Strengths and limits of the study

The limitations of this study are firstly the absence of immunological data, distinguishing between type 1 diabetes, that of the African subject with ketosis tendency and latent autoimmune diabetes in adults. Secondly, it is likely to have an underdiagnosis of dyslipidemias due to incomplete patient assessments and family history of patients which were often ignored. However, the size of the population, the long period concerned and the analytical component constituting the main strengths of this study, allow us to interpret our results.

3. Results

The average age of diabetic patients was 47.27 ± 11.8 years (28 - 42). The sex ratio was 0.83, with 4,946 women (54.9%) and 4,063 men (45.1%). Housewives were the majority in 39.6% of cases, followed by shopkeepers (16.9%). Over 12 years, diabetes was the 4th most observed condition in hospitalization with a rate of 10.1% (N: 13,108) after infectious diseases (26.9%), hepato-digestive diseases (25%), and nephropathies (12.9%). Diabetes complications represented 81.5% of the reasons for hospitalization, followed by glycemic imbalances secondary to another condition (12.7%), changes in general condition (3.3%) and vigilance disorders (2.5%). Mean blood glucose was 2.5 ± 1.17 g/l (0.35 - 9.13 g/l), and dyslipidemia was dominated by HDL hypocholesterolemia (52.4%). Patients' treatments were based on the patients' complications and comorbidities.

4. Discussion

Prevalence

The prevalence of diabetes was 10.1% in hospitalization (**Figure 1**), 29% in consultation and in total, 25% (9009/39,598) in internal medicine. In hospitalization, our figures are close to those of Mbeng in Congo (DRC) (8.65%), Mbaye in Senegal (10.4%) and Coulibaly in Mali (8.84%) [11]-[13]. This epidemiological place of diabetes here, in our African context, is therefore by far the most important. This observation is similar to that of multicenter studies on the global morbidity of non-communicable diseases (NCDs) from 1990 to 2021 and to that of the WHO which, among the main NCDs responsible for deaths, places diabetes in 4th place after cardiovascular diseases and cancers [14] [15]. Analysis of the evolution of its prevalence (**Figure 2**) showed a regressive trend in the department and even more pronounced in consultation. This decline contrasts with the number of diabetics which continued to increase over the 12 years of study. This is explained by the growth of other NCDs such as kidney diseases (3rd most frequent diseases in our study) similar to global trends [14]. Also, this apparent declining prevalence would be due to the persistence of communicable diseases, such as infections continuing to be prevalent in Africa. It follows that in reality, the prevalence is rather increasing with the number of diabetic patients climbing over the years, although masked in our study by other diseases. Similarly, Li, in a systematic analysis of risk factors attributable to NCDs (204 countries), highlights that since 1990, diabetes and nephropathies have experienced the highest increase in prevalence (+22.8%), in line with IDF predictions by 2045 [4] [14]. The average age of 47.27 years (28 - 42) was close to that of Diop (53.2 ± 9.6 years), but these figures, due to the youth of our populations, are lower than Western data (high prevalence between 75 and 79 years) [7] [16].

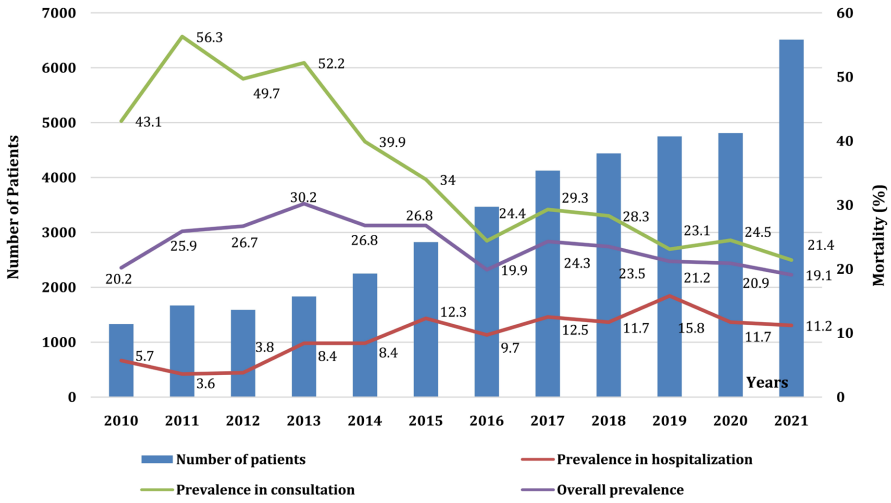

Figure 2. Annual evolution of the prevalence of diabetes in consultation and hospitalization according to the number of patients in internal medicine.

Morbidity

In our study, 54.2% of patients were unaware (**Table 1**) of their diabetes while

Némi found 33.9% [17]. This observation implies a higher probability of advanced complications at the initial diagnosis of the disease, especially with regard to the known insidious progression of type 2 diabetes, which promotes the development of atherosclerosis. Familial diabetes was noted in 17%. This history was more frequent in Ivorian multicenter studies (26.74% - 34.1%), which suggests an underdiagnosis in our study [18] [19]. Thus, the ignorance of diabetes and its extent in families illustrates its morbidity, its low screening and the lack of preventive consultation [20]. Type 2 diabetes (T2D) predominated (78.7%) as in the literature [7] [9]. It was not the only CVRF that was prevalent. There was also high blood pressure (HBP) (34.7%), a sedentary lifestyle (18.2%), alcohol consumption (16.2%), smoking (12.3%), overweight (9.1%) and dyslipidemia (5.9%) (**Table 1**). In Africa, these factors have been identified in diabetics. First, the diabetes-HBP association over the last 12 years varied from 11.09% to 53% [11] [16] [19] [21] [22]. This known association certainly incriminates atherosclerosis but also insulin resistance, the basis of T2D, activation of the sympathetic system and sodium renal retention, hence HBP [23] [24]. This same insulin resistance would also lead to dyslipidemia and overweight in our study [23]. The Ivorian population, like that of our study, unfortunately increases its cardiovascular risk with tobacco, alcohol and a sedentary lifestyle. The average blood sugar of 2.5 g/l was close to that of the Diop study (2.47 g/l; 1452 T2D in consultation) and that of Lokrou (2.40 g/l; 2623 in hospitalization). This imbalance shows both ignorance of diabetes, the presence of unbalancing factors and non-compliance with treatment. The latter would unfortunately be multifactorial in diabetics according to Achouri [25]. As for complications, they were of all kinds (**Table 2**). Firstly, they were metabolic (85%) and dominated by far by ketoacidosis (94.7%). In Ivory Coast, the study aimed at reducing mortality and the prevalence of ketoacidosis, has been shown that the first key to this African problem would remain therapeutic education [19]. Secondly, the complications were infectious such as diabetic foot (26.4%). Its particularity in Africa is the association of both obliterating arteriopathy of the lower limbs, neuropathy (deformities; dysesthesia) and finally, on this fragile terrain: trauma (even minimal) then superinfection. In Ivory Coast, with a proportion of 14.2% of superinfected diabetic feet, Koffi-Dago found an amputation rate of 26.3% [6]. This gesture would be reduced from 63% to 16% thanks to multidisciplinary prevention [19]. The current screening of asymptomatic peripheral arterial diseases in diabetics in our country by the Systolic Pressure Index is therefore timely [26]. Thirdly, cerebrovascular accidents (CVA) were noted, which accounted for more than half (52%) of macroangiopathies and 8.46% (763/9009) of diabetic patients, such as Ngailla (7%) and Dionadji (6.5%) [22] [27]. The non-invasive assessments carried out made it possible to detect silent myocardial ischemia (SMI) in 4.6% of cases (411/9009). This low figure is due to the orientation of SMI diagnosed in emergencies, towards cardiology but also the limit of this type of exploration in favor of invasive assessments or even tomoscintigraphy [28]-[30]. Probably due to limited screening, or incomplete records, the prevalence of CKD was rather low (1.3%; 118/9009) contrary to the Ivorian literature [31] [32].

Table 1. Characteristics and comorbidities of diabetic patients.

Characteristics of diabetic patients	N	%
Newly discovered diabetes	4883	54.2
Known diabetes	4126	45.8
Family history of diabetes (1st degree relative)	1531	17
No known family history	7478	83
Type of diabetes		
Type 1	1900	21.1
Type 2	7090	78.7
Gestational diabetes	3	0.03
Secondary diabetes	16	0.18
Hyperthyroidism	8	50
Corticosteroid-induced diabetes	5	31.25
Pancreatic tumors	2	12.5
Chronic calcific pancreatitis	1	6.5
Associated comorbidities/FDRCV		
High blood pressure	3123	34.7
Sedentary lifestyle	1638	18.2
Alcohol consumption	1458	16.2
Smoking	1110	12.3
Obesity/overweight (BMI: 25 kg/m^2)	823	9.1
Dyslipidemias	528	5.9
Total hypercholesterolemia > 2.5	138	26.1
Hypocholesterolemia HDL < 0.4	277	52.4
Hypertriglyceridemia > 1.5	120	22.7
Hypercholesterolemia LDL > 1.6	79	15

Table 2. Table of parameters relating to morbidity and mortality of diabetic patients.

Complications of diabetes in hospital and in consultation	N	%
Metabolic	**7660**	**85**
Ketoacidosis	7254	94.7
Hyperosmolar hyperglycemic syndrome	115	1.5
Hypoglycemia	291	3.8
Infectious		
Bacterial pleuro-pneumopathies	**6372**	**70.7**
Superinfected diabetic foot	2380	26.4

Continued

	Urinary tract infections	1557	17.3
	*Others**	1145	12.7
	Degenerative	**2461**	**27.3**
	Macroangiopathies	1468	16.3
	Stroke	763	52
	Silent myocardial ischemia	411	28
	Obliterating arteriopathies of the lower limbs	294	20
	Microangiopathies	**1000**	**11.1**
	Neuropathies	823	82.3
	Nephropathies	118	11.8
	Retinopathies	59	5.9
Hospitalization and mortality characteristics of patients			
Length of hospitalization (in days) N = 1320	1 - 3	387	29.3
	4 - 6	494	37.4
	7 - 9	283	21.4
	10 - 12	123	9.3
	≥13*	33	2.5
Becoming hospitalized diabetics (N = 1320)	Exeat	1016	77
	Transfer	12	0.9
	Exit against notice medical	153	11.6
	Death/Fatality hospitable	139	10.5
Epidemiological characteristics of mortality	Overall mortality (12 years/all patients combined) N = 13,108	2397	18.3
	Mortality proportional to diabetes mellitus N = 2397	139	5.8
	Diabetes-specific mortality N = 13,108	139	1.06

***Other infections:** Dental caries (14.6); Vaginitis (12.7); Intertrigo between toes (2.8); Myositis (2.8); Pulmonary tuberculosis (1.8); Oral candidiasis (1.8); Prostatitis (8.9); Septic arthritis (0.9).

Mortality

In the department, the overall mortality, all pathologies combined, amounted to 18.3% (Table 2). First, out of 1320 hospitalized diabetics, diabetes was fatal in 10.5%. Then, when considering the 2397 deaths (diabetes or not), the mortality proportional to diabetes mellitus was 5.8%. Finally, the specific intrahospital mortality linked to diabetes was 1.1% (11 deaths due to diabetes per 1000 hospitalized). In Abidjan, the hospital lethality rate of diabetes was similar to that of our study. Indeed, according to Lokrou, 8 out of 100 diabetic patients hospitalized died from diabetes (209/2623), while Yao reported a lethality rate of 8.9% (448/5027) a decade later [9] [33]. On the other hand, Mbeng found higher figures. Indeed, for an

overall mortality in internal medicine of 12.3% (596/4834; 5 years), the lethality was 27.13% (89 deaths due to diabetes among 328 hospitalized diabetics), the mortality proportional to diabetes of 14.93% (89 deaths due to diabetes among the 596 deaths in the department—all pathologies combined); and a specific mortality rate of 1.84%, or 18.4 deaths due to diabetes per 1000 hospitalized patients (all pathologies combined) [11]. Other hospital studies (East Africa) notably that of Dionadji or from diabetes death registers (Europe) like that of Tancredi found a lethality exceeding 16% [2] [27]. These data doubly high compared to those of our study are also observed at the level of proportional mortality of diabetes in Asia (13.6%) [1]. The analysis of the mortality curves in our study (**Figure 3**) first showed us a decreasing trend from 2011 to 2013 and then from 2016 to 2018. However, mortality has continued to increase in the same direction as hospitalizations since 2018, which thus characterizes its morbidity and mortality in every way. This increase, in recent years, has also been observed in American (N > 1 million; 1990-2021) and European studies [34]-[36]. In Africa (sub-Saharan; south), several studies confirmed this increase over the last 20 years despite the slight drop in mortality due to certain NCDs [37] [38]. This mortality was associated with factors (**Table 3**). First, there were CVDs such as age exceeding 50 years (50 - 59 years: 15.1%; p: 0.0018; OR: 1.8 [1.26 - 2.6] and age ≥ 60 years: 15.3%; p: 0.006; OR: 1.76 [1.19 - 2.6]), hypertension (11.5%; p: 0.03; OR: 1.79 [1.07 - 3]), smoking (28.8%; p < 0.001; OR: 3.74 [2 - 7]) and dyslipidemia (14.3%; p: 0.04; OR: 1.56 [1.04 - 2.34]). Regarding age, the majority of authors agree on the principle that mortality is as high as age increases, especially in the elderly depending on the type of their frailty according to the meta-analysis of Lin Wen [9] [35] [39]-[41]. The same is true for HBP, which is one of the main comorbidities associated with diabetes mortality according to studies [33] [34] [39]. Dyslipidemia also represents mortality factors like obesity, but the latter was not found in our study [42] [43]. From a gender perspective, women were associated with death, unlike men (OR: 2.34 vs. 0.43), contrary to several studies [35] [38] [40]. This could be justified for several reasons. First, women were predominant in the study and are known to be the first to seek healthcare. Second, they likely had a limited socioeconomic status as housewives. Third, female mortality could be linked to infections, especially urinary tract infections, which are common in women due to their urethral anatomy. In our study, complications had a significant relationship with deaths such as infections (11.1%; p: 0.047; OR: 2.44 [1.05 - 5.6]) which, in agreement with several authors were mainly urinary in women, and obviously pulmonary with an emphasis on COVID-19 pneumonia [1] [9] [27] [33] [40] [44]. Also, the involvement of the large vessels in our study (31.3%; p < 0.001; OR: 4.7 [2.94 - 7.5]), was consistent with other studies, especially with regard to mortality from diabetes associated with SMI, arterial disease of the lower limbs and especially stroke [1] [6] [27] [34] [38] [39] [45]. Finally, The microangiopathies found (37.1%; p < 0.001; OR: 5.44 [2.7 - 11.05]) were consistent with the literature, especially with regard to diabetic nephropathy complicated by chronic renal failure [1] [27] [38].

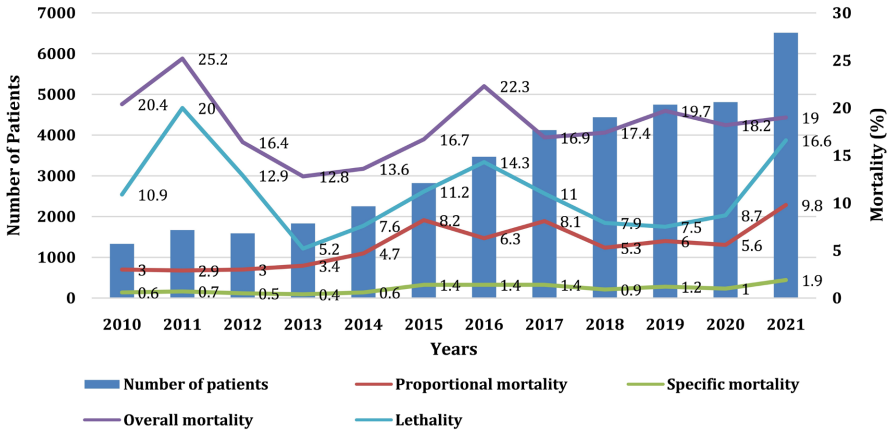

Figure 3. Annual evolution of mortality from diabetes in hospital according to the number of patients hospitalized in internal medicine.

Table 3. Factors associated with death in diabetic patients.

Factors	Deceased N: 139 (%)	Living N: 1181 (%)	*p*	OR
Age				
16 - 29	5 (6.1)	77	0.26	0.54 [0.21 - 1.35]
30 - 39	12 (4.9)	234	0.002	0.38 [0.2 - 0.7]
40 - 49	29 (7.6)	351	0.037	0.62 [0.4 - 0.96]
50 - 59	52 (15.1)	292	0.0018	1.8 [1.26 - 2.6]
60 and over	41 (15.3)	227	0.006	1.76 [1.19 - 2.6]
Sex				
Male	52 (7.02)	689	<0.001	0.43 [0.3 - 0.61]
Female	87 (15.03)	492		2.34 [1.6 - 3.37]
Comorbidities				
High blood pressure	121 (11.5)	933	0.033	1.79 [1.07 - 2.99]
Sedentary lifestyle	34 (11.6)	260	0.58	1.14 [0.8 - 1.7]
Alcohol intake	12 (9.5)	114	0.81	0.49 [0.27 - 0.88]
Smoking	15 (28.8)	37	<0.001	3.74 [2 - 7]
Obesity and overweight	16 (9.5)	152	0.75	0.88 [0.5 - 1.52]
Dyslipidemias	36 (14.3)	216	0.04	1.56 [1.04 - 2.34]
Complications				
Metabolic	126 (10.5)	1071	0.99	0.99 [0.54 - 1.82]
Infections	133 (11.1)	1064	0.047	2.44 [1.05 - 5.6]
Macroangiopathies	31 (31.3)	68	<0.001	4.7 [2.94 - 7.5]
Microangiopathies	13 (37.1)	22	<0.001	5.44 [2.7 - 11.05]

5. Conclusion

This study highlights both the high and growing prevalence and mortality of dia-

betes mellitus, especially among the elderly. Type 2 diabetes remains the most common form, with patients having several cardiovascular risk factors such as high blood pressure, a sedentary lifestyle, smoking, dyslipidemia, and being overweight. In Africa, infections and complications such as damage to large and small blood vessels are factors associated with this pandemic. This study is therefore of threefold importance. First, it involves mass screening, but above all targeted screening of people at risk, namely those with comorbidities and other cardiovascular risk factors. Second, it involves screening all adult members of the families of each diabetic patient. And finally, it involves multidisciplinary care, especially preventive care, for diabetic patients.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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