



RESEARCH ARTICLE

DIABETIC NEUROPATHY: EPIDEMIOLOGICAL ASPECTS AND VIBROTEST DIAGNOSIS AT THE GENERAL HOSPITAL AND NEXTIS MEDICAL CENTER IN DOUALA (CAMEROON)

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ARTICLE INFO

Article History:

Received 17th February, 2026
Received in revised form
20th March, 2026
Accepted 24th April, 2026
Published online 30th May, 2026

Keywords:

Diabetic neuropathy, epidemiology, vibrotest, Douala, Cameroon.

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ABSTRACT

Introduction: Diabetic neuropathy is a complication that develops insidiously in Africa, particularly in urban areas, with a high risk of affecting the lower limbs, resulting in dysfunction of the peripheral nerve fibers. **Material and methods:** A retrospective and prospective study was conducted from November 2023 to February 2024 at the General Hospital and the Nextis Medical Center for Endocrinology in the city of Douala. To accurately assess patient's plantar sensitivity, they were evaluated using an electronic vibrotest. Subsequently, anthropometric and physiological parameters were measured, and other personal information was obtained from medical records. **Results:** The study included 302 (60 ± 7 years) diabetic patients in a hospital setting in Douala. The results showed that the mean age at diagnosis of diabetes was 47 ± 10 years; 176 (58.2%) had dyslipidemia, including 124 men and 52 women. Neuropathy was diagnosed in 67.9% of patients using the vibrotest, compared to 36.1% using the monofilament test. Associations were found between neuropathy and duration of diabetes ($r = 0.4$; $p < 0.0001$); neuropathy and dyslipidemia ($r = 0.3$; $p = 0.0004$); and neuropathy and hypertension ($r = 0.4$; $p < 0.0001$). **Conclusion:** The use of the vibrotest enables early diagnosis of neuropathy.

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Citation: Dr. Ahmadou, Dr. Epacka Ewane Marielle, Dr. Dikoume Ebele Leatitia, Dr. Ikoula Elise and Pr. Mandengue Samuel Honoré. 2026. "Diabetic Neuropathy: Epidemiological Aspects and Vibrotest Diagnosis at the General Hospital and Nextis Medical Center in Douala (Cameroon)". *International Journal of Current Research*, 18, (05), 37421-37424.

INTRODUCTION

Diabetes is a serious chronic condition that occurs when the pancreas does not produce enough insulin or when the body is unable to effectively use the insulin it produces (1). According to estimates from the International Diabetes Federation (IDF), 537 million adults aged 20 to 79 worldwide were living with diabetes; this number is rising and is projected to reach 643 million by 2030 and 738 million by 2045 (2). It is part of the broad group of Noncommunicable Diseases (NCDs). These accounted for the leading cause of death, representing 74% of deaths worldwide (3). They share common behavioral risk factors that can be modified, including smoking, poor diet, lack of physical activity, and harmful alcohol use, which in turn lead to overweight, obesity, hypertension, hypercholesterolemia, and ultimately disease (3). Blood glucose cannot be stored or used by cells. The resulting chronic hyperglycemia is associated in the medium and long term with specific chronic complications such as retinopathy,

nephropathy, neuropathy, and coronary heart disease, affecting the eyes, kidneys, nerves, heart, and blood vessels, respectively (4). Diabetic neuropathy is one of the well-known complications of diabetes, with a prevalence in sub-Saharan Africa that varies widely between 6% and 47%, depending on the method used (5,6,7). In particular, a meta-analysis of 23 African studies involving 269,691 participants revealed an overall prevalence of 46% (8). In contrast, in Cameroon, some authors have reported prevalence rates of 36.1% (9) and 38.8% (10). This complication is caused by chronic hyperglycemia and is characterized by dysfunction of peripheral nerve fibers in people with diabetes after ruling out all other causes (11). In Cameroon, the prevalence of diabetic neuropathy was 27.3% (12) in 2006, while in 2011, it was 40% (13). When associated with peripheral vascular disease, diabetic neuropathy can manifest as a foot ulcer. Infection of these wounds can lead to amputation of the foot and lower leg. Risk factors include duration of diabetes, alcohol use, smoking, tall stature, age, and nutritional deficiencies (14,15,16). Since this complication

is debilitating and can sometimes have physical and psychological repercussions for those who suffer from it, we found it useful to evaluate methods for diagnosing this complication more directly in diabetic patients at two healthcare facilities in the city of Douala, Cameroon. To improve the method for early diagnosis of this complication, the vibrotest (an electronic device more sensitive than the monofilament) was used in addition to the monofilament, which is typically used in most referral healthcare facilities in Cameroon.

MATERIALS AND METHODS

Study context and type: The study was conducted in hospitals in Cameroon’s Littoral Region, specifically in the Wouri Department, one of the four departments that make up the Littoral Region, with Douala as its administrative capital. Still considered the economic capital of Cameroon, Douala is a cosmopolitan city with several major general hospitals, district hospitals, private hospitals, and religious hospitals. This study was conducted as a cross-sectional study among patients with type 2 diabetes in the Endocrinology Unit of the General Hospital of Douala and the Nextis Medical Center Clinic in Douala between November 2023 and February 2024.

Participants and Sampling: All diabetic patients who had undergone at least one checkup during the year were selected based on their availability. Individuals who refused to participate in the study were excluded. For each patient, in addition to the oral interview, a data collection form was completed to proceed with the evaluation of neuropathy using the vibrotest (figure 1). This form included data from the interview (age, sex, smoking status, alcohol use, date of diabetes diagnosis, complications) and data regarding the diagnosis of neuropathy. The test was performed on each participant at plantar sites exposed to increasing levels of vibration (10, 13, 19, 21, and 25 volts) emitted by the electrode. The minimum sample size for the study’s representativeness was 80 patients, calculated using the Lorentz formula with a prevalence of 5.5% (2). Neuropathy was defined according to the vibratory sensitivity scale (17). If ≤ 15 volts = Normal; if between (16–20) volts = Mild loss of sensation; between (21–25) volts = Moderate loss of sensation; and if > 25 volts = Severe loss of sensation.

Data analysis: These data were analyzed and processed using the statistical software StatView version 5.0 (SAS Institute Inc., Cary, NC, USA). Quantitative variables are presented as mean \pm standard deviation (SD), and qualitative variables as counts and percentages. Associations were determined using Spearman’s correlation test. A p-value of < 0.05 was considered statistically significant.

Code of Ethics: The study complied with the ethical guidelines of the 1975 Declaration of Helsinki.

RESULTS

Epidemiological aspects: The study included 302 patients, comprising 164 men (51%) and 148 women (49%), with a sex ratio of 1.11. The mean age was 60 ± 7 years. The most represented age groups were those between 50 and 60 years (13.9%) and those between 60 and 70 years (10.59%). Diagnostic findings: The mean age at diagnosis of diabetes

was 47 ± 10 years. Of all patients, 176 (58.2%) had dyslipidemia, including 124 men and 52 women. In contrast, 54 reported alcohol consumption (17.9%) and 11 reported tobacco use (3.6%), and more than half had a history of hypertension (17.5%), while 103 (73.6%) were hypertensive. Diabetic foot was found in 16.4% of patients, 17% had arteriopathy (Table I), and 12.5% had lower limb edema.

Distribution of complications

Table I. Prevalence of macroangiopathic complications by gender

	Macroangiopathies					
	Heart diseases		Arterial diseases		Stroke	
	Staff	Fréquence (%)	Staff	Fréquence (%)	Staff	Fréquence (%)
Men	43	14.2	23	7.6	9	3
Women	28	9.2	28	9.2	5	1.6
Total	71	23.5	51	17	14	4.6
Prevalence	23.5%		17%		4.63%	

Table II. Prevalence of microangiopathic complications by gender

	Microangiopathies					
	Rétinopathie		Kidney disease		Neuropathy	
	Staff	Fréquence (%)	Staff	Fréquence (%)	Staff	Fréquence (%)
Men	25	8.2	18	5.9	64	21.1
Women	14	4.6	45	15	45	15
Total	39	12.9	63	20.9	109	36.1
Prevalence	12.9%		20.9%		36.1%	

Diabetic neuropathy: Neuropathy was detected in 36.1% of patients using the monofilament test (Table II), whereas it was found in nearly twice as many (67.9%) using the vibrotest (Table III). Associations were found between neuropathy and duration of diabetes ($r = 0.4$; $p < 0.0001$); neuropathy and dyslipidemia ($r = 0.3$; $p = 0.0004$); and neuropathy and hypertension ($r = 0.4$; $p < 0.0001$). Correlations were found between neuropathy diagnosed by vibrotest and Systolic Blood Pressure ($r=0.14$; $p=0.048$); neuropathy and serum creatinine ($r=0.43$; $p=0.003$); and neuropathy and age ($r=0.46$; $p=0.003$).

Table III: Distribution of vibrotest scores by sensitivity in people with diabetes

Voltage	Sensitivity	Effectif	%
≤ 15 Volts	Normal	97	32.12
(16-21) Volts	Slight low	72	23.84
) 21-25) Volts	Moderate loss	47	15.56
> 25 Volts	Severe loss	86	28.47
Total neuropathy		205	67.9



Figure 1. Vibrotest for diagnosing neuropathy (Chennai, India)

DISCUSSION

Diabetic neuropathy remains a debilitating complication worldwide and requires prevention and appropriate management.

Despite its various applications, the electronic vibrotactile plays a key role in the early detection of this complication with greater sensitivity.

Age of the population: The results show that the age group with the highest prevalence of diabetes is that of people aged 50 to 60. The same was true in 2007, when 46% of people with diabetes worldwide were between 49 and 59 years old, and 35.9% in Cameroon in 1995 were between 50 and 59 years old (18–19). The predominance of people with diabetes in this age group can be explained by the tendency of people in this age group to become complacent about healthy living, as well as by their failure to adhere to dietary and lifestyle recommendations and health education.

Weight: Obesity was observed in 28.1% of patients. This proportion may be due to the emergence of other risk factors and their significant role in the development of this type of diabetes, formerly known as fatty diabetes. Some authors, such as Ducorps & al. (1996) (18), describe this as a tropical specificity of diabetes, since in the West the prevalence of obese individuals with type 2 diabetes is higher. This factor could therefore be taken into account in the clinical presentation of this type of diabetes among African individuals.

Complications: In a 1995 study of Sudanese diabetic patients, Elbagir & al. (15) found, as in our study, that coronary artery disease was the most common macrovascular complication, with a prevalence of 28%, followed by peripheral artery disease (10%) and stroke (5.5%). This decreasing trend in the prevalence of macrovascular complications was also observed in our study, with similar values (heart disease (23.5%), peripheral artery disease (16.9%), and 4.6% for strokes). Some studies conducted in Sudan in 1989 showed a prevalence of 6.2% for peripheral artery disease and 4.2% for heart disease (19), while Nambuya et al. in Uganda reported a prevalence of heart disease of 4.8% in 1996 (20). In sub-Saharan Africa in general, the prevalence of arterial disease ranged from 1.7% to 28% (21,22,23). An increase in the prevalence of these complications over time can therefore be observed, likely due to deteriorating living conditions. We found a prevalence of 16.9% for peripheral artery disease. Peripheral artery disease contributes to the development of diabetic foot (24). In our sample, 67% of patients with arteriopathy had diabetic foot. The prevalence of diabetic foot found in our study is 16.4%. This figure is close to that reported by Sano & al (25) in a retrospective study in Burkina Faso (18.9%). This highlights the thorny issue of care management compared to countries in the Global North, where the quality of care delays the onset of this condition, which is responsible for 70% of amputations among people with diabetes (26). Regarding retinopathy, Moukouri & al. found a prevalence of 37.3% in 1995 (27). Subsequently, Sobngwi & al. (28) reported a prevalence of 37.5% in 1999, similar to that of Moukouri & al. (27). These two results are more than twice as high as ours (12.91%). This decrease could be explained by the early management of diabetic patients using new diagnostic tools, particularly at the General Hospital of Douala, where diabetic screenings are conducted regularly.

Concerning neuropathy diagnosed using the monofilament test, the 1995 study by Elbagir & al. (15) found a prevalence of 37% and 40% among Sudanese individuals, similar to the findings of the present study (36.1%). However, these values

are lower than the prevalence found in the 2009 study by Pedersen & al. (51%) and higher than those reported by Hartemann and Lozeron in 2015 (30%) and by Granpre in 2013 (25%) (29,11,30). However, some Cameroonian authors in 2018 who used the monofilament method found similar values of 36.1% by Ahmadou and 38.8% by Bassagen & al. However, our values obtained using the vibrotactile (67.9%) remain nearly double those obtained using the monofilament method (36.1%). This difference could be explained by the high sensitivity of the electronic vibrotactile, due to the increasing electrical vibrations it emits, which offers the advantage of enabling early diagnosis of neuropathy while monitoring its improvement or progression. This was reported in the 2013 study by Lakshmana & al. (31), who also worked on the quadrant-type electronic vibrotactile. The work of Nsabayumva et al. (14) showed in 2011 that 1–2% of people with diabetes have severe neuropathic manifestations, 20–30% have moderate symptoms, and 40–60% have minor symptoms—results that differ from those found in our study, which reported 28.47% severe loss, 15.56% moderate loss, and 23.84% minor loss, respectively.

This discrepancy is likely due to the use of a less advanced vibrotactile than the one used in our study; nevertheless, the rate of sensory loss remains high (67.9%) and warrants special attention in people with diabetes. Although complications are the result of chronic hyperglycemia, we found in this study no association between neuropathy and HbA1c. This could be explained by the fact that neuropathy results from the effect of other risk factors, which themselves developed and became established as a consequence of diabetes.

CONCLUSION

Complications are common among people living with diabetes; regular diabetes checkups help prevent the onset of complications, particularly neuropathy, which can be diagnosed at a very early stage using the vibrotactile, which has proven to be more effective than the monofilament test. Its use would thus enable better management and help prevent the development of end-stage, disabling complications such as diabetic foot.

Declaration of Interest: The authors have declared that they have no conflicts of interest related to this article

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