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(RESEARCH ARTICLE)

Type 2 diabetes mellitus: Prevalence and risk factors associated, among patients at Franceville Amissa Bongo regional Hospital, Gabon

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Abstract

Introduction: To assess the type 2 diabetes mellitus prevalence and risk factors associated, among patients, at Franceville Amissa Bongo regional Hospital Gabon, A prospective and cross-sectional study was carried out between June and September 2023.

Materials and Methods: Blood glucose was measured using blood drawn from each participant, according to American Diabetes Association standards. As elsewhere, correlations between type 2 diabetes mellitus prevalence and the variables obtained, were carried out using R software version 3.6.1. Odds ratios were calculated within a 95% interval, and results were considered significant when the p-value ≤ 0, 05.

Results: Blood samples from 328 people, with a mean age of 48.24 ± 13.8 years, were collected for this study. The type 2 diabetes mellitus prevalence was 13.72% (95% CI: [0.10- 0.18]), (n=45). After univariate analysis, adjustment of variables by binary multivariate logistic regression, indicated female gender (Ajusted OR = 0.53; 95% CI [1.52; 39.41] p = 0.014*), cohabiting (Ajusted OR = 92.73 ; 95% CI [2.9; 29.05] p = 0.010*), inactive (Ajusted OR = 9.17; 95% CI: [1.11; 75.05] p = 0.040*), overweight/obese (Ajusted OR = 0. 017; 95% CI: [0.002; 0.18] p = 0.010*), a family history of type 2 diabetes mellitus (Ajusted OR = 50.13; 95% CI [8.87; 283.50] p = 0.000*) and high triglyceride levels (Ajusted OR = 0.03; 95% CI [0.003; 0.36] p = 0.005*), as type 2 diabetes mellitus potential risk factors, in the present study.

Conclusion: The type 2 diabetes mellitus prevalence in the study population was high. Prevention and control of this disease through early detection are essential.

Keywords: Type 2 diabetes mellitus; Prevalence; Risk factors; Franceville; Gabon

1. Introduction

Affecting around 5-10% of adults worldwide, diabetes is a very common, multifactorial and highly heterogeneous chronic endocrine disease (1). It is estimated that over 400 million people suffer from this disease, 4 out of 5 of whom live in low- and middle-income countries (2). Numerous studies predict a growing increase in diabetes mellitus by 2030, in both developed and developing countries (3). Furthermore, it has been projected that among 537 million adults aged 20 to 79, diabetes prevalence could reach 7.7% between 2030 and 2045 (4). Although numerous studies have shown that lifestyle modification is effective in preventing obesity and diabetes in high-risk individuals with impaired glucose

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tolerance (5), this burden remains the main factor in premature mortality in adults, and is responsible for almost 5 million deaths every year (6). However, a significant proportion of people with type 2 diabetes remain undiagnosed (90-95%) (7). In some very poor settings, such as sub-Saharan Africa, this proportion of undiagnosed diabetics can be as high as 80-90%, whereas it is generally around 20-30% in the world's wealthiest countries, most of which are in Western Europe and North America (8). Despite the existence of numerous studies on this disease, the prevalence rate of type 2 diabetes mellitus remains high in the Gabonese population and represents a major public health problem (9). In Gabon, the number of diabetics has tripled in 25 years, rising from 2% to almost 10%. And if nothing is done in the next 20 years, the number of diabetics will rise to 14% (10). Against this backdrop, this study was undertaken to assess the prevalence of type 2 diabetes mellitus among a Gabonese population living in a semi-urban area (Franceville and neighbouring departments).

2. Material and methods

2.1. Presentation the study area

This study was carried out in the Franceville town, capital of Haut-Ogooué région. Being the second most populated region in Gabon, Haut-Ogooué covers an area of 3,647 km^2, i.e. 13.6% of the country's surface area. It has a population of almost 128,729 (**11**). Crossed by the River Ogooué, it has eleven departments. The equatorial forest covers a large part of the province and attracts logging companies for its many forest species, including okoumé. As elsewhere in Gabon, this province is characterised by a succession of two rainy seasons and two dry seasons. This region of Gabon has a hot, humid climate. The province's economy is based on mining, forestry, fishing, agriculture and trade.

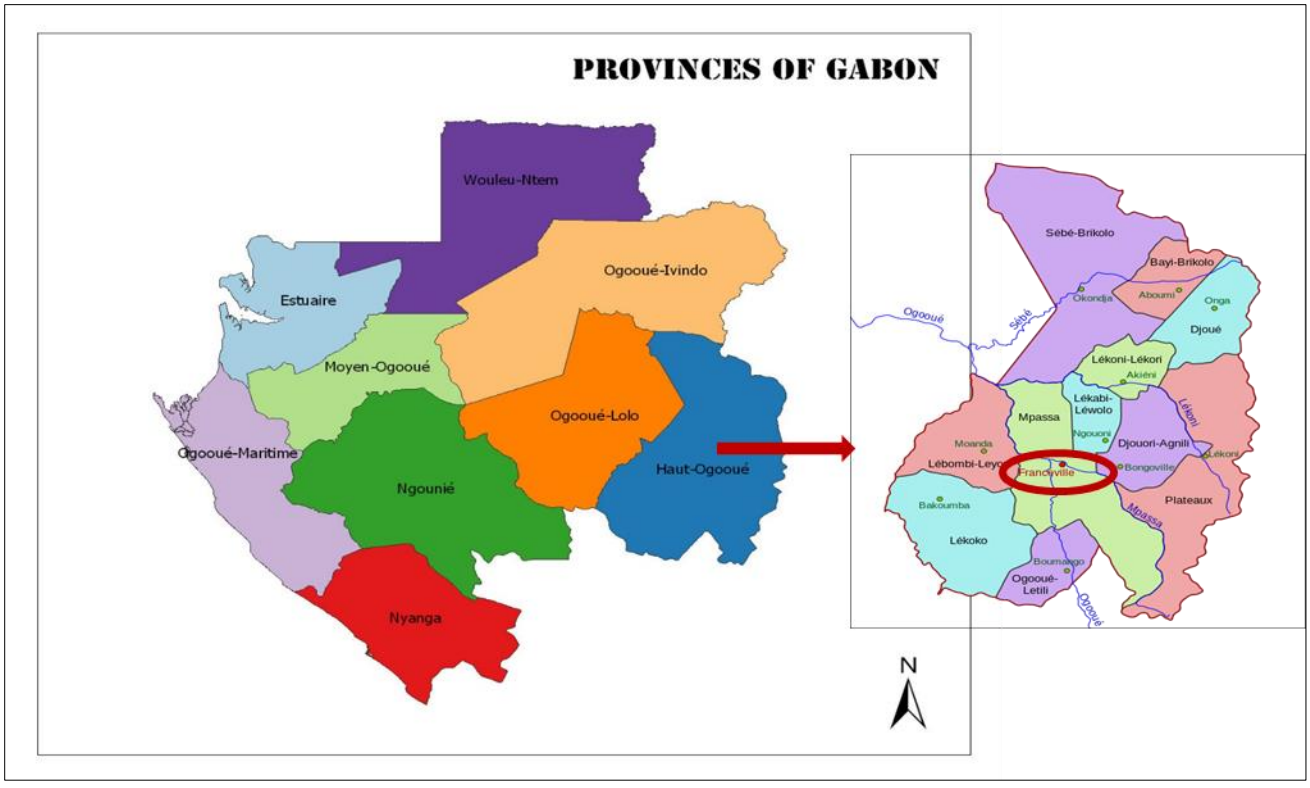

Figure 1 Map of Gabon and the province of Haut-Ogooué, with its departments and departmental capitals (11)

2.2. Presentation of AMISSA BONGO regional Hospital in Franceville

Amissa Bongo regional Hospital (ABRH) of Franceville is a modern public health facility covering an area of 8,600 m^2. It comprises a General Management Department, a Financial Affairs Department, a Human Resources Department, a Technical Services Department, a Medical Affairs Department and an Obstetric Nursing Department. With a hospital capacity of 162 beds, Amissa Bongo regional Hospital (ABRH) provides gynaecology-obstetrics services, general medicine, paediatrics, surgery, and many other services such as radiology, laboratory, etc. Amissa Bongo regional Hospital (ABRH) also provides care for high-risk pregnancies, cases of tuberculosis, human African trypanosomiasis,

leprosy and HIV/AIDS infection, endemic-epidemic diseases, psychiatric emergencies and mental illnesses, not forgetting re-education and functional rehabilitation care and dental, ear, nose and throat and ophthalmological care.

2.3. Type, period and study population

Carried out between June and September 2023, this prospective, cross-sectional, analytical study involved randomly selected men and women aged at least 15 years who had been diagnosed with type 2 diabetes at the biomedical analysis laboratory of the ABRH, in Franceville during the study period and who met the inclusion criteria.

2.4. Inclusion and exclusion criteria for study participants

People aged 15 or over who had consented to take part in the project and complete the questionnaire submitted to them, were included in this study. Children and people who did not wish to take part in the study, or whose blood glucose measurements were unusable, were excluded.

2.5. Determining the sample size

As used elsewhere, the sample size for the study was calculated using the single proportion population formula by positing the formula:

$$n = (Z\alpha / 2)^2 (P (1- P)^2 / (d)^2) (12).$$

In this, n represents the sample size, Zα /2 is the standard normal deviation or standard error associated with the chosen confidence level (1.96) corresponding to a 95% confidence interval (CI), P is the prevalence of type 2 diabetes mellitus. In the absence of P values obtained elsewhere, or in previous studies in the town of Franceville and surrounding departments, this P value was taken to be 50%. d is considered to be the precision/marginal error (d = 0.05) or 5%. Initially, the sample size determined for the study was 298 people. As applied in two studies elsewhere, errors resulting from the probability of non-compliance or drop-out were minimised, and the sample size was increased by 10% (**12; 13**). The final sample size used in this study was 328 participants.

2.6. Survey questionnaire

To collect data on potential risk factors for type 2 diabetes, participants completed a pre-set structured questionnaire including socio-demographic characteristics, medical history, social history and lifestyle, with height and weight measured using a calibrated portable scale and steel tape measure respectively. Patients wore light clothing and no shoes, as has been done in Tanzania by some authors (14).

2.7. Operational definitions

- **Body mass index (BMI):** Calculated from the formula weight (kg)/height $(m)^2$, participants' BMI was considered normal for a value between 18.5 and 24.9 kg/m^2. The individual was considered lean for a BMI < 18.5 kg/m^2; overweight if the BMI varied between 25 and 29.9 kg/m^2 and obese if the BMI ≥ 30 kg/m^2 (15).
- **Hypertension:** As elsewhere, blood pressure was taken in a single visit using a blood pressure monitor and hypertension was defined on the basis of a diagnosis of hypertension or a blood pressure ≥ 140/90 mmHg on two readings taken at least 5 minutes apart (16).
- **Alcohol consumption** was considered on the basis of a frequency of more than 3 to 4 (2 to 3 for women) glasses of red wine per day, or more than 10 (5 for women) beers per week. Traditional alcoholic beverages such as palm or corn wine were not taken into account**.**
- **Current smoking** was defined as the consumption of at least one cigarette per day**.**

2.8. Sample collection and diagnosis

2.8.1. Sample collection

After signing the informed consent form, venous blood samples (from the folds of the elbow) were taken in EDTA tubes, if the patient was fasting or the following day if not, in order to test fasting glycaemia and HBA1c, at the ABRH laboratory in Franceville.

2.8.2. Diagnosis of type 2 diabetes mellitus and lipids

Following the American Diabetes Association (ADA) 2023 standards of diabetes care, and as has been done elsewhere, the diagnosis of type 2 diabetes was made by measuring fasting plasma glucose (FPG), with a risk test. Diabetes was

defined by the presence of a fasting plasma glucose (FPG) level ≥ 7.0 mmol/L or a random plasma glucose level equal to or greater than 11.1 mmol/L in a patient with classic symptoms of hyperglycaemia (American Diabetes Association., 2009). Triglycerides (TG), total cholesterol, high-density lipoprotein (HDL), low-density lipoprotein (LDL) and triglycerides were measured in the laboratory on a Roche Cobas 6000 analyser, using blood plasma samples taken from all participants. As elsewhere, the thresholds were used in accordance with the suggestions of the National Cholesterol Education Program Adult Treatment Panel III **(**17).

2.9. Quality assurance

Using standardised data collection tools, data quality was assured by pre-testing questionnaires on 5% of participants who were not included in the study, cafter appropriate training of staff in data collection and management of an integrated quality control system at the Amissa Bongo regional Hospital in Franceville. All laboratory procedures were performed according to standard operating procedures**.**

2.10. Statistical analysis of data

Entered in a Microsoft Excel 2016 format, data were then analysed using R software version 3.6.1, including measurement of rates and associations. Descriptive statistics were used and qualitative data comparisons were made to determine factors associated with the prevalence of type 2 diabetes. A 95% confidence interval was estimated and a p-value ≤0.05 was considered statistically significant.

3. Results

3.1. Type 2 diabetes mellitus prevalence, among study participants (N = 328)

328 people took part in this study. With a mean age of 48.24 ± 13.8 years, women outnumbered men, giving a sex ratio (M/F) of 0.72. The overall type 2 diabetes mellitus prevalence was 13.72% (95% CI: [0.10- 0.18]), (n=45), compared with 86.28% (95% CI: [0.82- 0.90]) (n=283) who were negative (Figure 2).

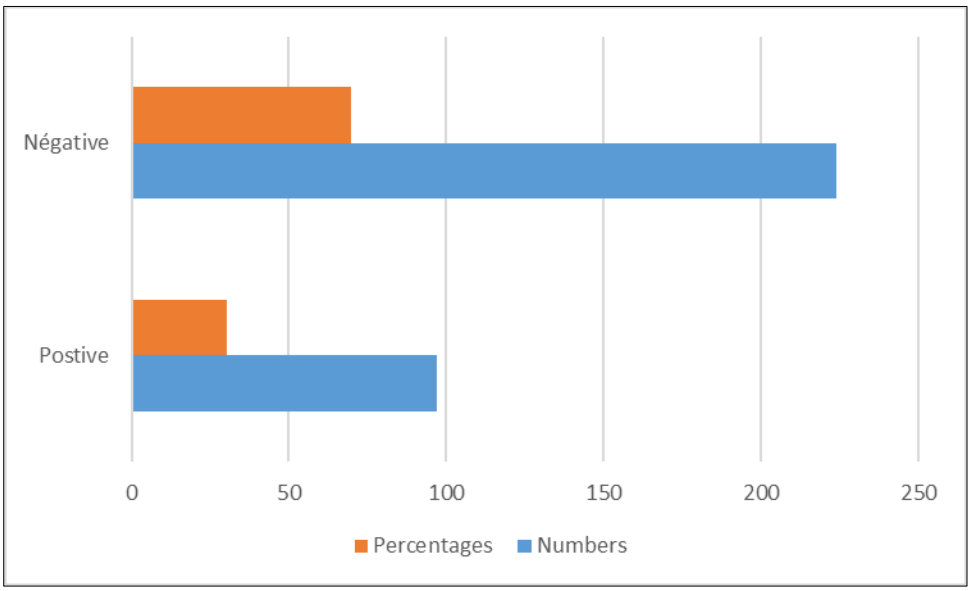

Figure 2 Type 2 diabetes mellitus prevalence, among study participants (N=328)

3.2. Type 2 diabetes mellitus prevalence, according participants socio-demographic characteristics (N = 328)

The results obtained by univariate analysis indicated that, among the participants in the present study, female gender (OR = 0.27; 95% CI : [0.14; 0.53]), age groups 41 - 60 years (OR =0.33; 95% CI : [0.17 ;0.65]), and ≥ 61 years (OR = 2.48; 95% CI [1.33 ; 4.63]; single (OR = 9.16; 95% CI : [4.55; 18.44]), or cohabiting (OR = 0.24; 95% CI: [0.12; 0.47]), not in employment (OR = 4.34; 95% CI [1.95; 9.65]), were significantly associated with a higher risk of developing type 2 diabetes mellitus (Table 1).

Table 1 Univariate analysis of the type 2 diabetes mellitus prevalence in study participants according to socio-demographic characteristics (N = 328)

Socio-demographic characteristics	Total number (%)	Type 2 diabetes mellitus Prevalence		Crude odds ratio 95%[CI]	p-value
		positive (%)	negative (%)		
Gender					
Male	137 (41.76)	31 (22.63)	106 (77.37)	Reference	-
Female	191 (58.24)	14 (7.33)	177 (92.67)	0.27 [0.14 ; 0.53]	≤ 0.0001*
Age groups (years)					
19 - 40	77 (23.48)	11 (14.29)	66 (85.71))	Reference	-
41 - 60	178 (54.27)	14 (7.87)	164 (92.13)	0.33 [0.17 ; 0.65]	0.000*
≥ 61	73 (22.25)	20 (27.40)	53 (72.6)	2.48 [1.33 ; 4.63]	0.000*
Marital status					
Married	46 (14.03)	8 (17.39)	38 (82.61)	1.39 [0.6 ; 3.21]	0.44
Single	52 (15.85)	23 (44.23)	29 (55.77)	9.16 [4.55 ; 18.44]	≤ 0.0001*
Cohabiting	200 (60.83)	14 (7)	186 (93)	0.24 [0.12 ; 0.47]	≤ 0.0001*
Widowed	30 (9.14)	0 (0)	30 (100)	Reference	-
Professional status					
Employed	145(44.21)	8 (5.52)	137 (94.48)	Reference	-
Not working	183 (55.79)	37 (20.22)	146 (79.78)	4.34 [1.95 ; 9.65]	≤ 0.0001*
Education level					
Illiterate /Primary	145 (44.21)	20 (12.79)	125 (86.21))	Reference	
Secondary /Higher	183 (55.79)	25 (13.66)	158 (86.34)	1.01 [0.54 ; 1.09]	0.97
Residence					
Franceville	276 (84.15)	34 (12.32)	242 (87.68)	Reference	
Other	52 (15.85)	11 (21.15)	41 (78.85)	1.91 [0,9 ; 4,07]	0.09

OR = odds ratio; **CI**= confidence interval; * = significant test

3.3. Type 2 diabetes mellitus prevalence, according participants risk factors (N = 328)

Here, the results indicated that, smoking (OR = 0.39; 95% CI [0.19; 0.8] p=0.009*) people who had a BMI between 25 and ≥ 30 kg/m^2 i.e. overweight/obese (OR = 9.61; 95% CI [4.78; 19.32] :] p≤ 0. 001*), with a family history of diabetes mellitus (OR =37.6; 95% CI: [16.06; 88.01] p≤0.001*), with an abnormal low-density lipoprotein (LDL) level (OR = 12.92; 95% CI: [6.38; 26.18] p≤0. 001*), an abnormal high-density lipoprotein (HDL) level (OR = 14.06; 95% CI: [6.68; 29.6 p≤ 0.001*), an elevated triglyceride level (OR = 13.49; 95% CI: [6.56; 27.76] p≤ 0. 001*), and poor quality abnormal cholesterol (OR = 0.23; 95% CI: [0, 027; 2.00] p≤ 0.001*), presented a higher risk of type 2 diabetes mellitus. Table 2.

Table 2 Univariate analysis of type 2 diabetes mellitus prevalence, according to risk factors identified in study participants (N = 328)

Risk factors identified among participants	Total number (%)	Type 2 diabetes mellitus Prevalence		Crude odds ratio 95% [CI]	p-value
		Positive (%)	Negative (%)		
Smoking					
Yes	139 (42.38)	11 (7.91)	128 (92.09)	0.39 [0.19 ; 0.8]	0.009*
No	189 (57.62)	34 (17.99)	155 (82.01)	Reference	-
Alcohol consumption					
Yes	118 (35.98	23 (19.49)	95 (80.51)	2.18[1.16 ;4.11]	0.0015*
No	220 (64.02)	22 (10)	198 (90)	Reference	-
BMI (Body Mass Index)					
Normal (BMI =18.5 and 24.9 kg/m^2.)	180 (57.5)	3 (5.80)	177 (94.2)	Reference	-
Lean (BMI < 18.5 kg/m^2)	64 (17.5)	11 (4.76)	53 (95.34)	1.4 [0.77 ; 2.94]	0.36
Overweight/obese (BMI between 25 and ≥ 30 kg/m^2.)	84 (10.83)	31 (53.85)	53 (45.15)	9.61 [4.78 ; 19.32]	**≤0.001***
Family history of diabetes mellitus					
Yes	68 (20.73)	37 (54.41)	31 (45.59)	37.6[16.06 ;88.01]	**≤ 0.001***
No	260 (79.27)	8 (3.08)	252 (96.92)	Reference	-
Low-density lipoprotein (LDL) levels					
Normal (> 0,35 g/l)	268 (81.71)	17 (6.34)	251 (93.66)	Reference	1
High	60 (18.29)	28 (46.67)	32 (53.33)	12.92[6.38 ;26.18]	**≤ 0.001**
High-density lipoprotein (HDL) levels					
Normal (<1,6g/l)	243 (74.09)	11 (4.53)	232 (95, 47)	Reference	1
High	85 (25.91)	34 (40)	51 (60)	14.06 [6.68; 29.6]	**≤ 0.001***
Triglyceride levels					
Normal (2 to 2,5g/l) blood	279 (85.06)	20 (7.17)	259 (92.83)	Reference	1
High	49 (14.94)	25 (51.02)	24 (48.98)	13.49[6.56 27.76]	**≤ 0.001***
Cholesterol quality					
Good (< 2g/l)	232 (70.73)	14 (6.04)	218 (93.96)	Reference	1
Bad	96 (29.27)	31 (32.29)	65 (67.71)	.43 [3.73; 14.8]	**≤ 0.001***

OR = odds ratio; **CI**= confidence interval; * = significant test

3.4. Multivariate logistic regression analysis of type 2 diabetes mellitus prevalence, according participants socio-demographic characteristics and risk factors

Further study, using binary multivariate logistic regression analysis, identified being female (Adjusted OR = 0.53; 95% CI: [1.52, 39.41] p = 0.014*), cohabiting (Adjusted OR = 92.73; 95% CI: [2.9; 29.05] p = 0.010*), inactive (Adjusted OR =

9.17; 95% CI: [1.11; 75.05] p = 0.040*), overweight/obese (Adjusted OR = 0.017; 95% CI: [0.002; 0.18] p = 0.010*), having a family history of type 2 diabetes (Adjusted OR = 50.13; 95% CI: [8.87; 283.50] p = 0.000*), and having high triglyceride levels (Adjusted OR = 0.03; 95% CI: [0.003; 0.36] p = 0.005*), as the only potential type 2 diabetes mellitus risk factors, in this study. Table 3.

Table 3 Multivariate logistic regression analysis of the prevalence of type 2 diabetes mellitus, according to socio-demographic characteristics and risk factors in study patients

Risk factors identified among participants	**Total number (%)**	**Type 2 diabetes mellitus Prevalence**		**Ajusted Odds ratio 95%[CI]**	**p-value**
		Positive (%)	**Negative (%)**		
Gender					
Male	137(41.76)	31 (22.63)	106 (77.37)	1	
Female	191(58.24)	14 (7.33))	177 (92.67)	7.74 [1.52 ; 39.41]	0.014*
Age (years)					
19 - 40	77 (23.48)	11 (14.29)	66 (85.71)	1	-
41 - 60	178 (54.27)	14 (7.87)	164 (92.13)	8.22 [0.33 ;205.55]	0.2
≥ 61	73 (22.25))	20 (27.40)	53 (72.6)	2.21 [0.2 ; 25.51]	0.53
Marital status					
Married	46 (14.03)	8 (17.39)	38 (82.61)	NA	NA
Single	52 (15.85)	23 (44.23)	29 (55.77)	3.29 [0.17 ; 62.37]	0.43
Cohabiting	200 (60.83)	14 (7)	186 (93)	92.73 [2.9 ; 29.05]	0.010*
Widowed	30 (9.14)	0(0)	30 (100)	1	-
Professional status					
Employed	145(44.21)	8 (5.52)	50 (94.34)	1	-
Not working	183 (55.79)	37 (20.22)	54 (89.17)	9.17 [1.11 ; 75.05]	0.040*
Smoking					
Yes	139 (42.38)	11 (7.91)	128 (92.09)	0.22 [0.05 ; 1.08]	0.62
No	189 (57.62)	34 (17.99)	155 (82.01)	1	-
Alcohol consumption					
Yes	118 (35.98)	23 (19.49)	95 (80.51)	10.37 [1.96 ; 54.94]	0.06
No	220 (64.02)	22 (10)	198 (90)	1	-
BMI (Body Mass Index)					
Normal (BMI =18.5 and 24.9 kg/m^2)	180 (57.5)	3 (5.80)	177 (94.2)	1	-
Lean (BMI< 18.5 kg/m^2)	64 (17.5)	11 (4.76)	53 (95.34)	NA	NA
Overweight/ obese (BMI between 25 and ≥ 30 kg/m^2.)	84 (10.83)	31 (53.85)	53 (45.15)	0.017 [0.002 ; 0.18]	0.010*
Family history of diabetes mellitus					
Yes	68 (20.73)	37 (54.41)	31 (45.59)	50,13[8,87 ;283,50]	0,000*

No	260 (79.27)	8 (3.08)	252 (96.92)	1	1
Low-density of lipoprotein (LDL) level					
Normal (> 0,35 g/l)	268 (81.71)	17 (6.34)	251 (93.66)	1	1
High	60 (18.29)	28 (46.67)	32 (53.33)	1.07 [0.07 ; 16.37]	0.967
High-density of lipoprotein (HDL) level					
Normal (<1,6g/l)	243 (74.09)	11 (4.53)	232 (95. 47)	1	1
High	85 (25.91)	34 (40)	51 (60)	0.06 [0.07 ; 16.37]	0.074
Triglycéride level					
Normal (2 to 2,5g/l) blood	279 (85.06)	20 (7.17)	259 (92.83)	1	1
High	49 (14.94)	25 (51.02)	24 (48.98)	0.03 [0.03 ; 0.36]	0.005*
Cholesterol quality					
Good (< 2g/l)	232(70.73)	14 (6.04)	218 (93.96)	1	1
Bad	96 (29.27)	31 (32.29)	65 (67.71)	0.23 [0.023 ; 2.00]	0.185

OR = odds ratio; **CI**= confidence interval; * = significant test

4. Discussion

The prevalence of non-communicable diseases throughout the world, especially in developing countries, is becoming worrying. This is the case of type 2 diabetes mellitus, which is responsible for galloping morbidity and mortality. To design, plan and evaluate appropriate intervention strategies against this public health problem, it is very important to know the epidemiology, distribution and extent of diabetes, as well as the associated risk factors in populations. (2). With the primary objective of determining the type 2 diabetes mellitus prevalence in patients at the Amissa Bongo regional Hospital in Franceville, south-east Gabon, the present study showed that women outnumbered men in participation. This result corroborates that reported in a previous study in which there was a high female representation for the diagnosis of type 2 diabetes (18). This result may simply be due to the awareness that most women have of the major hormonal fluctuations and body changes due to reproductive factors that they undergo throughout their lives, and are always willing to find out about their health status (19). Contrary to the results of previous studies in which, the type 2 diabetes mellitus prevalences were 34.6% (1), and 16.8% (20), respectively, a lower prevalence of 13.72% (95% CI: [0.10- 0.18]) was indicated in the present study. This result is higher than not only the 8.5% obtained in Americans with a positive diagnosis of type 2 diabetes (21), but also the 6.2% obtained in Ghana (22), and the 10.75% in a study in Beijing, China (23) and 6% in Ethiopia (24). This variability in the type 2 diabetes mellitus prevalences in the different studies could be explained by a number of parameters, such as the different lifestyles of the populations studied, the different study timetables, and the different sample sizes. In addition, a number of studies have included differences in life expectancy and study parameters, which may also influence the differences in prevalences reported here (25).

In univariate analysis, the type 2 diabetes mellitus prevalence, was significantly associated with female gender, the age ranges 41-60 and ≥ 61, being single or cohabiting, unemployed, smoking, a body mass index (BMI) between 25 and ≥ 30 kg/m^2, i.e. overweight/obese, a family history of diabetes mellitus, abnormal low-density lipoprotein (LDL) levels, abnormal high-density lipoprotein (HDL) levels, high triglyceride levels, and poor cholesterol quality.

Further study, using variable adjustment and binary multivariate logistic regression, identified that being female was 5.3 times statically associated with type 2 diabetes. Although in agreement with that which has indicated that, T2DM is more easily predicted in women than in men, (26), the result of the present study is contrary to that which has suggested that the prevalence of type 2, increases more in men than in women are of interest (27). This can be justified by the fact that, over the course of their lives, women undergo hormonal changes that make them vulnerable to a number of pathologies. Furthermore, in African societies, women are more sedentary than men, which leads to the early onset of overweight/obesity in women. Numerous cross-sectional studies have investigated the association between type 2 diabetes and patients' marital status (28). In contrast to a study that reported that married individuals during a 5-year follow-up had significant weight gain, and therefore associated with an increased risk of developing T2DM (29), the present study found that cohabitation was associated with type 2 diabetes. This finding may be justified by the social uncertainty and instability that cohabiting individuals may experience. Although a certain study indicated that the association between diabetes mellitus and occupational activity was inconsistent (30), participants in the present study

without occupational activity were associated with type 2 diabetes mellitus. This result, which implies a low socioeconomic status attributable to unfavourable lifestyle factors (obesity), is consistent with previous studies which found that people from high-income countries with low incomes were more likely to have type 2 diabetes (31). In a context of middle- or low-income countries such as Gabon, professional inactivity is synonymous with poverty among the elderly, particularly pensioners, where income is low. In contrast to the result obtained in a study elsewhere (32), the present study showed a significant association between the prevalence of type 2 diabetes mellitus and being overweight/obese (Adjusted OR = 0.017; 95% CI: [0.002; 0.18] p = 0.010*). This result is consistent with similar studies which indicated in a bivariate analysis that the duration of diabetes was significantly associated with overweight/obesity. (33). This can be justified by the fact that nowadays, the uncontrolled sedentarisation of many Gabonese towns is pushing people to live Western-style lives, consuming products rich in sugar, salt or fat found in supermarkets. This diet encourages overweight and obesity, which are major risk factors for type 2 diabetes mellitus (34). In this study, type 2 diabetes mellitus prevalence was significantly associated with a family history of type 2 diabetes (Adjusted OR = 50.13; 95% CI: [8.87; 283.50] p = 0.000*). This result is in agreement with a study that reported that a family history of diabetes increases type 2 diabetes mellitus risk, with a odds ratio of 6.14 (95% CI: 2.8, 13.46) (35). This could be proper because due to a combination of genetic and environmental factors such as shared family lifestyle, children inherit high blood pressure ((36). Similar to a recent study conducted elsewhere (37), the present study indicated that having high triglyceride levels was 0.3 times significantly associated with type 2 diabetes mellitus. This result corroborates the fact that excessive consumption of sugary foods increases blood triglyceride levels and makes muscle cells resistant to insulin, leading to the onset of type 2 diabetes (38)

Study limitations.

Despite the contributions made, the present study nevertheless has a number of limitations that deserve to be highlighted, so that they can be taken into account in future studies. Given the conceptual framework of the study, and its cross-sectional nature, it was not possible to establish temporal relationships and limit the evaluation of cause-and-effect associations. Secondly, the results of this study obtained in a hospital setting cannot be generalized, as they do not represent the entire diabetic population of the city of Franceville or of Gabon as a whole. Finally, the present study may contain a recall bias that could influence self-reported data.

5. Conclusion

This cross-sectional study, which aimed to determine the prevalence and risk factors associated with type 2 diabetes mellitus among patients at Franceville regional Hospital, revealed that the risk factors significantly associated with this disease were, respectively, female gender, cohabitation, no occupational activity, overweight/obesity, family history of type 2 diabetes and high triglyceride levels. Consequently, the health authorities involved in diabetes care in Gabon should be aware of this situation and take appropriate measures to tackle this public health problem.

Recommendations

This study recommends:

- Introduce systematic screening for diabetes mellitus for all people attending health care center.
- Use standard precautions and measures to control diabetes mellitus for all risk factors such as excessive consumption of salty or sugary fatty foods and lack of sporting activity, which may increase the prevalence of this disease.
- Planning to carry out more extensive studies on the prevalence of diabetes, in order to substantiate the results and ultimately be able to recommend a policy in this area.
- Early detection of diabetes and appropriate treatment should be implemented, particularly in young adults **(39).**

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare no competing interests in the publication of this article.

Statement of ethical approval

The study was authorized by the Gabon South-East Regional Health Department, in letter No. 0345/PHO/SG/DRSSE/SGP/D, and endorsed by the hospital administration management. The sampling was designed on the basis of the voluntary participation of the participants in the study, after explaining the rationale, benefits, and ensuring the confidentiality of the study, Participation in the study was finalized by written and informed consent of each participant. To maintain anonymity, code numbers were used instead of nominal identifiers.

Statement of informed consent

All authors concur with the submission presented by the corresponding author.

Availability of data

In order to preserve the confidentiality of the participants, the data generated and analyzed during this study are not publicy available. However, they may be available from the corresponding author upon reasonable request

Authors' contributions and materials

TNM, EA and LCOE designed and initiated the study. AJEN, MPM wrote the manuscript. CB and TNM performed the statistical analysis. LCOE, EA, ULOS, and TNM made major contributions to the study design and statistical analysis. All authors contributed to the drafting of the manuscript and approved the submitted version of the manuscript**.**

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