

## BIOLOGICAL ANALYSIS, AN ESSENTIAL TOOL FOR DIAGNOSIS AND TRACKING OF PATHOLOGIES: DIABETES

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### ABSTRACT

Using biological analyzes is essential for establishing diagnoses. In order to better understand and interpret these biological analyzes for the diagnosis and monitoring of diabetes, and especially to compensate for the lack of information on these analyzes and more particularly on diabetes, a study was conducted at the CHR in Daloa in the service of diabetology. This study met our objective which is to show the importance of biological analyzes in the diagnosis and monitoring of diabetes. After conducting an extensive literature search, an investigation was conducted in diabetic patients. It involved 114 patients interviewed and 1,000 patients registered in the records and registers of the diabetology service. Data processing was carried out using Excel and Word software. The methods used are the statistical and comparative method. The analysis of the various results made it possible to diagnose diabetes using biological analyzes such as the capillary blood glucose test, the urine test and the glycated hemoglobin. They also allowed us to identify people with diabetes and the type of diabetes. The majority are adults over the age of 40 with type 2 diabetes and a low level of education. They had an unhealthy eating habit and were not physically active which led to overweight and obesity. Although the majority of people have improved their eating habits, it is very difficult for them to participate in physical activity. The analysis of the different results has made it possible to show that for the follow-up, the treatment recommended by the doctor is either medication, dietetics and physical exercise.

**KEYWORDS:** Diabetes, laboratory tests, glycemia, glycated hemoglobin.

### INTRODUCTION

Today, diabetes is a major public health problem affecting a large part of the population, a rapidly growing pathology with serious consequences, both health and socio-economic (Trivin, 1998). In fact, diabetes has long been considered a disease specific to rich countries, however it currently affects several developing countries, and even the most disadvantaged social strata (Arbouche et al., 2012).

Diabetes is a chronic disease characterized by permanent hyperglycemia. There are two main types of diabetes mellitus: type 1 diabetes and type 2 diabetes, which affects 10% and 90% of people with diabetes, respectively. It particularly affects adults over 45 years old, sedentary and overweight (Sawadogo, 2014).

Estimates from the International Diabetes Federation (IDF) in 2013 indicate that 382 million people have diabetes worldwide. This number is expected to exceed 592 million in less than 25 years. In fact, an estimated 175 million diabetics are currently undiagnosed who are exposed to diabetes complications through ignorance. In Côte d'Ivoire, IDF estimates indicate 501.53 thousand diabetes cases and 11,884 deaths linked to this disease (IDF, 2013).

The severity of this disease is mainly due to the many complications that occur in the short or long term. Most of these complications lead to incapacity, disability or poor health. Amputations related to diabetic foot, chronic kidney disease. Blindness and stroke and diabetic

neuropathy are the most formidable complications (Kebela, 2012).

To remedy its complications, an early diagnosis of diabetes is required, which is established on the basis of fasting plasma glucose, or during the day in the event of symptoms. It can also be established by measuring glycated hemoglobin (HbA1c) or after an oral glucose load (Braillard, 2017).

However, for management, the three main therapeutic means for treating diabetes are dietetics, drugs and physical exercise. They are interdependent and influence each other, which requires the use of a close monitoring strategy in which glycemic self-monitoring is the cornerstone (Sawadogo, 2014).

In addition, given the many problems that this pathology causes today, such as the high cost of treatment and the many complications caused, the various biological analyzes used to diagnose diabetes and their interpretations remain unknown, difficult and very complex. Indeed, the lack of information on these analyzes, on the disease and on the management of diabetics represents a major concern that must be addressed.

It is in this context that this study was initiated, with the general objective of showing the importance of

biological analyzes in the diagnosis and monitoring of diabetes. More specifically, it involves identifying and describing the different biological analyzes of diabetes; to determine the frequency of this pathology within the population; and how the follow-up of people with diabetes is done.

## MATERIAL AND METHODS

### 1. Presentation of the study area

#### 1.1. Presentation of the Department of Daloa

Daloa is a city in west central Côte d'Ivoire, in West Africa. Chief town of the Haut Sassandra Region Department. The city is located 141 km from Yamoussoukro, the political capital and 383 km from Abidjan, the economic capital. It is bounded to the north by the Department of Vavoua, to the south by the Department of Issia, to the east by the Department of Zuénoula and Bouaflé and to the west by the Department of Duékoué. In 2012, its population was estimated at 261,789 inhabitants, it is the 3rd most populous city in Côte d'Ivoire (Anonymous, 2017). In addition, the department is watered by the Sassandra river and by its tributary the "Lobo" whose ramifications the Dice and the Gore flood all the localities. The Bété, Niamboua, Zombo and part of Niédéboua, various foreigners and foreigners make up the bulk of this population (Anonymous 1, 2017). Our study thus took place in certain places of the city (Figure 1).

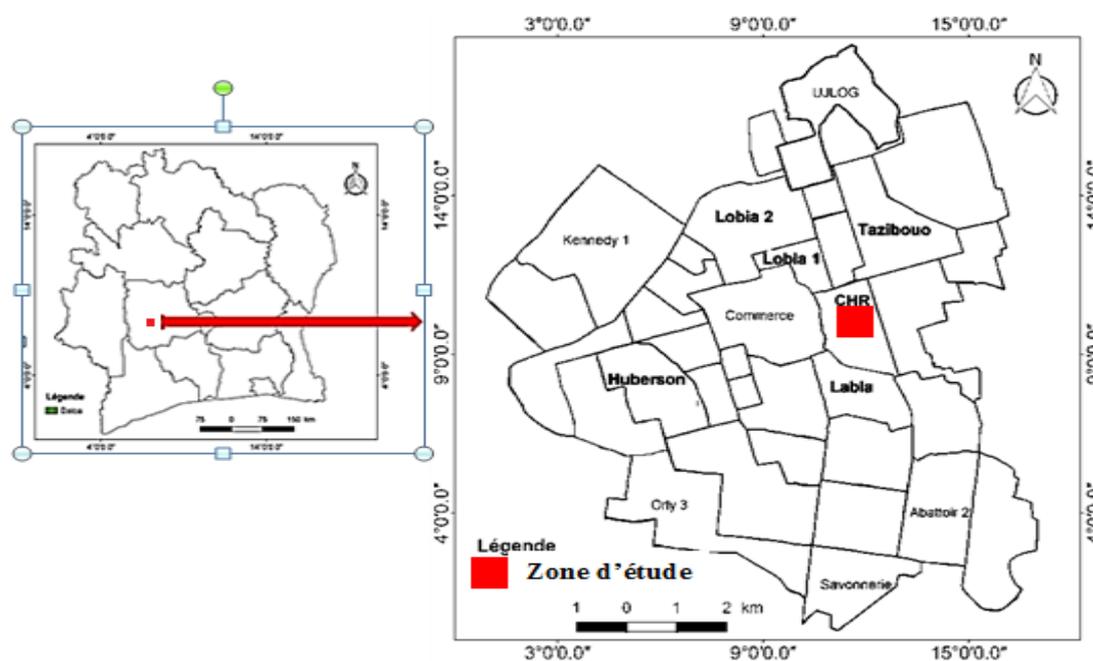


Figure 1: City of Daloa.

#### 1.2. Presentation of the hosting structure

Daloa central hospital, built in the Kirmann district since 1961, was set up as a Regional Hospital Center (CHR) in 1980. The Daloa CHR covers an area of approximately 27 hectares, of which 15 hectares are built. It is both the referral hospital for the Daloa health district and for the

entire Haut-Sassandra administrative region. It has a larger technical platform than other health facilities in the area. As such, the CHR welcomes other patients from the district, all patients from the localities, whose state of health deserves care which cannot be satisfied by the better primary or secondary centers. Thus, several

patients are sent there every day to its various departments for their care.

This health facility also has 03 wastewater treatment basins from services, a theoretical capacity of 183 beds and real capacity of 150 beds (Medicine 45, Surgery 36, Pediatrics 33, Gyneco-obstetrics 32, Ophthalmology 04). It has 225 human resources (administrative and social staff: 14, medical staff: 26, contractual staff: 60, paramedical staff: 125).

- Administrative Services of CHR: Direction, General surveillance, Economat, Office of the entries, Unit of seizures and data processing, Social service and that of the archives.

- Medical services: Medicine, Pediatrics, Surgery, Gyneco-obstetrics, Ophthalmology, ENT, Psychiatry and Micro-clinic of diabetes.

- Medico-technical services: A surgical unit, An obstetric unit, A dental office, a Kinesitherapy unit, a mini block of Ophthalmology, an electrocardiogram service (ECG), a medical analysis laboratory, an anti-venereal dispensary, a pharmacy and a medical imaging service (two radio rooms and an ultrasound unit).

## 2. MATERIAL

For the realization of our work, two (02) types of materials will be used.

### 2.1. Biological material

Our biological material will consist of blood and urine.

### 2.2. Technical material

The technical material consisted of: a questionnaire, an on glucometer. Call extra, pen, cotton, needle, blood collection tubes, urine collection boxes, urine strips, CLOVER A1c™ Self meter.

## 3. METHODS

### 3.1. Type and period of study

This is a retrospective study and research on diabetic patients who come for blood sugar control. This study will take place from December 11 to February 11.

### 3.2. Study location and population

Our study was carried out at the Daloa Regional Hospital Center in the diabetology department.

The study population concerns diabetic patients who come for a blood sugar check, registered patients, in the register and diabetology files.

### 3.3. Inclusion and non-inclusion criteria

Type 1 and type 2 diabetic patients who came for a blood sugar check and type 2 diabetic patients who have been registered and who have a file with the diabetology service.

Diabetic and non-diabetic patients who are coming for the first time to be diagnosed or checked. Type 1 or 2 diabetic patients who are in critical condition.

### 3.4. Diagnosis method

To diagnose diabetes, different methods have been used, namely:

- Fasting blood sugar;
- Urine exam;
- Glycated hemoglobin.

#### 3.4.1. Fasting blood sugar

The blood sugar level is measured using a strip meter and a drop of blood collected at the tip of a finger. The principle of measuring blood sugar is done in several stages.

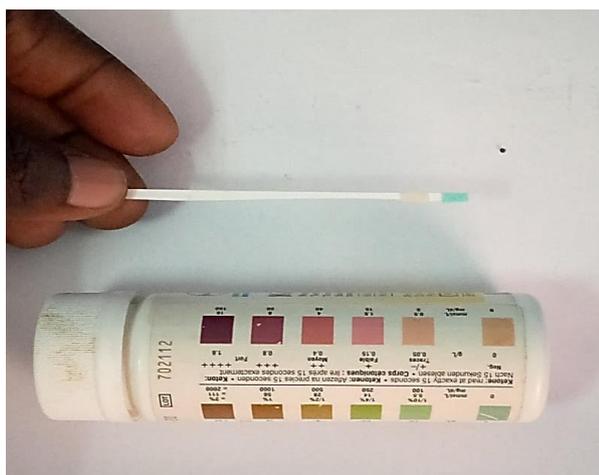
The first step is to get a glucometer and test strips. Then you have to insert the strip into the meter to activate it, Clean the sampling area as well as your hands, wait for the device to request a sample. Next, take a drop of blood from a fingertip and apply it to the strip (Figure 2). Wait for the results for about 5 seconds then read the results.



**Figure 2: Blood glucose collection kit.**

### 3.4.2. Urine exam

For urinalysis, special test strips are used to test for sugar and acetone. On the label, the glycosuria values are given in grams per 100 milliliters (%). The urine test is done when the patient's blood glucose level taken on the glucometer is very high. When the blood sugar is very high, the patient is asked to go to the toilet with a small box and take a small amount of urine. When the patient returns the doctor introduces a urine strip into the patient's urine and after a few seconds the two colors that appear on the strip are compared to the different colors marked on the strip box in order to determine the sugar level in the urine. The search for ketone bodies is an important element of monitoring in order to detect an insulin deficiency in front of an imbalance of diabetes. Usually performed in the urine (ketonuria) using test strips (Figure 3).



**Figure 3: Ketodiastix strip for urinalysis.**

### 3.4.3. Glycated hemoglobin

The production of glycated hemoglobin is a multi-step operation. First you need to plug in the device and turn it on (Figure 4). Until the device is ready to perform an analysis. This stage lasts approximately 5 minutes, depending on the ambient temperature. Do not move the

player during warm-up. The goal is to perform a series of internal tests during the preheating phase to verify the proper functioning of its optical and mechanical systems.

Lift the cover of the CLOVER A1c™ Self once the reader is in stand-by mode and the 'Open cover' icon is displayed. Take a pouch from where the pouches are stored. Tear the pouch by pulling on the side with the serrated edge. DO NOT use scissors to open the pouch. Scissors can damage the reagent pack. You must use the cartridge within 30 minutes after opening the pouch. WARNING: When handling the reagent pack and cartridge, take care not to touch the code area on the front or the level indicator on the back. Any contamination or dust on these two places can alter the results of the analyzes.

Carefully insert the cartridge into the cartridge compartment when the "insert cartridge" icon appears. Hold the cartridge so that the side with the barcode is on the left.

The cartridge is correctly placed when you hear or feel a sharp noise.

Gently shake the reagent pack 5 or 6 times before applying the blood sample. Place the blood sample on the collection area by bringing them into contact without rushing. Check that the sampling area is completely filled. Once the capillary rod is filled with blood, you should start the analysis within five minutes.

Then insert the reagent pack into the drive cartridge. The "Close lid" icon is displayed. The analysis starts automatically as soon as the lid is closed. Do not open, shake or move the reader while an analysis is in progress.

A 5 minutes countdown will be displayed until the HbA1c level is displayed you can open the lid after the analysis is complete. The screen will display the

"Remove cartridge" icon. Gently remove the cartridge by pushing it slightly to the left and pulling it out.



Figure 4: Apparatus for testing HbA1c glycated hemoglobin.

### 3.5. Data processing and statistical analysis

The questionnaire is made up of variable qualitative and quantitative responses. The socio-demographic profile of

the patients was determined by a descriptive analysis. The various surveys providing quantitative data were treated using standard statistical analysis. The results of the samples are based on basic techniques: averaging, comparison of means or percentages and analysis of variances.

## RESULTS

### 3.1. Biological analyzes and different types of diabetes

#### 3.1.1. Diabetes bioassays

At the Daloa Regional Hospital Center, the various biological tests used to diagnose diabetes are capillary glycemia, urine test and glycated hemoglobin (HbA1c). However, out of 1000 patients who have been registered in the diabetology files, the capillary glycemia test was carried out 1000 times or 100 %, the urine test was carried out 207 times or 20.7 % and tested glycated hemoglobin was produced 155 times or 15.5% in 1000 patients. The following graph shows the proportions of each analysis (Figure 5).

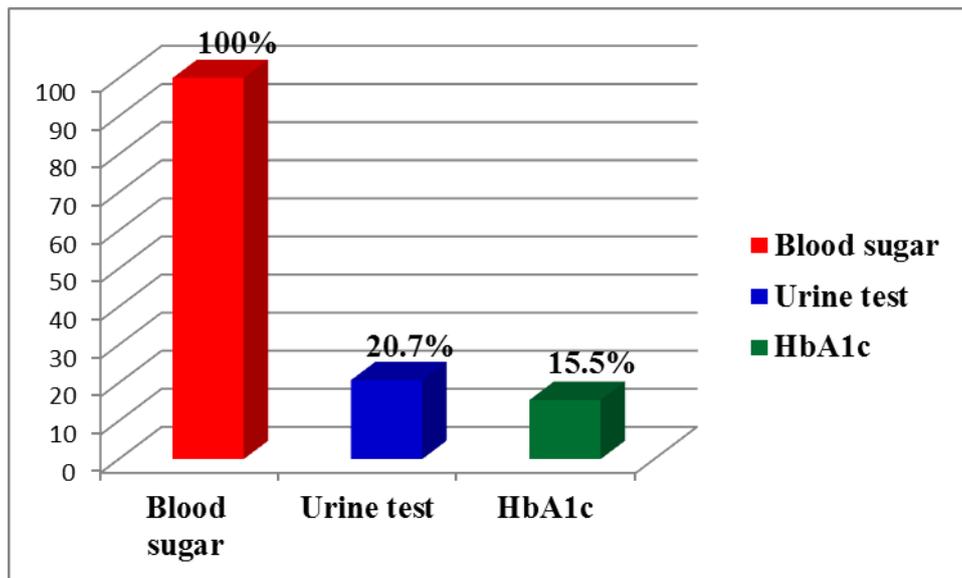


Figure 5: Proportion of biological analyzes performed on 1000 patients.

### 3.1.2. General proportion of diabetes in the study population

#### 3.1.2.1. Proportion by gender

At the Daloa CHR Diabetes Center, according to the register, we have 54.61 % men with diabetes and 45.39 % women. The following diagram shows the Proportion by gender (Figure 6).

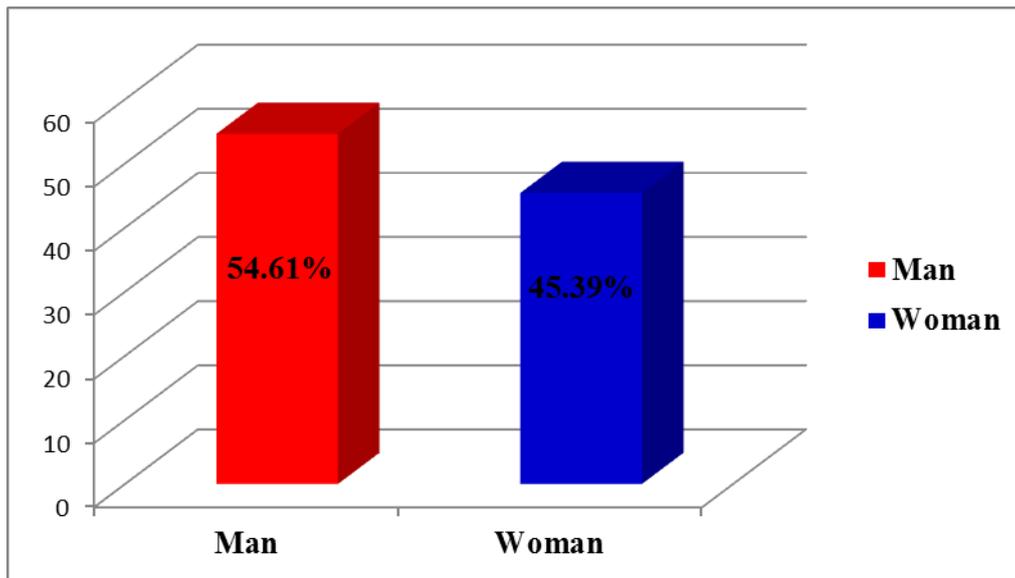


Figure 6: Proportion by gender.

**3.1.2.2. Proportion by type of diabetes**

At the diabetology center of the Daloa CHR, according to the register, we have 98.18% and 97.81% concerning type 2 respectively in men and women and 1.82% and

2.19% for type 1 diabetes. respectively in men and women. The following diagram shows the Proportion by type of diabetes (Figure 7).

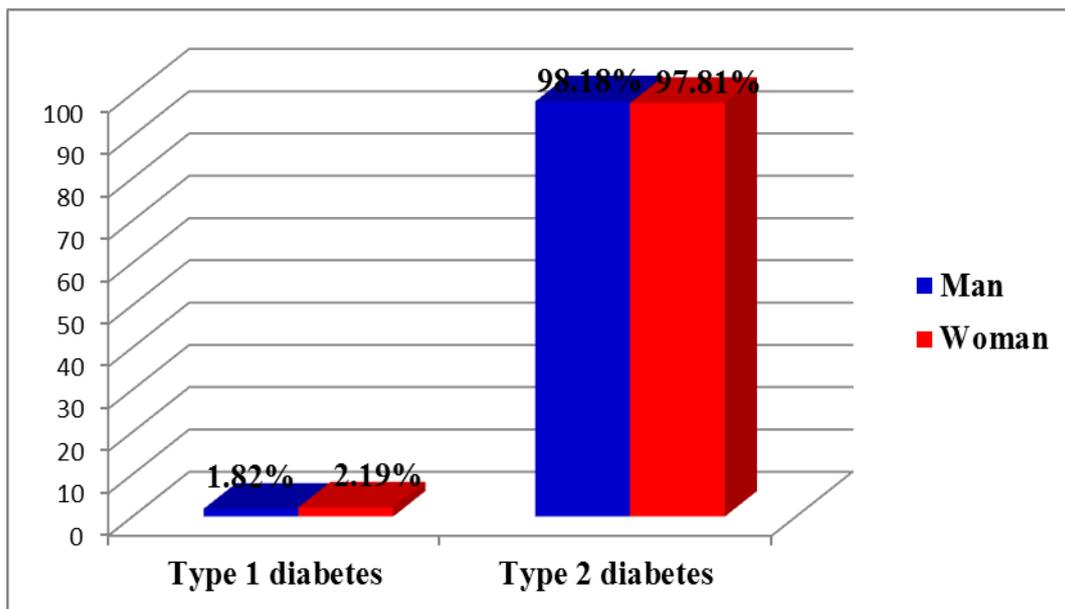


Figure 7: Proportion by type of diabetes.

**3.2. Characteristics of diabetic patients during controls**

**3.2.1. Classification by age**

At the Daloa Regional Hospital Center, in patients who come for blood sugar control, 4 % are under 30 years old, 20 % are between 30 and 40 years old and 76 % are over 40 years old. The following pie chart shows the age classification of these patients (Figure 8).

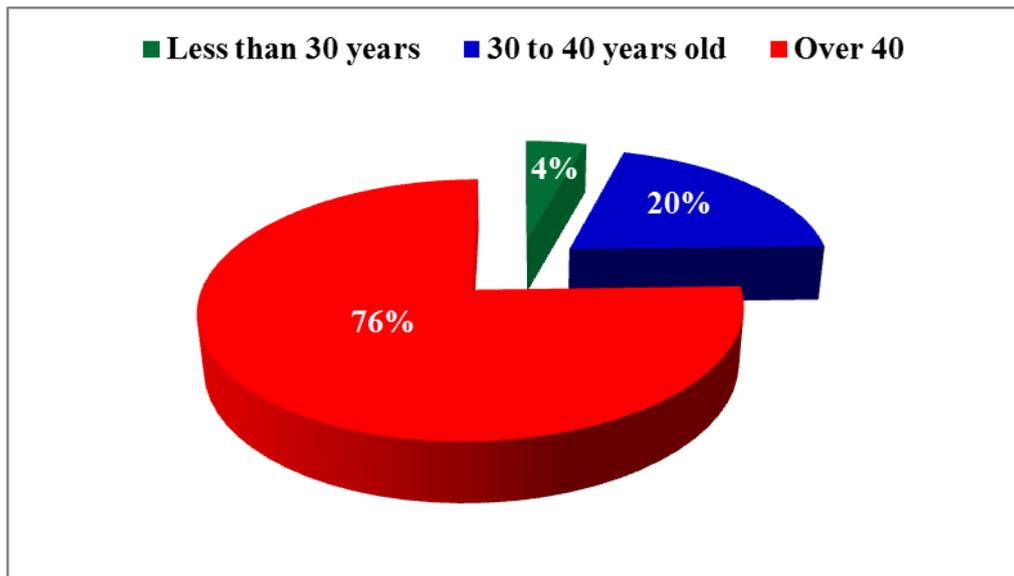


Figure 8: Classification by age.

### 3.2.2. Gender classification

In Daloa, of the patients who come for blood sugar control, 61% are men and 39% are women. The following pie chart shows the gender classification of these patients (Figure 9).

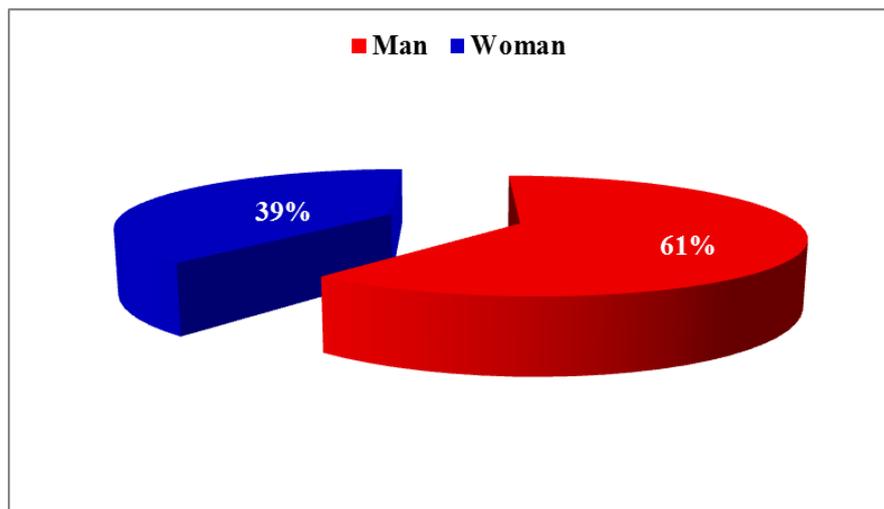


Figure 9: Gender classification.

### 3.2.3. Classification by level of education

The results of our surveys have revealed that 64% of diabetic patients who come for blood sugar control are illiterate compared to 36% of educated people. The pie chart below shows classification by level of education (Figure 10).

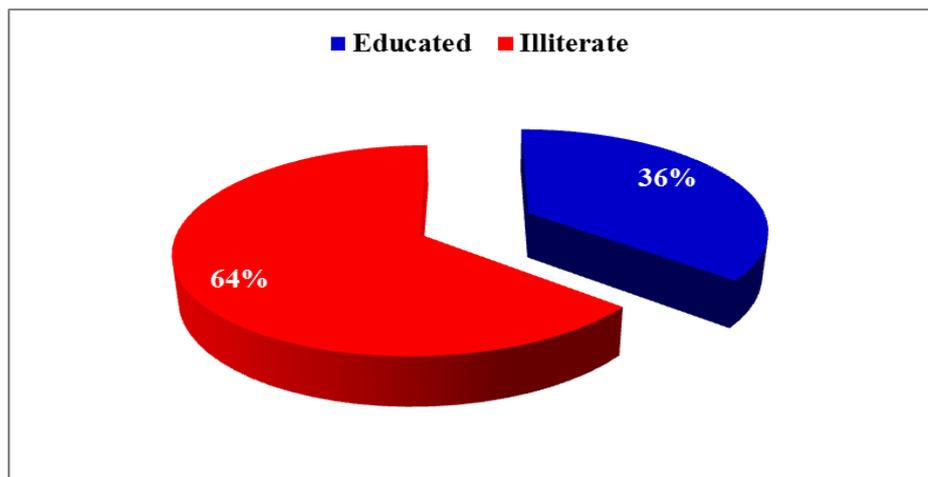


Figure 10: Classification by educational level.

**3.2.4. Body mass index (BMI)**

The results of our surveys have shown that in the diabetic patients of the CHR of Daloa 41 % are obese, 32 % are of normal weight, 21 % are overweight and 6 %

are lean. The pie chart below shows the distribution of these patients based on their body mass index (Figure 11).

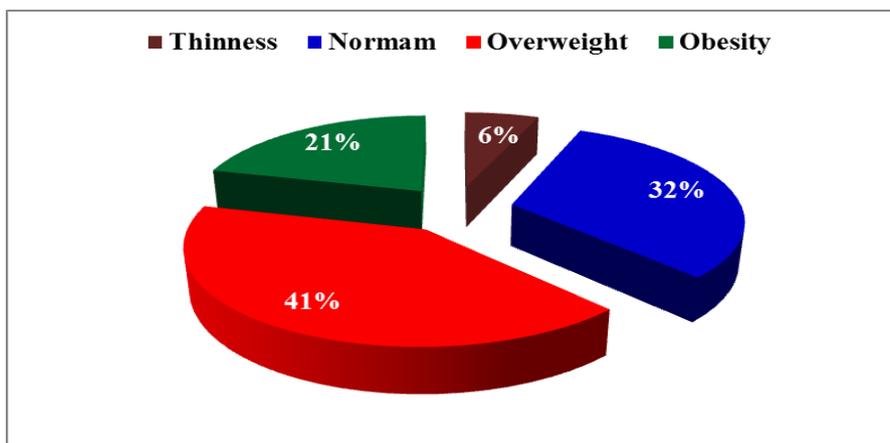


Figure 11: Body mass index.

**3.3. Food and daily situation of the patient**

**3.3.1. Before being diagnosed with diabetes**

At the Daloa Regional Hospital Center, before being diagnosed with diabetes, we found that only men used alcohol and tobacco. Regarding physical activity, men

including women did not participate in physical activity. However, the majority of men and women consume sugary drinks and foods often or occasionally, and very often consume fatty foods.

Table 1: Situation of patients before diagnosis of diabetes.

Habit	Consuming / Practicing		Not consuming / Non-practicing	
	Effective	Percentage	Effective	Percentage
Alcohol	65	57 %	49	43 %
Tobacco	32	28 %	82	72 %
Fatty foods	114	100 %	0	0 %
Sweet foods	92	81 %	22	19 %
Sports activity	23	20 %	91	80 %

**3.3.2. After being diagnosed with diabetes**

At the Daloa Regional Hospital Center, after having been diagnosed with diabetes, the majority of patients who consumed alcohol, tobacco or fatty foods stopped these

habits. However, the majority do not participate in sports. A few of them often walk.

**Table 2: Situation of patients after diagnosis of diabetes.**

Habit	Consuming / Practicing		Not consuming / Non-practicing	
	Effective	Percentage	Effective	Percentage
Alcohol	23	20 %	91	80 %
Tobacco	17	15 %	97	85 %
Fatty foods	19	17 %	95	83 %
Sweet foods	14	12 %	100	88 %
Sports activity	31	27 %	83	73 %

### 3.4. Management of diabetics

At the diabetology department in Daloa, when a patient's blood sugar level exceeds 2.5 g / l, a urine test is carried out to determine his sugar level in this urine. If the sugar level is high, the patient is immediately hospitalized 24 hours, treat with insulin and control to lower his blood sugar. Then, after treatment, the doctor prescribes medication, either oral antidiabetics and / or insulin with a strict diet and a little physical exercise depending on the patient's condition and age. The patient must then come to regular appointments to follow his progress and adapt his treatment according to the evolution. Regarding insulin prescribed by doctors, the most used to treat diabetics is the novomix 30, the lantus solo start and for oral antidiabetics we have metformin.

In Daloa, the majority of diabetic patients do not vaguely know what diabetes is. Although doctors provide as much information as possible on the disease and the management of diabetes, these patients wish to have even more information on the causes, the monitoring, but above all on dietetics and complications. However, all patients find it extremely expensive to treat diabetes and the majority of them do not have a device to measure their blood sugar.

### DISCUSSION

Our study carried out in the diabetology department of the Daloa Regional Hospital Center on diabetic patients allowed us to identify 1000 patients registered in the registers and to interview 114 people. It was difficult to reach a higher and larger number. There are various reasons for this: the lack of space to interview patients, the advanced age and the weak or critical state of the patients and the time available to interview patients since the analyzes are carried out very early. in the morning and fasting.

From this study, a general idea emerges on the use and importance of biological analyzes and the diagnosis as well as the management of diabetes.

The various biological analyzes used to diagnose diabetes in the diabetology department are the blood glucose test with 100 % then the urine test with 20.7 % and the glycosylated hemoglobin with 15.5 % on the 1000 patients. Glycosylated hemoglobin is done less often than other tests. This situation is explained by the fact that it is an analysis that is done every 3 months. This statement goes in the same direction as that of (Biomnis, 2012).

According to Biomnis (2012), glycosylated hemoglobin is a reflection of the average blood glucose levels of the previous 120 days (2 to 3 months), corresponding to the lifespan of red blood cells.

Men are more likely to have diabetes than women, with 60 % and 40 % respectively. The high number of men is due to the fact that men do less and less physical activity and consume more alcohol and tobacco unlike women. These results are in agreement with (Bellet, 2016). According to her, the prevalence of diabetes is higher in the male population due to a different lifestyle, different eating habits and sometimes more difficult to change than in women.

In men as in women, the dominant type of diabetes is type 2 diabetes with an average of 98 % compared to 2 % for type 1 diabetes. As everywhere in the world, type 2 diabetes is the predominant form. In sub-Saharan Africa more than 90 % of diabetes cases are recorded (Lokrou *et al.*, 1994; Lokrou and Alléchi, 1995). Type 1 diabetes and pancreatic diabetes are poorly present. This is in line with previous work by the ADA which speaks of rarer forms (ADA, 2011).

In patients who come for blood sugar control, 4 % are under 30 years old, 20 % are between 30 and 40 years old and 76 % are over 40 years old. The high number of older people is due to the fact that diabetes is a disease that occurs in older and older people. Sawadogo (2014) also joins us when she states that diabetes is a disease that particularly affects adults over 45 years old, sedentary and overweight.

The education level of diabetic patients at Daloa level is very low, with an average of 36 % educated and 64 % illiterate. The low level of education is due to the fact that the majority of diabetic patients are traders, planters and housewives. These results are in agreement with those of Adjoua *et al.* (2016) in a study on the complications of diabetes in Côte d'Ivoire. According to this study, the analysis of the level of education shows that 72.22 % of people with diabetes do not have BEPC, therefore a low level of education. This low level is a problem since patients will find it difficult to put therapeutic measures into practice effectively.

The results of our surveys have shown that in diabetic patients of the CHR of Daloa 41 % are obese, 32 % are of normal weight, 21 % are overweight and 6 % are lean.

This observation is clear and therefore indicates to us that prevention and reminders of diet and hygiene measures, physical activity and continuous treatment seem to be the key to success in achieving correct BMI. It is essential to remind these people that the impact of BMI on diabetes is important, the higher the BMI and the higher the risk of diabetes but also and above all of micro and macrovascular complications that are sometimes incurable (Bellet, 2016). It is therefore essential for all diabetic patients who are overweight or obese, that a consultation with a dietitian takes place in order to take stock of the person's eating habits and physical activity. Thus, with the collection of all this information, the dietitian will be able to dictate rules to follow.

Regarding the significance of diabetes, the expected response was given by all patients but in a vague manner. This is comparable to the results of Togola (2018), who find that 92 % of patients knew the definition of diabetes. This could be explained by the ease of the expected response. The results showed that before being diagnosed with diabetes, patients used to consume alcohol, tobacco, sugary foods and the consumption of fatty foods without being physically active. All of these bad habits are due to the ignorance of the dangers of diabetes in these patients. Indeed, the education of the patient for a good management of his habits is underlined by Togola (2018), when he considers that the education of the patient by the transmission of theoretical knowledge and practical know-how allows diabetics to achieve the empowerment and autonomy essential for the good daily management of their diabetes. In addition, after being diagnosed with diabetes, the majority of patients who consumed alcohol, tobacco or fatty and/or sugary habits discontinued these habits. However, the majority do not participate in sports.

The results showed that all patients were unanimous on the very high cost of treating diabetes. Indeed, the treatment remains very expensive insofar as diabetes requires lifelong care. These results converge with those of (IDF, 2011). According to IDF (2011), health care spending related to diabetes represented 11 % of total health care spending. It is estimated that about 80 % of the countries covered by the IDF report gobble up between 5 % and 18 % of their total health care spending in diabetes. The treatment prescribed by the doctor is either oral antidiabetics and/or insulin with a strict diet and a little physical exercise. These results correspond to those reported by Sawadogo (2014) which stipulates that the three main therapeutic means are dietetics, drugs and physical exercise; they are interdependent, influence each other, which requires the use of a close monitoring strategy in which self-monitoring of blood sugar is the cornerstone.

When a patient's blood sugar exceeds 2.5 g/l, a urine test is done to determine their sugar level in that urine. This practice is also observed in the study carried out by Bellet (2016) which stipulates that in the event of blood

sugar > 2.5 g/l, a urine strip must be carried out in the patient in search of ketone bodies and that ketoacidosis can take place and is characterized by the presence of clinical signs.

## CONCLUSION

The study based on patient registers and records and a survey of 114 patients revealed several results for us. Among the results obtained, an identification and a description of the method of carrying out the various biological analyzes was highlighted as well as the proportion of each analysis which was carried out on 1000 patients. The different biological analyzes carried out are capillary glycemia, urine test and glycated hemoglobin (Hb1Ac). This study showed that men with diabetes are significantly more numerous than women and that in men as in women type 2 diabetes dominates largely with an average of 98% against 2% for type 1 diabetes. strongly affects adults over 40 with 76 % with a very low level of education for diabetics with 64 % of illiterates against 36 % of educated people. The study also showed that before being declared diabetic, the patients had a bad eating habit and did not engage in physical activity, however although the majority have changed their eating habit, it is difficult for them to practice physical activity because of their advanced age. Regarding useful therapeutic measures, this is a healthy diet, physical activity and oral antidiabetic drugs and / or insulin.

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