**Original Research Article**

# Epidemiological, clinical and paraclinical aspects of the association of diabetes and covid-19 in a Lome Regional Hospital ,Togo



**Abstract**

Diabetes is one of the most frequently reported comorbidities in patients with COVID-19 in non-critical forms of the infection. The aim of the study is to describe the **Epidemiological, clinical and paraclinical aspects of** diabetic patients hospitalized for COVID-19. This was a retrospective descriptive study conducted over 19 months from March 21, 2020 to October 31, 2021, covering the medical records of patients with COVID-19 hospitalized at Lomé Commune Regional Hospital, Togo. In this study, 321 diabetic patients were included. Data were collected from patients'; hospitalization records using an established survey form. The median age of the patients was 59 years. Mortality was 27% and factors associated with death were age equal to or greater than 60, parenchymal involvement equal to or greater than 50%, and hospital stay of less than 7 days. The association of diabetes and COVID-19 must be taken seriously, as it is a deleterious combination for elderly patients with a severe form of the disease.

**Key words: Epidemiological, Diabetes, COVID-19, patients**

## Introduction

On December 31, 2019, the World Health Organization (WHO) was informed by the Chinese authorities of an outbreak of pneumonia linked to SARS-COV-2 [1]. This disease was later named COVID-19.

The first case in Togo was reported on March 06, 2020 in a traveler. This was a 42 years oldpatient returning from Europe [2]. The first death was recorded on March 27, 2020 [3].

The clinical presentation of COVID-19 varies from asymptomatic cases to forms of severe pneumonia associated with multivisceral failure, particularly in older patients or those with chronic comorbidities such as diabetes [4, 5].

Published data show that diabetes is one of the most frequently reported comorbidities in patients with COVID-19 in non-critical forms of the infection [6].

According to Chinese data, the prevalence of diabetes in patients with a critical form of COVID-19 reaches 15 to 25%, a result 2 to 4 times higher than in non-critical patients [6]. An even higher prevalence of diabetes, in excess of 50%, has been reported in the USA in patients admitted to intensive care for a critical form of COVID-19 [6].

We initiated this study at the Lomé-commune Hospital in Togo, with the general aim of describing the profile of diabetic patients hospitalized for COVID-19 at the Lomé Commune Regional Hospital(CHR-LC). More specifically, the aim was to describe the epidemiological, clinical, therapeutic and evolutionary characteristics of COVID-19 in diabetics.

## Methodology

### Scope of study

We conducted our study at the Lomé Commune Regional Hospital (CHR-LC), which is the national reference center for the care of patients with COVID-19 in Togo. It is located at Kégué in the district of Lomé. CHR-LC is a regional hospital dedicated solely to the treatment of COVID-19 in 2020. In order to reduce the risk of nosocomial infection linked to SARS-CoV-2, the CHR-LC is organized into three zones: a green zone dedicated to admission and the staff office, an orange zone which is the intermediary between the green zone and the red zone where undressing and disinfection take place, and was intended for the

hospitalization of patients with a capacity of 102 beds. The care staff included: 3 pulmonologists, 3 intensive care physicians, 3 internists, 2 infectious diseases specialists, 1 nephrologist, 1 cardiologist, 4 general practitioners, 1 pharmacist, 1 radiologist, one biologist, 5 senior laboratory technicians, 4 senior radiology and medical imaging technicians, 6 senior anesthesia and intensive care technicians, 1 medical assistant, 5 state-qualified nurses.

**Study method**

This was a retrospective descriptive study conducted over 19 months from March 21, 2020 to October 31, 2021, covering the medical records of patients with COVID-19 hospitalized at CHR-LC.

The target population was diabetic patients infected with COVID-19. The study population was diabetic patients infected with COVID-19 and hospitalized at CHR-LC.

Diabetic patients (known or newly diagnosed, fasting venous blood glucose ≥ 1.26 g/l) hospitalized at CHR-LC for COVID-19 (diagnosis confirmed by a positive PCR test for Sars-Cov-2) were included.

Any diabetic patient infected with COVID-19 whose file was unusable was not included.

Data were collected from patients' hospitalization records using an established survey form.The form was initially tested on around ten files to ensure its good design before moving on to collecting data from the full sample. The data was collected after reading and analyzing the files.

For ethical provisions, Our study took into account patient anonymity throughout the data collection and analysis process.

Authorization from the authorities involved in the management of the CHR-Lomé commune was obtained before the start of our study.

The parameters studied were :socio-demographic characteristics, history and comorbidities, antidiabetic treatment prior to admission, vaccination status, clinical and paraclinical signs (hemoglobin level, white blood cell count, platelets, lymphocytes, urea, creatininemia, blood glucose, glycated hemoglobin, total cholesterol, triglycerides, HDL-c, LDL-c, transaminases, sedimentation rate, CRP, HBsAg, Ac anti-HCV, RSV, D-dimer, standard chest X-rays, chest CT.

Evolutionary aspects included the occurrence of thrombo-embolic complications, pulmonary superinfections, ARDS, diabetic ketoacidosis decompensation and hyperosmolar hyperglycemia and stroke, and finally the outcome of the hospital stay, i.e. recovery or death.

### Operational definitions

- Diabetes was defined as fasting capillary blood glucose ≥ 1.26 g/l.
- Hypoglycemia was defined as blood glucose below 0.7 g/l
- Normoglycemia was defined as a blood glucose level between 0.7 g/l and 1.10 g/l.
- We defined controlled diabetes as a glycated hemoglobin level equal to or less than 7%, and uncontrolled diabetes as a glycated hemoglobin level greater than 7%.
- Hypertension was defined according to WHO criteria by a BP greater than 140/90 mmHg and classified as WHO grade I, II, and III.

## RESULTS

### Characteristics of the study population

During our study period, we included 321 diabetic patients out of 2011 patients admitted to hospital, i.e. a prevalence of diabetes of 15.96%.
During the same period, the CHR-LC recorded 320 deaths (with or without comorbidity), giving an overall lethality of 15.91%.
Of the 321 diabetics hospitalized, we recorded 86 deaths, representing a lethality rate of 26.79% in the diabetic population.

Male sex was the most represented in our series, with 166 patients out of 321, i.e. 51.7%. The M/F sex ratio was 1.07.
Subjects in our sample ranged in age from 20 to 95 years with a median age of 59 years (IQR: 50-67). The predominant age group was 60 and over with a proportion of 49.8%, followed by 50 to 60 year olds with 26.8%. The two age groups combined accounted for 76.6%.
Ninety-one point three percent (91.3%) of patients lived in urban areas, particularly in Lomé and its surrounding areas.

### Clinical data

#### History and co-morbidities

The three main comorbidities were hypertension in 63.2% of cases, overweight or obesity in 16.8%, and a history of stroke in 4.7% (Table 1).

**Table 1**: Distribution of patients according to comorbidities

| | Number | Percentage |
|---|---|---|
| High blood pressure | 203 | 63.2 |
| Overweight or Obesity | 54 | 16.8 |
| STROKE | 15 | 4.7 |
| Chronickidneydisease | 9 | 2.8 |
| Asthma | 6 | 1.9 |
| Neoplasia | 4 | 1.2 |
| HIV infection* | 3 | 0.9 |
| Tuberculosis | 2 | 0.6 |
| Smoking | 2 | 0.6 |

**Vaccination status**

Fifteen patients in our series had already received the anti-COVID-19 vaccine.

Theirdistribution according to the type of vaccine received was as follows:

AstraZeneca® : 09 patients received one dose and 04 patients received two doses

Pfizer/biotech®: 01 patient received a dose

Johnson and Johnson® : 01 patient received a dose.

**Patterns and duration of symptoms**

The duration of symptoms prior to admission ranged from 1 to 30 days, with a median duration of 7 days (IQR: 4-8). Forty-nine point one percent (49.1%) had a duration of less than a week prior to admission.

The median body mass index (BMI) in our series was 28 kg/m2 (IQR: 26.00 36.00). The minimum BMI is 18 kg/m2 and the maximum 60 kg/m2. BMI was greater than 25 kg/m2 in 79% of patients.

The median peripheral arterial oxygen saturation (SaO2) in our study was 95% (IQR: 89–97). Minimum SaO2 was 40% and maximum 99%.

Two hundred and nineteen patients, i.e. 68.2%, had good room airsaturation (SaO2 ≥ 95%) and 102 patients, i.e. 31.8%, were on oxygen at admission (SaO2 < 95%).

**Blood pressure**

One hundred and fifty-one patients (47%) had normal BP on admission (Figure 1).

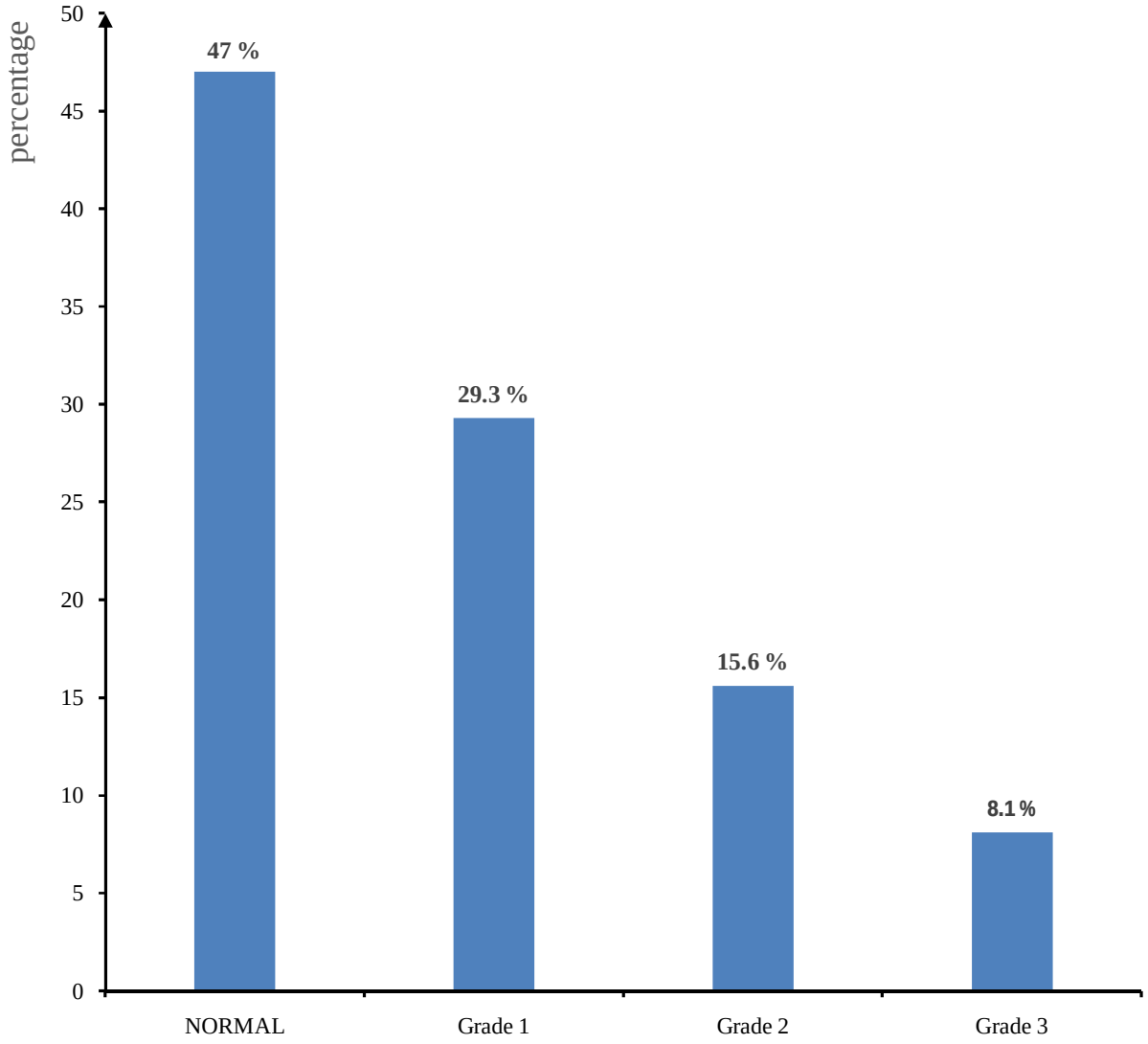


**Figure 1**: Distribution of patients according to the WHO classification of HBP

The clinical signs presented by patients on admission are recorded in Table 2:

**Table 2**: Signs in diabetic patients with COVID-19

| | **Number** | **Percentage** |
|---|---|---|
| Dyspnea | 183 | 57 |
| Cough | 151 | 47 |
| Asthenia | 142 | 44.2 |
| Fever | 127 | 39.6 |
| Headache | 69 | 21.5 |
| Myalgia | 52 | 16.2 |
| Alteredconsciousness | 34 | 10.6 |
| Ageusia | 17 | 5.53 |
| Anosmie | 14 | 4.4 |
| Vomiting | 13 | 4 |
| Abdominal pain | 9 | 2.8 |
| Nausea | 6 | 1.9 |
| Stroke | 6 | 1.9 |
| Diarrhea | 4 | 1.2 |
| Sore throat | 2 | 0.6) |
| Skin rash | 1 | 0.3 |

Dyspnea was the main symptom (57% of cases), followed by cough (47% of cases).

## Biological data

### Fasting venous blood glucose

The median blood glucose level in our study was 2.08 g/l (IQR: 1.42 - 2.87), with a minimum of 0.2 g/l and a maximum of 6.1 g/l. Calculations were carried out on 268 files in which blood glucose levels were measured on admission, i.e. 83.5%. Normoglycemia was noted on admission in 19.03%, hyperglycemia in 80.22% and hypoglycemia in 0.75%.

**Glycated hemoglobin**

One hundred and twenty-three patients, or 38.32%, had their glycated hemoglobin measured. The mean was 8.9%, with a standard deviation of 2.42.Minimum glycated hemoglobin was 4.7%, maximum 15.2%. Of the 123 patients, 29 (23.6%) had controlled diabetes.

Table 2 shows the medians of the biochemical parameters and Table 3 the biochemical disturbances observed in patients hospitalized for COVID-19 in our study.

**Table 3**: Median values of the biochemical parameters studied

| | Number | Median [IQR] |
|---|---|---|
| Uremia (g/l) | 267 | 0.31[0.21-0.47] |
| Creatininemia (mg/l) | 261 | 11 [09-14.90] |
| AST(IU) | 262 | 50[38-80] |
| ALT(IU) | 262 | 38[27-53] |

IQR: interquartile range; g: gram; mg: milligram; l : liter

IU: international unit.

AST : Aspartate transaminase (AST); Alanine Transaminase (ALT)

Biochemical disturbances were found in some cases such as the renal checkup where hyperazotemia and hypercreatininemia were noted respectively in 26.6% and 25.3% of cases. With regard to liver function tests, 38.2% and 19.8% of cases respectively showed an increase in AST and ALT levels greater than 1.5 times the upper limit of normal.

**Table 4:** Disturbances of biochemical parameters

| | | Number | Percentage |
|---|---|---|---|
| Uremia ≥ 0.45g/l | (N=267) | 71 | 26.6 |

| | | | |
|---|---|---|---|
| Creatinemia ≥ 14g/l | (N=261) | 66 | 25.3 |
| AST ≥ 1.5N | (N=262) | 100 | 38.2 |
| ALT ≥ 1.5N | (N =262) | 52 | 19.8 |

**Morphological data**

Ninety-eight (98) files in our sample had a thoracic CT angiography, i.e. 30.5%. The median extent of parenchymal involvement was 60.0% [IQR: 40-70] with a maximum involvement of 90% and a minimum of 5%. Severe parenchymal involvement was found in 51% and critical in 20.4% (Table 5).

**Table 5**: Characteristics of chest X-rayinvolvement on frontal

| | Number | Percentage |
|---|---|---|
| Normal image | 37 | 22.4 |
| Unilaterallesions | 33 | 20.0 |
| Bilaterallesions | 95 | 57.6 |

Alveolar syndrome was the most common radiographic lesion (51.6%), followed by interstitial syndrome (42.2%) (Table 6).

**Table 6:** Distribution of types of lesions on frontal chest X-ray

| | Number | Percentage |
|---|---|---|
| Alveolar syndrome | 66 | 51.6 |
| Interstitial syndrome | 54 | 42.2 |
| Alveolo-interstitial syndrome | 4 | 3.1 |
| Infiltrate/atelectasis | 3 | 2.3 |
| Miliaria | 1 | 0.8 |

**Thoracic CT angiography**

Ninety-eight (98) files in our sample had a thoracic CT angiography, i.e. 30.5%.

The median extent of parenchymal involvement was 60.0% [IQR: 40-70], with a maximum of 90% involvement and a minimum of 5%.

Severe parenchymal involvement was found in 51% and critical in 20.4% (Table 7).

**Table 7**: Severity of parenchymal involvement

| | Number | Percentage |
|---|---|---|
| Minimal | 02 | 2.04 |
| Moderate | 10 | 10.20 |
| Extent | 16 | 16.33 |
| Severe | 50 | 51 |
| Critical | 20 | 20.41 |

**Complications identifiedduringhospitalization**

Of the 321 cases in our series, 81 patients or 25.23% presented with acute respiratory distress syndrome, a ketoacidotic complication was found in 10 patients (3.1%), a stroke in ten patients (3.1%) including 9 Ischemic stroke (ICH) and 1 hemorrhagic stroke (HC).

Of the 98 thoracic CT angiography performed, 19 cases of pulmonary embolism (19.40%) and 7 cases of pulmonary superinfection (7.14%) were noted (Table 8). There was no correlation between the extent of lung injury and venous blood glucose at admission.

**Table 8**: Distribution of patients according to types of complications

| | Number | Percentage/number |
|---|---|---|
| ARDS* | 81 | 25.23 (n = 321) |
| Pulmonaryembolism | 19 | 19.40 (n = 98) |
| Diabeticketoacidosis | 10 | 3.12 (n = 321) |
| Stroke * | 10 | 3.12 (n = 321) |
| Pulmonarysuperinfection | 7 | 7.14 (n = 98) |

* ARDS: acute respiratorydistress syndrome

* Stroke: cerebrovascular accident

**Therapeutic and evolutionary data**

All patients systematically received hydroxychloroquine combined with a macrolide (Azithromycin). Other treatments included antibiotics, anticoagulants and corticosteroids. Respiratory assistance was required in 197 patients (61.4%), 3.4% of whom had undergone orotracheal intubation.

One hundred and eighty-one patients (56.4%) were hospitalized in the ward and 140 patients (43.6%) in intensive care.

The average hospital stay was 11.53 ± 7.5 days.

Hospitalization < 7 days was noted in 65 patients, i.e. 20.25% of cases, and ≥ 7 days in 256 patients, i.e. 79.75% of cases.

**Factors associated with death in diabetics with COVID-19**

Death was significantly associated with age ≥ 60 years (p<0.001), parenchymal involvement ≥ 50% (p=0.001) and length of hospital stay (p<0.001) as shown in Table 9.

**Table 9**: Study of the association between hospitalization outcome and variables of interest

| | Hospitalizationoutcome | | *p-value* |
|---|---|---|---|
| | Death | Healing | |
| Hyperglycemia on admission | | | |
| Yes | 64 (83.1 %) | 151 (79.9 %) | 0.337 |
| No | 13 (16.9 %) | 38 (20.1 %) | |
| **Computedtomography(CT) ≥ 50%** | | | |
| Yes | 27 (96.4 %) | 41 (60.3 %) | **0.001** |
| No | 1 (3.6 %) | 27 (39.7 %) | |
| **Length of hospitalstay** | | | |
| < 7 days | 56 (65.1 %) | 9 (3.9 %) | **< 0.001** |
| ≥ 7 days | 30 (34.9 %) | 224 (96.1 %) | |
| Controlleddiabetes | | | |
| Oui (HbA1c ≤7 %) | 8 (36.4 %) | 20 (20.0 %) | 0.88 |
| Non (HbA1c >7 %) | 14 (63.6 %) | 80 (80.0 %) | |
| **Age ≥ 60 ans** | | | |
| Oui | 56 (65.1 %) | 100 (43.3 %) | **< 0.001** |
| Non | 30 (34.9 %) | 131 (56.7 %) | |

CT: Computedtomography

The risk of death was multiplied by 2 if age ≥ 60 years. Moreover, fatal outcome was 46 times more likely to occur within 07 days of hospitalization (OR: 46.1; CI: 20.7- 102.5); p<0.001). Finally, diabetic patients whose parenchymal involvement was evaluated at 50% or more were 13 times more likely to die (OR: 13.8; CI: 1.8-108.9; p =0.013).

**Table 10**: Factors associated with death of diabetics with COVID-19 according to the binary logistic regression model.

| | DEATH (+)<br>Adjusted OR (95% CI) |
|---|---|
| **Age ≥ 60 years** | |
| No | 1 |
| Yes | 2.4 (1.5 – 4.1)<br>p< **0.01** |
| **Hospital stay< 7 days** | |
| No | 1 |
| Yes | 46.4 (20.7 - 102.5)<br>p< **0.001** |
| **Computedtomography(CT)≥ 50 %** | |
| No | 1 |
| Yes | 13.82 (1.8 – 108.9)<br>p = **0.013** |

OR : Odds Ratio ; CI: Confidence Interval; CT: computed tomography

## DISCUSSION

### Strength and weakness of our study

The topic is very important as it tries to describe the incidence of diabetes during COVID period. Also, it will help the policy makers to allocate resources towards the diabetic patients in case of future epidemics like COVID.

However, our study, like most retrospective studies, was confronted with the lack of certain information in patients' medical files.
The absence of data from paraclinical examinations in certain patients was the main limitation. This is the reason why venous blood glucose and glycated hemoglobin measurements were missing in certain files. Data relating to paraclinical examinations were collected from analysis results available in patient files.

**History and comorbidities**
We highlighted in our series, 63.2% of hypertensive patients, 16.8% were overweight or obese. These results are similar to those of Mané et al, who found in their series 39.40% hypertension and 8.85% obesity [7].
Just as hypertension emerged in our study as the major comorbidity associated with diabetic patients with COVID-19, data from the literature have also reported it [8, 9, 10, 11].

**Patterns and clinical signs**
The median body mass index in our series was 28kg/m2 (IQR: 26.00-36.00), with 21% of patients having a BMI < 25 kg/m2, 32% between 25.0 and 29.9 kg/m2 (overweight), and 47.0% having a BMI ≥ 30 kg/m2. These results are very similar to those reported by Bertrand Cariou et al [10], i.e. a median BMI of 28.4 kg/m2, with 24.8% of patients having a BMI < 25 kg/m2, 36.2%( overweight), and 39.0% obese.
The median time from onset of COVID-19 symptoms to hospitalization in our study was 7 days. This result is close to that of Bertrand Cariou et al [10], who reported a median delay of 5 days.
The three most common signs in our study were dyspnea (57%), cough (47%) and asthenia (44.2%). This triad is also noted by Mané et al in Dakar with asthenia (90.14%), dyspnea (78.81%) and cough (52.21%) [7].
Compared to the literature, fever was less frequent in our study.Indeed, in the studies by Zhou et al., Wu et al. and Guan et al. fever was more common, in 94%, 93.5% and 88.7% respectively [12]. In our study, fever was found in 39.6% of cases, this low representation was found in the study of Mané et al in Dakar which found fever in 43% of cases [7].
This low representation of fever in our study could be explained by the alteration of the immune system in diabetics especially when they are not controlled as was the case for the patients found in our study (median HbA1c of 8.9%).

**<u>Biological and morphological data</u>**

**Venous blood glucose**
Median venous glycemia in our study was 2.08 g/l (IQR: 1.42 - 2.87).
Two hundred and fifteen patients (80.22%) had hyperglycemia on admission.

This hyperglycemia was also noted by Mané et al in Senegal with a median of 2.02 g/l, as in China, Wu et al. and Chen et al for 45% and 52% respectively in their series [4, 13].
In the CORONADO study, blood glucose levels on admission were lower, with a median of 1.72 g/l.
The hyperglycemia found on admission can be explained initially by the hypersecretion of endogenous glucocorticoids secondary to the stress induced by the infection. On the other hand, the pancreas and other organs involved in controlling blood glucose are rich in angiotensin-converting enzyme 2 inhibitors, a protein that constitutes a gateway for SARS-CoV2. The virus is then able to hinder insulin secretion and even destroy β-pancreatic cells by invading the entire tissue [14].

**Imaging**

The median extent of parenchymal involvement was 60.0% [IQR: 40-70], with a maximum of 90% and a minimum of 5%.
28.57% (28 cases) of patients had parenchymal involvement < 50% and 71.42% (70 cases) of patients had parenchymal involvement ≥ 50%.
Mané et al found parenchymal involvement < 50% in 76.35% (155 patients) and parenchymal involvement ≥ 50% in 23.65% (48 patients) of 203 diabetics who underwent chest CT [7].

**Evolution, complications and severity indicators**

The complications found in our study were mainly represented by ARDS in 25.23% of cases, followed by pulmonary embolism in 19 patients and then ketoacidotic complications in 10 patients. These complications are probably the cause of the high mortality rate.
The mortality rate of diabetics in our study was 26.79%, a rate higher than that reported by Mané et al., i.e. 14.36% deaths [7].
Nevertheless, our results are broadly in line with those reported in the literature, where mortality ranges from 5.4% to 35% [15, 16].

The high frequency of these complications and deaths can be explained by the fact that the majority of our patients had associated significant risk factors, namely: 49.8% were aged ≥ 60 years, 63.2% had associated hypertension, 16.8% were overweight or obese and 80% had uncontrolledglycemic.
Death was significantly associated with age ≥ 60 years, parenchymal involvement ≥ 50%, and length of hospital stay.
This result is similar to those reported by Mané et al. in Senegal [7].
Our study found no association between hospitalization outcome and admission hyperglycemia, nor with patients' diabetic control.
These results are in line with the CORONADO study, in which HbA1c measurement did not appear to have a significant impact on the severity of COVID-19 in hospitalized diabetics, and there was no association between hyperglycemia on admission and the risk of an adverse outcome leading to death after multivariate analysis [17].

However, Mirani et al. in Italy reported an association between hyperglycemia measured on admission and COVID-19 prognosis (adjusted OR: 1.22; CI: 1.04–1.44) [18].Special attention should be given to the diabetes population during the infection of SARS-Cov-2 [19].

**CONCLUSION**

The present study allowed us to describe the profile of diabetic patients infected by SARS-CoV-2 in our context.
This was a retrospective, descriptive and analytical study of the medical records of diabetic patients hospitalized in the national reference center for the care of COVID-19, the Lomé Commune Regional Hospital.
The median age of our patients was 59 years. Mortality was 27%. Factors associated with death were age equal to or greater than 60, parenchymal involvement equal to or greater than 50%, and hospital stay of less than 7 days.
The main comorbidities associated with diabetes in our study were high blood pressure and obesity.
The association of diabetes and COVID-19 must be taken seriously, as it is a deleterious combination for elderly patients with a severe form of the disease.

## Ethical Approval:

As per international standards or university standards written ethical approval has been collected and preserved by the author(s).

Disclaimer (Artificial intelligence)

Authors hereby declare that No generative AI technologies such as large language models (ChatGPT, COPILOT, etc) and text to image generators have been used during writing or editing of this manuscript

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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