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Factors Associated with Mortality in Covid-19 Patients Hospitalized in Conakry's CT-EPI, from 2020 to 2022

Jean Konan Kouame ^a, Mamadou Alpha Diallo ^a, Abdoulaye Sow ^b, Sadou Sow ^c, Ibrahima Sory Cherif ^d, Mamadou Oury Balde ^d, Djiba Diakite ^x, Alpha Oumar Diallo ^v, Kadiata Bah ^e, Alain Ntumba Katende ^f, Mariama Souare ^f, Issiaga Konate ^e, Amadou Lamarana Sow ^f, Amadou Bailo Diallo ^e, Jean Marie Kipela ^g, Fode Bangaly Diakité ^a & Kipela Jean Marie ^d

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Results: In total, 10,404 Covid-19 patients were included in the study. Patients infected with Covid-19 in the age groups of 40-59 years, 60 years and over had a risk of death increased by 3 times respectively (OR = 2.99; 95% CI = [2.17-4.10]; p = 0.01) and 11 times (OR = 11.23; 95% CI = [8.42-14.98]; p = 0.000) more than Covid-19 infected patients in the 0-39 range years adjusting for other factors. Patients infected with Covid-19 who were hospitalized at CT-Epi in Gbessia compared to those hospitalized at the Donka National Hospital had a risk of death multiplied by 18 (OR=18.90; 95% CI = [13.70-26.08]; p = 0.000); holding the other variables constant in the model. Patients infected with Covid-19 hospitalized at the CT-Epi at Camp Alpha had a 78% lower risk of dying (OR = 0.22; 95% CI = [0.09-0.50]; p = 0.000), compared those hospitalized at the Donka National Hospital, all other things being equal. Patients suffering from Covid-19 associated with diabetes alone had a 5-fold increased risk of dying (OR = 5.20; 95% CI = [2.45-11.04]; p = 0.000) compared to those who did not suffer from diabetes, maintaining the other findings in the model. Patients suffering from Covid-19 in combination with

HIV alone had a 6 times increased risk of dying (OR = 6.59; 95% CI = [2.50-17.40]; p = 0.000) compared to those which there was no association, adjusting for the other variables. Patients suffering from Covid-19 and several comorbidities had a twice as high risk of dying (OR = 2.57; 95% CI = [1.66-4.40]; p = 0.000) compared to those which had not, adjusting for the other variables.

Conclusion: During the emergencies of the Covid-19 outbreak in Guinea, the proportion of deaths due to comorbidities was 43.7%. The response to the outbreak through the dispatch of mixed teams and the management of confirmed cases and the strengthening of epidemiological surveillance has reduced the risk of transmission of the virus in the country. The factors that determine morbidity and mortality are age, CT-Epi, diabetes, HIV & several comorbidities.

Keywords: covid-19, comorbidities, CT-Epi conakry, binary regression.

I. INTRODUCTION

Coronavirus disease (Covid-19) caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is a pandemic that has resulted in several thousand confirmed cases and deaths. (2). The mortality rate around the world shows variations that merit evaluation (2). It has been shown that comorbidities are frequently associated with Covid-19 and constitute risk factors for the severity of the disease (3).

In their study, Sina et al found that risk factors are associated with morbidity and mortality of CHD 2019 in several countries, including Central and Eastern Europe, Bangladesh, Brazil, China, India, Iran, Pakistan and Turkey. They found that there were more confirmed cases and deaths among men than women in most of these countries (see reference by Sina et al). In addition, the case-fatality rate for men was higher than for women (4). There are factors associated with the occurrence of morbidity and mortality linked to Covid-19, but these morbidity and mortality phenomena are significantly lower in sub-Saharan Africa than in high-income countries (5, 6).

In sub-Saharan Africa, some authors have reported that non-communicable diseases (NCDs) are associated with the occurrence of mortality in patients

Author ^a & ^b: World Health Organization, Conakry, Guinea. e-mails: Konank@who.int, diallomalpah@gmail.com, amalasow@gmail.com, sowsa@who.int, mbalde@who.com, souarem@who.int, konate@who.int, Katendea@who.int

Author ^c: Department of Medicine, Faculty of Health Sciences and Technology, University Gamal Abdel Nasser, Conakry, Guinea. e-mails: sowsa@who.int, docta135@gmail.com

Author ^d: Regional Health Directorate, Labe, Guinea. e-mail: cehrifrahimasory@gmail.com

Author ^e: Regional Health Directorate, Nzerekore, Guinea.

Author ^f & ^g: World Health Organization, Dakar Office, Dakar, Senegal. e-mails: Diakitef@who.int, Kipelam@who.int



with severe Covid19, notably cardiovascular disease (including hypertension) with a proportion of 24.6%, diabetes with 18.4% and chronic obstructive pulmonary disease (asthma) with 5.3%. The data compiled by Skip LA et al to assess the epidemiological and clinical characteristics of the Covid-19 cases who died throughout the African region south of the Sahara. More specifically, data on sex, age, underlying conditions and mode of detection were associated with the occurrence of deaths (7). In Burkina Faso in 2020, they point out that nearly half of confirmed Covid19 cases had a history of hypertension (45.5%), diabetes (21.2%) or other cardiovascular or pulmonary conditions, such as stroke, embolism or heart disease (9.1%) (7). In Mali in 2021, Soumana et al showed that mortality in patients infected with covid19 was associated with factors such as obesity, diabetes, hypertension, COPD, smoking, immunosuppression and chronic renal failure (8). In Senegal in 2022, Maryam Diarra et al found that patients aged over 65 and those suffering from hypertension, cardiovascular disease and diabetes were strongly associated with death (9).

In response to the first case of the pandemic in Guinea, the country has set up care facilities. According to data from the Agence Nationale de Sécurité Sanitaire (ANSS) for August 2022, 733,221 tests have been carried out in the country, of which 37,496 have been confirmed, with a positivity index of 5.1%. 37,302 patients have been hospitalized in the various CT-Epi units, of whom 36,787 have been cured, representing a cure rate of 98.1%. A total of 785 deaths due to Covid-19 were recorded, including 447 hospital deaths (10).

Despite the evidence of the association between comorbidities and the occurrence of morbidity and mortality in Covid-19- infected patients, there is insufficient information on the factors influencing the mortality of Covid-19-infected patients with comorbidities in the epidemiological treatment centers of Conakry in Guinea from 2020 to 2022. It therefore seems appropriate to analyze the factors associated with mortality in Covid-19-infected patients hospitalized in Conakry's CT-Epi from 2020 to 2022.

II. MATERIALS AND METHODS

a) Study Sites

The CT-Epi of Donka, Gbessia and Camp Alpha Yaya DIALLO served as the setting for our study. These CT-Epi are part of the six (06) epidemiological treatment centers in the capital Conakry, namely Nongo, Camp Alpha Yaya, Gbessia, Maison Centrale, Donka and Kenien. (21).

b) Study Design

Secondary data collected in the Conakry CT-Epi on patients infected with Covid-19 from 12 March 2020 to 31 December 2022 were analyzed.

c) Target Population

Suspected cases of Covid-19 who were hospitalized in three CT-Epi in Conakry, namely Donka, Gbessia and Camp Alpha Yaya during the collection period.

d) Study Population

The study population consisted of all patients infected with Covid-19 confirmed by Gold standard RT-PCR and hospitalized in CT-Epi.

e) Calculating Statistical Power

The sample size was 820 disabled people aged between 15 and 60 and the statistical power of this sample was calculated using the following parameters:

For: $n = 10\,404$

The first-species error $\alpha = 0.05$

- An expected prevalence of 0.4
- An observed prevalence of 0.5

This gives a statistical power of $(1-\beta) = 99\%$.

f) Choice of Variables

i. Dependent Variable

The dependent variable in this study was death, which was measured in people infected with Covid-19 and hospitalized at the Donka, Gbessia and Camp Alpha Yaya CT-Epi in Conakry.

ii. Independent Variables

The variables were age, sex, marital status, level of education, patient residence, diabetes alone, hypertension alone, HIV alone, TB alone, chronic respiratory diseases, associated comorbidities and epidemiological treatment centers (CT-Epi).

g) Operational Organization of Data Collection

A secondary analysis of the data collected on patients infected with COVID-19 was performed. The main objective of this study was to analyze the factors associated with mortality in patients infected with Covid-19 at the Gbessia epidemiological treatment center in Conakry, Republic of Guinea.

Ethical Considerations

Data collection was approved by the National Health Research Ethics Committee of the Republic of Guinea.

III. DATA PROCESSING

The study data were collected in the Donka, Gbessia and Camp Alpha Yaya CT-Epi in Conakry. They were used for this work. After exploration of this database, our variables were selected. The selected variables were recorded in accordance with the different predefined modalities. The dependent variable was formed from the death variable. Out of a total of 10,416 observations, twelve (12) variables (marital status,

profession, level of education and residence of patients, etc.) had missing values. Given the high proportion of missing values (over 15%), it was decided to exclude them from our analysis.

IV. DATA ANALYSIS

The first stage of the analysis was a descriptive analysis of all the selected variables. The socio-demographic characteristics of the study subjects were described. Numbers and percentages were calculated for each qualitative variable selected and compared using Pearson's chi² test.

The bivariate analysis consisted of estimating the association between the dependent variable and each of the selected independent variables using simple logistic regression. This analysis yielded crude Odds Ratios (OR) with their 95% confidence intervals (CI). A significance level of 0.2% was used to include the explanatory variables in the final model.

For the multivariate analysis, a standard multivariate binary logistic regression was used to

analyze the factors associated with mortality in patients infected with Covid-19, yielding adjusted odds ratios (AORs). A p value < 0.05 was considered statistically significant.

V. RESULTS

We included 10,404 Covid-19-infected patients hospitalized in the epidemiological treatment centers in Conakry in our analysis.

Table I presents some socio-demographic characteristics and the distribution of patients infected with COVID-19 hospitalized in the Conakry CT-EPI. Males were more represented with a proportion of 61.6%, and the 0-39 age group was the most represented with 52.4%. The Donka CT-Epi had the highest number of hospitalized patients with a percentage of 87.9%. Approximately 6% of patients had a co-morbidity.

Table I: Description of Covid-19-Infected Patients Hospitalized in Conakry's CT-Epis, 2020-2022

Variables	Number (N=10,404)	Percentage (%)
Gender		
Male	6408	61,59
Female	3996	38,41
Age (year) 0 -39		
40-59	5422	52,11
60 and over	2847	27,36
	2135	20,52
CT-EPI		
Donka	9145	87,90
Camp AlphaYaya Gbessia	749	7,20
	510	4,90
Comorbidities		
No	9778	93,98
Yes	626	6,02

Figure 3 shows the proportion of deaths among Covid-19 patients hospitalized in Conakry's CT-EPI. 6% of hospitalized patients died during the study period.



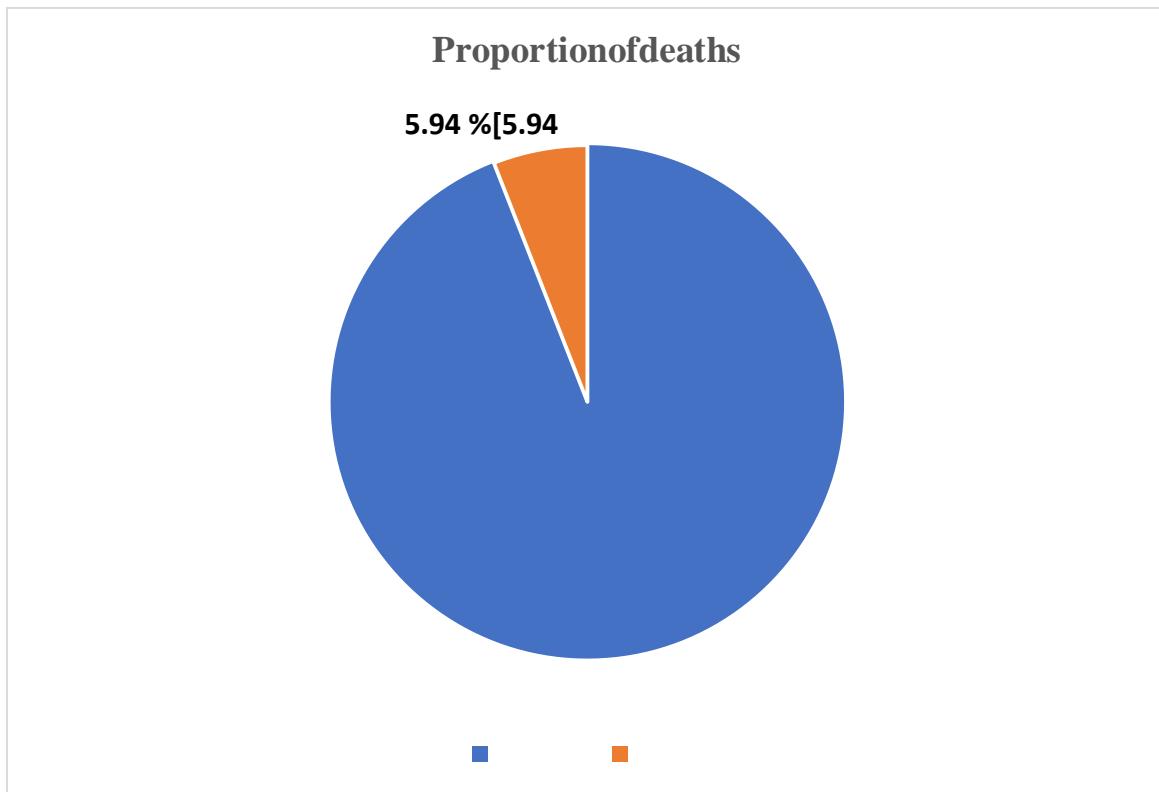


Figure 1: Proportion of Deaths among Covid-19-Infected Patients Hospitalized In Conakry's CT-EPI, 2020-2022

Table III shows the distribution of deaths among patients hospitalized in the Conakry CT-EPI according to characteristics. The age group 60 years and over was

the most represented with 66.3%. More than half (51.9%) occurred in the Gbessia CT-EPI. The proportion of deaths due to comorbidities was 43.7%.

Table II: Breakdown of Deaths among Covid-19-Infected Patients Hospitalized in Conakry's CT-EPI By Characteristics, 2020- 2022

Variables	DEATH		p
	Number (N=618)	Percentage (%)	
Gender			
Male	387	62,62	
Female	231	37,38	0,587
Age (year)			
0 -39	69	11,17	
40-59	139	22,49	
60 and over	410	66,34	<0,001
CT-EPI			
Donka	291	47,08	
Camp Alpha Yaya	6	0,97	
Gbessia	321	51,94	<0,001
Comorbidities			
No	348	56,31	
Yes	270	43,69	<0,001

Figure 4 shows the distribution of deaths by type of comorbidity. Around 45% of patients with diabetes alone died. More than a third (36.7%) of patients with cardiovascular disease alone and 36.4% of

patients with HIV alone died. Two-thirds (66.7%) of patients with tuberculosis alone died. More than half of the patients with respiratory diseases alone (53.8%) and associated comorbidities (53.9%) had died.

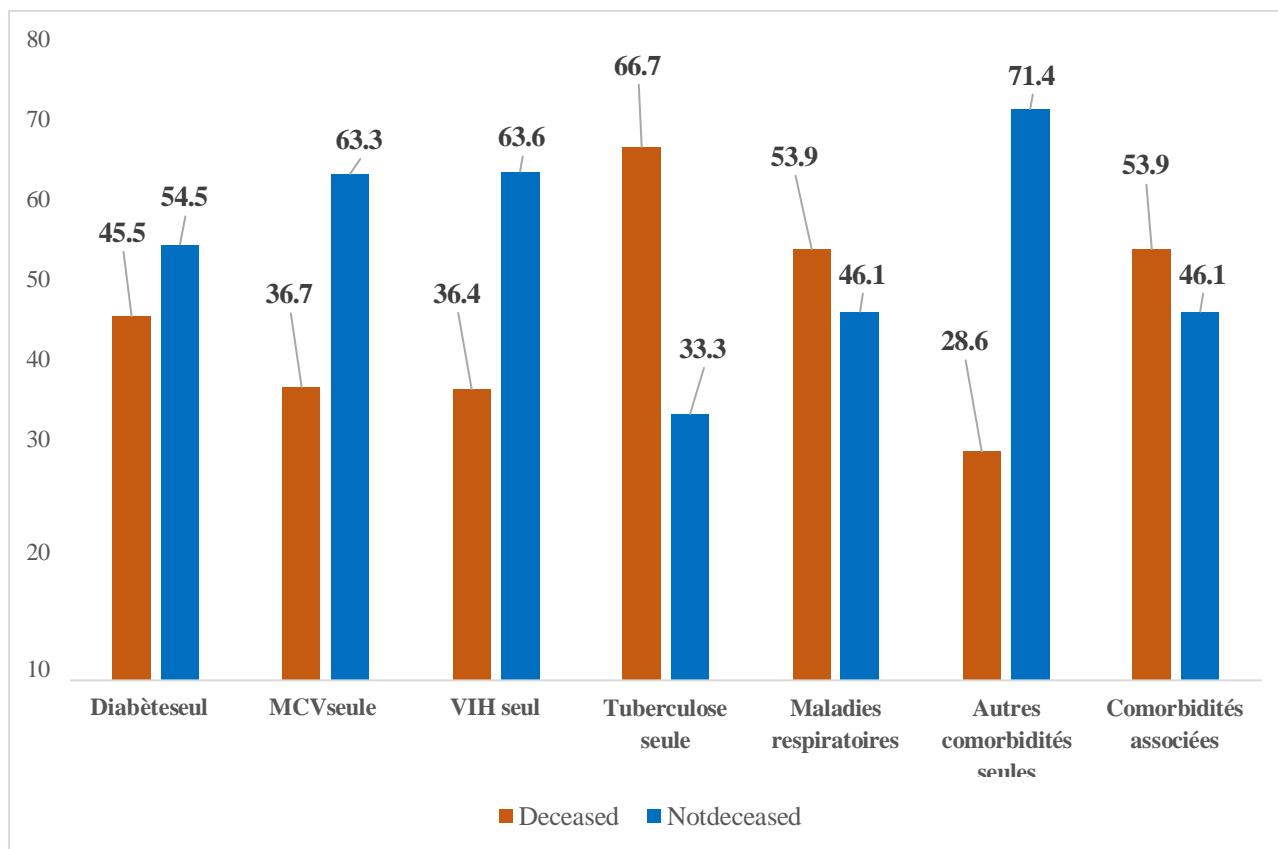


Figure 2: Proportion of Deaths by Type of Comorbidity among Covid-19-Infected Patients Hospitalized in Conakry's CT-EPI, 2020 - 2022 (N = 10 404)

Table IV shows the results of the bivariate logistic regression analysis. In the univariate analysis, the variables significantly associated with death in patients infected with Covid-19 were age, CT-Epi, diabetes alone, HIV alone, TB alone, chronic respiratory disease alone, other comorbidities alone and associated comorbidities.

Compared with Covid-19 patients aged 0-39 years, patients aged 40-59 years and 60 years and over were respectively 4 times (OR= 3.98; CI95% = 2.97 - 5.33; p= 0.000) and 19 times (OR=19.05; CI95% = 14.67 -24.72; p= 0.000) more likely to die from Covid-19. Compared with Covid-19-infected patients hospitalized at the Donka National Hospital, patients hospitalized at the Gbessia CT-Epi were 18 times more likely to die from their disease (OR=18.90; 95% CI = [13.70 - 26.08] p= 0.000). In contrast, patients hospitalized at the CT-Epi in the Alpha Yaya camp had a 75% lower probability of dying than patients hospitalized in Donka (OR = 0.25; 95% CI = [0.11- 0.55] p= 0.000).

Compared with non-diabetic Covid-19-infected patients, patients with diabetes alone had 13 times the risk of dying from Covid-19 (OR = 13.81; 95% CI = [8.45 - 22.60] p= 0.000). Compared with uninfected patients, patients infected with HIV alone were 9 times (OR = 9.21; 95% CI = [4.5 - 18.80] p= 0.000) more likely to die from their infection; patients infected with TB

alone were 32 times more likely (OR = 31.97; 95% CI = [7.98 - 128.14] p= 0.000) ; respiratory disease alone, 18 times more likely (OR = 18.67; 95% CI = [6.26 - 55.73] p= 0.000); other comorbidities alone, 6 times more likely (OR = 61.35; 95% CI = [1.23 - 32.80] p= 0.000) and associated comorbidities 22 times more likely (OR = 22.33; 95% CI = [16.74- 29.79] p= 0.000) to die from their condition.

Table III: Factors Associated with the Occurrence of Death among Covid-19-Infected Patients Hospitalized in Conakry's CT- Epi, 2020-2023 in Bivariate Analysis

Features	Crude Oddsratio (95% CI)p	
Gender		
Male	Ref.	
Female	0,95(0,81-1,13)	0,587
Age		
(year)	Ref.	<0,001
0 - 39	3,98(2,97-5,33)	<0,001
40-59	19,05(14,67-24,72)	
60 and over		
CT-EPI		<0,001
Gbessia	51,68(41,71-64,03)	<0,001
Camp Alpha Yaya Donka	0,25(0,11-0,55)	
Ref.		
Diabetes	Ref.	<0,001
alone	No	13,81(8,45-22,60)
Yes		
CVD alone	No	
Yes	Ref.	<0,001
10,79(8,33-13,99)		
HIV		
Alone	Ref.	<0,001
No	9,21(4,51-18,80)	
Yes		
TB		
only	No	31,97(7,98-128,14)
Yes		<0,001
Respiratory disease		
alone	No	Ref.
Yes	18,67(6,26-55,73)	<0,001
Other comorbidities		
alone	No	Ref.
Yes	6,35(1,23-32,80)	0,027
Associated comorbidities		
alone	No	Ref.
Yes	22,33(16,74-29,79)	<0,001

Table V shows the results of the multivariate binary logistic regression analysis in explaining the occurrence of death in Covid- 19 infected patients. The variables age, CT-Epi, diabetes alone, CVD alone, HIV alone, TB alone, chronic respiratory disease alone, other comorbidities alone and associated comorbidities were reintroduced into the multivariate logistic regression model. This final model involved 10,404 observations. The explanatory variables that were significantly associated with death at a threshold <2% were the age ranges of Covid-19 infected patients, CT-Epi, diabetes alone, HIV alone and associated comorbidities. Covid-19-infected patients in the 40-59 age bracket had a 3-fold increased risk of death (AOR = 2.99; CI95% = [2.17-4.10]; p = 0.01) and those aged 60 and over an

11-fold increased risk of death (AOR = 11.23; CI95% = [8.42-14.98]; p = 0.000) compared with Covid-19-infected patients in the 0-39 age bracket when adjusting for other factors.

Covid-19-infected patients hospitalized at the CT-Epi de Gbessia compared with those hospitalized at the Hopital National Donka had an 18-fold increased risk of death (AOR= 18.90; CI95% = [13.70- 26.08]; p = 0.000); holding other variables constant in the model. Covid-19 patients hospitalized at Camp Alpha CT-Epi had a 78% lower risk of death (AOR=0.22; 95% CI = [0.09-0.50]; p=0.000), compared with those hospitalized at Donka National Hospital. Patients with

Covid-19 associated with diabetes alone had a 5-fold increased risk of death (OR =5.20; 95% CI = [2.45-11.04]; p = 0.000) compared with those without diabetes, holding other constants in the model. Patients with Covid-19 in combination with HIV alone had a 6-fold increased risk of death (OR =6.59; 95% CI = [2.50-

17.40]; p = 0.000) compared with those without HIV, adjusting for other variables. Patients with Covid-19 and several comorbidities had a 2-fold increased risk of death (OR =2.57; 95% CI = [1.66- 4.00]; p = 0.000) compared with those without, adjusting for other variables.

Table IV: Factors Associated with the Occurrence of Death in Patients Infected with Covid-19 Hospitalized in Conakry's CT-Epi, 2020-2023, Multivariate Analysis

Features	Adjusted odds ratio (95% CI)	p
Age (year) 0 -39		
40-59	Ref.	
60 and over	2,99 (2,17-4,10) 11,23 (8,42-14,98)	<0,001 <0,001
CT-EPI		
Gbessia	18,90 (13,70-26,08)	<0,001
Camp Alpha Yaya Donka	0,22 (0,09-0,50) Ref.	<0,001 Ref.
Diabetes alone		
No	Ref.	
Yes	5,20 (2,45-11,04)	<0,001
CVD alone		
No	Ref.	
Yes	1,52(1,00-3,31)	0,052
HIV Alone		
No	Ref.	
Yes	6,59(2,50-17,40)	<0,001
Tuberculosis alone		
No	Ref.	
Yes	4,00(0,85-18,91)	0,080
Chronic respiratory diseases alone		
No	Ref.	
Yes	0,93(0,27-3,25)	0,912
Other comorbidities alone		
No	Ref.	
Yes	0,58(0,10-3,53)	0,555
Associated comorbidities		
No	Ref.	
Yes	2,57(1,66-4,00)	<0,001

VI. DISCUSSION

The general objective of this study was to analyze the factors associated with mortality in patients with Covid-19 hospitalized in the Conakry CT-Epi in the Republic of Guinea from March 2020 to December 2022.

- a) *The Overall Prevalence of Mortality in the Covid-19 Infected Population Hospitalized in the Conakry CT-EPI*

The death rate among Covid-19-infected patients hospitalized in Conakry's CT-Epi is not negligible, at 6%, but it is low compared with death rates in northern countries. This result may be linked to a

younger population, which limits the risk and number of deaths, and a favorable climate (hot and humid), which reduces viral transmission. This death rate could be underestimated by the fact that several cases of death were notified at community level and were not included in the total number of deaths occurring in the CT-Epi.

This result is similar to those found by certain researchers in Africa, who reported the same realities in 2020, with an even lower number of deaths per standardized population (22). Although reduced, the trend is identical for North Africa, which has 5 times fewer cases and 10 times fewer deaths per standardized population than the regions of Europe (22). Other studies have documented the overall mortality of patients infected with Covid-19 at 5%, which is close to our result (23).

Overall prevalence of mortality due to comorbidities in Covid-19 patients hospitalized in Conakry's CT-EPIs In our analysis, we found high proportions of co-morbidities among patients who died of Covid-19 in the Conakry CT-Epi. This could be explained by the realities of African countries, with the epidemiological transition from infectious diseases to chronic diseases and the precarious health situation. Our results are in line with previous research which has shown a high proportion of co-morbidities in patients who die of Covid-19. A study conducted in South Africa by Waasila Jassat et al (24) reported that in 2022, 37.4% of patients who died from Covid-19 had hypertension, 27.4% had diabetes, 9.1% were living with HIV, 3.6% had tuberculosis (24).

Laura Skrip et al demonstrated in Burkina Faso in 2020 that the presence of underlying conditions was high among cases of death in Covid-19 patients. They also pointed out that almost half of confirmed Covid-19 cases had a history of hypertension (45.5%), diabetes (21.2%) or other cardiovascular or pulmonary conditions, such as stroke, embolism or heart disease (9.1%). (7).

Factors associated with the occurrence of death in patients infected with COVID-19 hospitalized in the Conakry CT-Epi, multivariate analysis.

With regard to the risk factors for death associated with Covid-19 infection in patients, our study showed that the age groups of patients infected with Covid-19, the epidemiological treatment centers in Conakry (CT-Epi), diabetes alone, HIV alone and associated comorbidities accounted for this high case-fatality rate.

In our analysis, age groups appear to be risk factors for death among Covid-19 patients, with a more pronounced emphasis on the 60+ age group, which is 11 times more likely to die. In our context, this excess mortality among elderly patients could be explained by the association of co-morbidities in elderly subjects, which would contribute to a decline in immunity and precarious health conditions. In Mali,

Bourahima Koné et al found that the age group [65-75] was the most affected, with 31.06%. (25). Kombila U. D. et al in Gabon in 2022, found that age over 65 was the main independent risk factor for death ($p < 0.001$; OR = 4.632 IC95% [2.243-9.565]) (26). Other authors have also shown clear evidence for the association between mortality in Covid-19 patients and age and have also explained that age is a risk factor for mortality (27).

The epidemiological treatment center (CT-Epi de Camp Alpha Yaya) appears in our study to be a protective factor for hospitalized patients infected with Covid-19. However, another treatment center (CT-Epi de Gbesia) appears to be a risk factor for patients. It should be noted that we did not find any data in the scientific literature concerning the treatment centers for hospitalized patients infected with Covid-19. However, it should be noted that the CT-Epi at Camp Alpha Yaya did not have a resuscitation unit for the management of severe cases, so all severe cases from the CT-Epi at Camp Alpha Yaya were referred to the CT-Epi at Gbessia.

According to a multicenter study carried out by the World Health Organization (WHO) in 2020, prevention and treatment services for non-communicable diseases (NCDs) with co-morbidities have been severely disrupted since the start of the Covid-19 pandemic. This study was carried out in 155 countries by the WHO, which confirms that the impact is global, but that low-income countries in sub-Saharan Africa are the hardest hit. Health services have been partially or completely disrupted in many countries. This situation exposes patients suffering from NCDs (diabetes, arterial hypertension, heart disease, kidney disease, obesity, etc.) to the risk of serious illness and death due to Covid-19. In more than half (53%) of the countries responding to the survey, hypertension treatment services are partially or totally disorganized; in 49% of countries, services for treating diabetes and its complications are disorganized; in 42% of countries, cancer treatment services are disorganized; and in 31% of countries, cardiovascular emergency services are disorganized. (28).

In Yaoundé, Mendimi Nkodo J.M et al also explained in their analysis that the risk of death was higher in infected patients with a combination of comorbidities such as arterial hypertension, diabetes, cardiovascular disease, obesity, chronic kidney disease, tuberculosis, HIV, etc., which undoubtedly explains the systemic dysfunction of the blood microcirculation in the lungs and other organs. (29).

A study carried out in South Africa by Waasila Jassat et al (24) reported that among patients who died in 2022 from Covid-19: 37.4% had hypertension, 27.4% had diabetes, 9.1% were living with HIV and 3.6% had tuberculosis. It also found that other associated factors were chronic heart disease, chronic kidney disease, etc.

(24). For Peter et al in South Africa in 2020, the triple burden of Covid-19, tuberculosis and the human immunodeficiency virus is one of the major global health challenges of the 21st century. Tuberculosis is a risk factor for Covid-19 in terms of both severity and mortality (30).

VII. LIMITATIONS OF THE STUDY

Our study was based on collected data, and we came up against shortcomings in filling in the forms, which made it impossible to use information on gender, level of education, profession, economic level and place of residence. The type of study used in our work is a cross-sectional survey which makes it possible to establish an association between death and the various explanatory variables but cannot establish a causal link. Despite its limitations, this study has the merit of laying the foundations for an analysis of the factors associated with death in Covid-19-infected patients hospitalized in the epidemiological treatment centers in Conakry.

VIII. CONCLUSION

Our study determined the factors associated with the occurrence of death in Covid-19-infected patients hospitalized in the Conakry epidemiological treatment centers from 2020 to 2022. The age groups of patients infected with Covid-19, the epidemiological treatment centers in Conakry (CT-Epi), diabetes alone, HIV alone and associated comorbidities are variables that influence the occurrence of death in patients infected with Covid-19. Further quantitative and qualitative research is needed to determine the best means of correctly measuring and also determining the factors associated with death in patients with co-infection comorbidities and Covid-19, who constitute a vulnerable population.

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