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Real-Time Surveillance of SARS-COV-2 Infection in the South-East Health Region in Gabon, Central Africa

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Abstract

This study aimed to describe the near-real-time characteristics of SARS-Cov-2 positive cases in Haut-Ogooué province in the context of the COVID-19 pandemic. From May 5, 2020, to August 18, 2021, 16,309 patients who sought consultation at hospitals in the region were included. RNA was extracted and molecular analyses were performed from nasal and throat swabs. Statistical analysis was performed using SPSS software. Out of the 16,309 patients included, 2,880 were positive for SARS-CoV-2 (17.7%). Most of them were from from Passa (Franceville) 1,874 (65%) and Lébombi-Léyou (Moanda) 932 (32.4%). The prevalence of SARS-CoV-2 infection was associated with age group, clinical status at baseline, symptomatic cases being more common in the elderly, professional activity and comorbidities. Patients with comorbidities exhibited a more unfavorable prognosis. Multiple comorbidities were associated to poorer clinical outcomes. Early detection of COVID-19 was crucial in Haut-Ogooué for identifying confirmed positive cases and preventing further spread of the virus.

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Surveillance; SARS-CoV 2;
COVID-19; Haut-Ogooué; Gabon.

Introduction

Since December 2019, there has been an outbreak of COVID-19, an unknown origin pneumonia, in Hubei province, China. This outbreak has raised global concerns about its transmission capacity, severity, and mortality rate (1). In response, various strategies have

been implemented, such as lockdown measures, home isolation, quarantine measures, mask-wearing, and social distancing (2). Through laboratory research studies, Chinese scientists have identified the cause of this severe acute respiratory syndrome as coronavirus 2 (SARS-CoV-2) (3, 4). However, different countries have faced challenges in successfully combating this virus, as

evidenced by the variability in SARS-CoV-2 prevalence (2). Gabon has taken on the challenge of establishing and implementing SARS-CoV-2 genomic surveillance, reporting the detection of SARS-CoV-2 variants in 81.1% of tested samples. Among these variants, the British variant (B.1.1.7) accounted for 40% of cases, the B.1.525 variant for 32% of cases, the South African variant (B.1.351) for 6% of cases, and the Indian variant for 3% (5). In Gabon's fight against SARS-CoV-2, their strategies include SARS-CoV-2 PCR testing, contact tracing, and treatment (5). This study aimed to provide an overview of the near real-time surveillance of SARS-CoV-2 infection in the Haut-Ogooué region of Gabon's Southeast health region (Figure 1).

Material and Methods

Study design, patients and ethical considerations

This multicenter study took place from May 5, 2020, to August 18, 2021, in the Haut-Ogooué Region, covering the surveillance and response to COVID-19 since the first case emerged in Haut-Ogooué (South-East Gabon). Haut-Ogooué, one of Gabon's nine regions with a 2013 population of 250,799, is the second most populous after Estuaire. Its capital, Franceville, and its economic hub, Moanda, lie within a 36,547 km² area characterized by forest-covered plateaus. Located in eastern Gabon, Haut-Ogooué borders the Republic of Congo and is divided into 11 departments: Djoué (Onga), Djouori-Agnili (Bongoville), Lékon-Lékori (Akiéni), Lékoko (Bakoumba), Lemboumbi-Leyou (Moanda), Passa (Franceville), Plateaux (Lékoni), Sébé-Brikolo (Okondja), Ogooué-Létili (Boumango), Lékabi-Léwolo (Ngouoni), and Bayi-Brikolo (Aboumi). The health region is managed by a Regional Health Directorate (DRS). The study included 16,309 patients, with suspected, probable, and confirmed SARS-CoV-2 cases defined per WHO criteria for those seeking care in Haut-Ogooué region during the study. We used data from the routine epidemiological surveillance system within the epidemiological and endemic control base (BELE), which receives all signals from the health region, and oral consent was obtained from each participant or their legal guardian during the consultation.

Diagnosis

Nasal and throat swabs were collected from each patient. RNA was extracted using the QIAamp® Viral RNA Mini Kit, adhering to the manufacturer's recommendations (Qiagen, Courtaboeuf, France).

Nucleic acids were detected using real-time PCR and confirmed by next-generation sequencing, the gold standard for COVID-19 diagnosis.

Data collection and statistical analysis

Overall, data collection was done through an epidemiological tool locally developed called *Surveillance Syndromique des Maladies Infectieuses à Potentiel Epidémique* (SuSyMIPE), (6). Surveillance relied on daily notification data gathered during consultations by general practitioners at each site. The data collected at each site were utilized to monitor trends in febrile influenza-like illness (FIA) or non-febrile illness, reported by the number of cases meeting the case definition and the total number of daily patient visits to the emergency department. These data included demographic (sex, age), professional activity and clinic variables, such as patient hospital identification numbers, all of which were collected and generated by medical staff and routinely recorded from a questionnaire administered by the Health Ministry and WHO. A data manager at the provincial coordination level oversaw the data set. The CIRMF laboratory sent data daily and anonymously to the Regional Epidemiology Unit of Haut-Ogooué, enabling a high level of reactivity at the Epidemiological Base to combat Great Endemics, adapt assistance according to alerts, and to follow up and potentially investigate direct contact cases directly.

Data were logged in Microsoft Excel 2022. Statistical analyses were conducted using IBM SPSS Statistics version 20 software (United States). Categorical and quantitative variables were described by proportions and means, respectively. The chi-square test was employed to compare proportions of categorical variables. For counts less than five, Fisher's exact test was used. A p-value of less than 0.05 was considered statistically significant.

Results and Discussion

SARS-COV-2 infection

Out of 16,309 suspected cases, 2,880 samples tested positive for SARS-CoV-2 (17.7%) during the study period (Table 1).

The patients were 1 614 males and 1 266 females, resulting in a sex ratio M/F of 1.27. COVID-19 patients were identified across eleven departments of the South-East health region (Haut-Ogooué). Of the 2,880 patients, 932 (32.4%) were reported in Lébombi-Léyou

(897 in Moanda), 1,874 (65%) in Passa (Franceville), 33 (1.14%) in Lékoko (Bakoumba), 12 (0.42%) in Sébé-Brikolo (Okondja), 10 (0.3%) in Lékabi-Léwolo (Ngouoni), 8 (0.28%) in Djouori-Agnili (Bongoville), 5 (0.2%) in Lékoni-Lékori (Akiéni), 4 (0.1%) in Ogooué-Létili (Boumango), and 2 (0.07%) in Plateaux (Leconi).

Evolution of SARS-COV-2 infection in the region

The index case was an asymptomatic 49-year-old man with comorbidity living in Franceville, who was reported on 6 May 2020 (Fig 2), during the 19th week of the year. Within the following week, 136 new cases were detected, with 134 in the Passa department, accounting for 97.8%, and 2 cases, or 2.2%, in Lébombi-Léyou. A significant rise in daily case numbers began on May 6, 2020. The incidence rate of confirmed cases peaked in the 20th week with 159 cases, then steadily declined to zero by mid-August 2021, in the 32nd week.

Evolution of SARS-COV-2 infection according age

Table 1 presents the age distribution of confirmed cases, highlighting a peak in the 25-49 year age group. During Haut-Ogooué's second outbreak, this age group constituted the majority at 64.8%. The male-to-female sex ratio was 1.27, with an average age of 37 years, ranging from 3 to 91 years, including 172 children under 15. Table 2 indicates that the incidence of SARS-CoV-2 infection was significantly associated with age group ($p < 0.001$), clinical status at the first visit, with symptomatic forms more common among the elderly ($p < 0.019$), professional activity ($p < 0.001$), and comorbidities ($p < 0.027$).

Comorbidity with SARS-CoV-2

Deaths from SARS-CoV-2 were notably higher in elderly patients with comorbidities. Specifically, 16 out of 70 (22.8%) patients with comorbidities passed away in the South East Health Region, according to the analyzed clinical records. Only 1 of the 16 deceased patients (6.2%) had no associated pathology, while an overwhelming 69 out of 70 (98.6%) had one, two, or at least three chronic diseases. The comorbidities included hypertension, diabetes, and respiratory diseases. Figure 3 illustrates that the most prevalent comorbidities were hypertension (45%), diabetes (18.3%), combined hypertension and diabetes (11.6%), and hypertension with obesity (3.3%), with the remaining conditions comprising 21.8%. cardiovascular disease, particularly

hypertension, was the most commonly reported comorbidity. Among the 16 patients who died, 12 (75%) were over the age of 50. The case fatality rate escalated with age. The gender ratio of male to female among the deceased was 1.28, with an average age of 60 years (ranging from 46 to 83 years), including 3 who were over the age of 50. Out of these 16 patients, 15 had comorbidities. Notably, 10 out of the 16 patients (62.5%) were admitted to the intensive care COVID (SICOV) unit of the AMISSA BONGO Regional Hospital in Franceville, where they were hospitalized for several days in poor general clinical condition.

SuSyMIPE has been implemented at CIRMF to enable the automatic detection in near real-time of any abnormal event related to potential epidemic infectious diseases (6). Over six years, SuSyMIPE has been a simple, versatile, and scalable tool, applicable to any infectious syndrome, capable of processing a significant amount of data. Moreover, our tool has been effective for real-time surveillance of identifiers using both syndromic and traditional surveillance methods. SuSyMIPE has been instrumental in detecting known seasonality or expected events related to infectious diseases with epidemic potential, providing primary notifications of abnormal events, including measles outbreaks (6).

As Covid-19 emerged, the country swiftly entered a state of control over the new infectious disease. Policies led by the Steering Committee of the Plan for Monitoring and Control of the Coronavirus Pandemic in Gabon (COPIL) were formulated and effectively implemented. However, new cases are increased daily in the South-East health region, indicating a spread to all health departments, although only 9 out of 11 have been reached so far. These results have been instrumental in informing clinicians, regional and national public, as well as private health institutions. This is a comprehensive descriptive study on the real-time epidemiological surveillance of cases and clinical characteristics of SARS-CoV-2, including data from 2880 patients notified daily in health service-carriers of the Haut-Ogooué region. Males were more infected by SARS-CoV-2 than females, as previously reported for MERS-CoV infections. Overall, the prevalence of SARS-CoV-2 was 17.7% in the study population. The age group most infected was 25-49 years old (64.8%) while younger (<15 years-old) and elderly were less infected. A previous study conducted in 2021 in 3464 people in Libreville reported a nearly prevalence of 17.2% (7).

Table.1 Demographic characteristics and individual positive factors for Sars-Cov-2 in the Southeast health region between May 2020 - August 2021. N = 2 880¹

Sex	<i>n</i> (%) ¹
M	1 614 (56.0)
F	1 266 (44.0)
Occupation	
Administrative	1 040 (36.1)
Artisan	78 (2.7)
Defense force	626 (21.7)
Driver	35 (1.2)
Health professional	140 (4.9)
Kindergarten	2 (0.1)
Retired	39 (1.4)
Student	450 (15.6)
Trader	347 (12.0)
Without	123 (4.3)
Age group	
≤15	37 (13)
16 -24	172 (6.0)
25 - 49	373 (13.0)
50 and old	1 866 (64.8)
469 (16.2)	
Exposition	
Community case	2 871 (99.7)
Unknown	9 (0.3)
Health departments	
Akiéni	5 (0.2)
Bakoumba	33 (1.1)
Bongoville	8 (0.3)
Boumango	4 (0.1)
Fcv	1 874 (65.1)
Léconi	2 (0.1)
Moanda	897 (31.1)
Mounana	35 (1.2)
Ngouoni	10 (0.3)
Okondja	12 (0.4)
Clinical situation at entry	
Asymptomatic	2 847 (98.9)
Moderate	10 (0.3)
Paucisymptomatic	12 (0.4)
Severe	3 (0.1)
Symptomatic	8 (0.3)
Comorbidities	
Asthma	4 (0.1)
Asthma + Diabetes	2 (0.1)
Cardiopathy	2 (0.1)
Diabetes	10 (0.3)
Diabetes NID	1 (0.0)
Epilepsy	1 (0.0)
HTA	26 (0.9)
HTA + AT	1 (0.0)
HTA + Cardiopathy	1 (0.0)
HTA + Diabetes	8 (0.3)

HTA + Maternity	1 (0.0)
HTA + Obesity	2 (0.1)
HTA + renal failure	1 (0.0)
None	2 807 (97.6)
Pneumonia	1 (0.0)
Pregnant women	6 (0.2)
Sinusitis	1 (0.0)
Surpoids/Insuf.Veineuse	1 (0.0)

Table.2 Relationship between gender and associated factors between May 2020 - August 2021, in the Haut-Ogooue, Gabon

	Female, N = 1 266 ^I	Male, N = 1 614 ^I	<i>p</i> -valeur ²
Occupation			
Administrative	43,4% (451)	56,6% (589)	
Artisan	39,7% (31)	60,3% (47)	
Defense force	43,1% (270)	56,9% (356)	
Driver	11,4% (4)	88,6% (31)	
Health professional	58,6% (82)	41,4% (58)	
Kindergarten	0,0% (0)	100,0% (2)	
Retired	51,3% (20)	48,7% (19)	
Student	48,7% (219)	51,3% (231)	
Trader	38,6% (134)	61,4% (213)	
Without	44,7% (55)	55,3% (68)	
Age	36 (14)	37 (13)	0,007
CI_Age			<0,001
"<=15"	57,6% (99)	42,4% (73)	
"(16-24)"	44,8% (167)	55,2% (206)	
"(25-49)"	43,8% (818)	56,2% (1 048)	
"50 and more"	38,8% (182)	61,2% (287)	
Exposition			>0,9
Community case	44,0% (1 262)	56,0% (1 609)	
Unknown	44,4% (4)	55,6% (5)	
Residence			
Akiéni	40,0% (2)	60,0% (3)	
Bakoumba	27,3% (9)	72,7% (24)	
Bongoville	75,0% (6)	25,0% (2)	
Boumango	25,0% (1)	75,0% (3)	
Fcv	43,1% (808)	56,9% (1 066)	
Léconi	50,0% (1)	50,0% (1)	
Moanda	45,8% (411)	54,2% (486)	
Mounana	45,7% (16)	54,3% (19)	
Ngouoni	30,0% (3)	70,0% (7)	
Okondja	75,0% (9)	25,0% (3)	
Clinical situation at entry			0,8
Asymptomatic	43,9% (1 249)	56,1% (1 598)	
Moderate	50,0% (5)	50,0% (5)	
Paucisymptomatic	41,7% (5)	58,3% (7)	
Severe	66,7% (2)	33,3% (1)	

Symptomatic	62,5% (5)	37,5% (3)	
Comorbidities			0,027
Asthma	75,0% (3)	25,0% (1)	
Asthma + Diabetes	100,0% (2)	0,0% (0)	
Cardiopathy	50,0% (1)	50,0% (1)	
Diabetes	40,0% (4)	60,0% (6)	
Diabetes NID	100,0% (1)	0,0% (0)	
Epilepsy	100,0% (1)	0,0% (0)	
HTA	57,7% (15)	42,3% (11)	
HTA + AT	0,0% (0)	100,0% (1)	
HTA + Cardiopathy	0,0% (0)	100,0% (1)	
HTA + Diabetes	37,5% (3)	62,5% (5)	
HTA + Maternity	100,0% (1)	0,0% (0)	
HTA + Obesity	50,0% (1)	50,0% (1)	
HTA + renal failure	0,0% (0)	100,0% (1)	
None	43,6% (1 223)	56,4% (1 584)	
Pneumonia	100,0% (1)	0,0% (0)	
Pregnant women	100,0% (6)	0,0% (0)	
Sinusitis	100,0% (1)	0,0% (0)	
Surpoids/ Insuf.Veineuse	100,0% (1)	0,0% (0)	
TID	0,0% (0)	100,0% (1)	
Manquant	2	1	
¹ % (n); Mean (SD)			
² Student's test; chi-square test of indépendance; Fisher's exact test			

Figure.1 Map of the departments of the Haut-Ogooué health map.

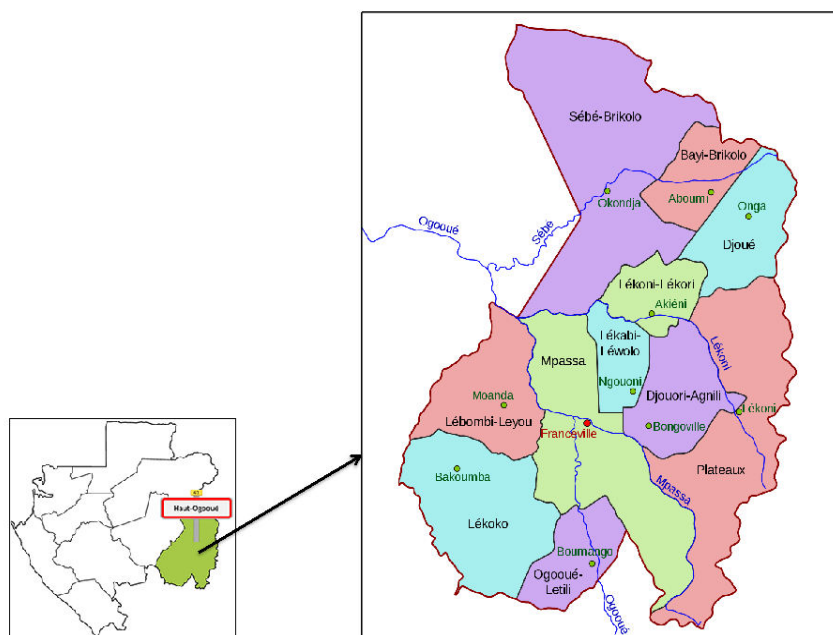


Figure.2 Trends over time in the number of SARS-CoV-2 positive cases in all affected departments in the Southeast health region between May 2020 - August 2021, in the Haut-Ogooue, Gabon

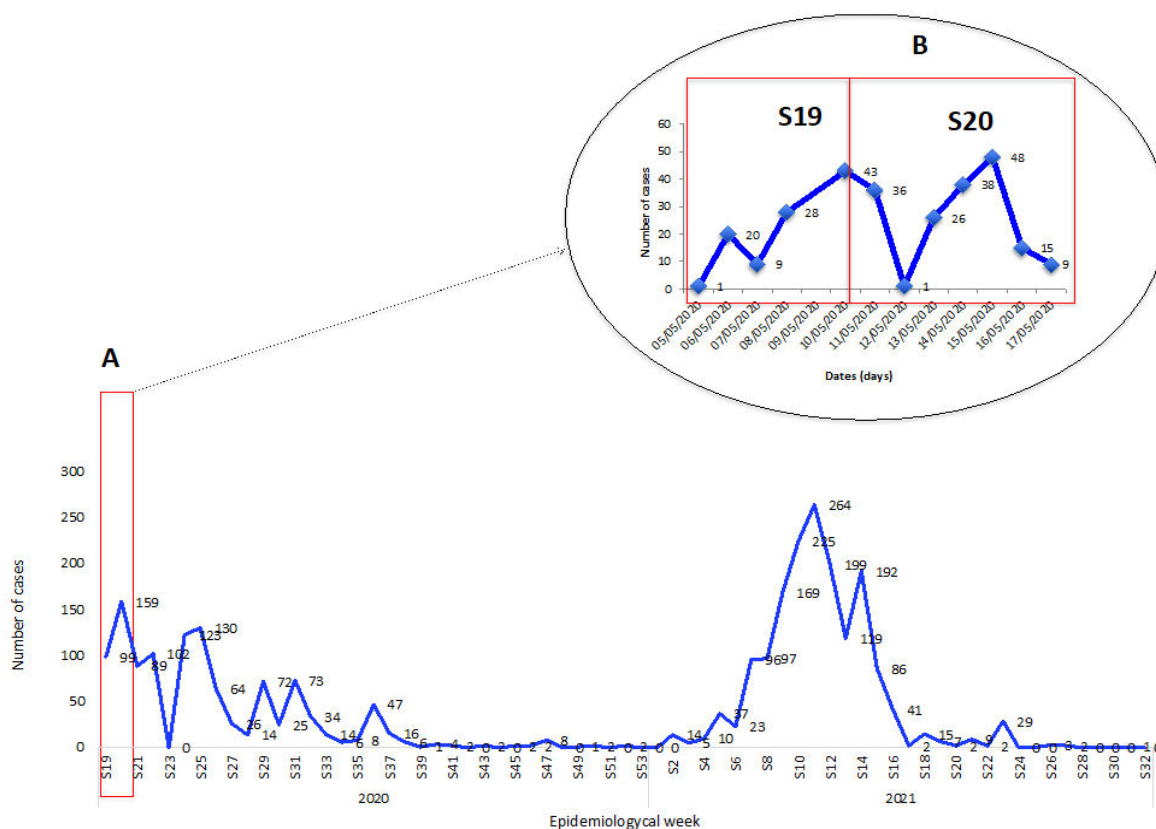
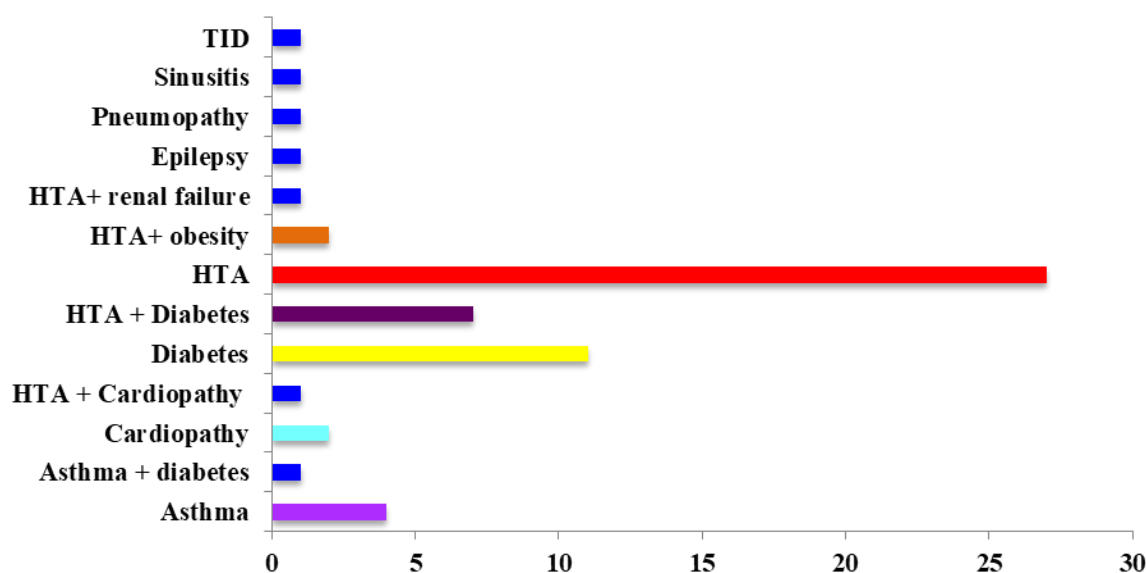


Figure.3 Distribution of COVID-19 positive cases according to type of comorbidities between May 2020 - August 2021 of Haut-Ogooué province, Gabon..



SARS-CoV-2 infection was more found in young and middle-aged adults 88.4%, followed by children 7.7% and 3.8% (7). That supported that young and middle-aged adults contribute to important community transmission of COVID-19 (7). The lowest rate of infection (8%) was observed in the elderly and children (13%), whereas the highest infection rate was observed in young and middle-aged adults (~19%), (7). That should be explain by the fact that, in Gabon, children, young and middle-aged adults represent, respectively, 4%, 40% and 56% of the population (7). That can be add to the population activity (young and middle-aged are more active) and the strong measures to protect the most vulnerable persons including total confinement, mask wear in public places, cases close contact cases quarantine (7). However, the average age of infected patients for SARS-CoV-2 in our study of (37-year-old) is lower than that observed respectively in developed countries such as France (8, 9).

Additionally, this study show that in the South-East health region in Gabon (Haut-Ogooué province), Franceville and Moanda were the health departments most concerned by SARS-CoV-2 infections with 65.1% and 31.1% of infected patients, respectively. These two areas are more urban, thus demography, population density add to socio-economic activities causing travels and mobility are more important and participate to an intense spread of the virus.

SARS-CoV-2 is more likely infected elderly men with comorbidities, due to weakened immune functions. Most prevalent comorbidities were hypertension (45%), diabetes (18.3%), combined hypertension and diabetes (11.6%), and hypertension with obesity (3.3%).

In our study the rate of asymptomatic patients was 98.9%. In African context, the literature reported that nearly 70% of SARS-CoV-2 positive subjects are asymptomatic, 29% showed mild to moderate symptoms (influenza-like symptoms associated with anosmia and ageusia) and only 2% presented severe symptoms (mild dyspnea) and 1% showed critical symptoms (respiratory failure) and died (7). The selected features of SARS-CoV-2 in this African context are in some aspects similar but in others different to what was observed elsewhere (7). Except for the report from the Tuscany region of Italy (50–75% of asymptomatic cases), (10), the proportion of SARS-CoV-2 positive asymptomatic cases in our context is different from what is observed in developed countries (11, 12). The level of comorbidities in SARS-CoV-2 infected persons was relatively low in

our setting (2.4%). Only 0.3% of SARS-CoV-2 infected persons had diabetes, one of the first factor that heightens COVID-19 related morbidity and mortality (13). Gabon is both an example of Africa's resilience to COVID-19 and an illustration that the early detection of asymptomatic cases strategy allows efficient control of the pandemic.

In summary, patients with severe COVID-19 or those admitted to intensive care have shown higher mortality rates. However, this study has some limitations. Firstly, it included only 2,880 patients with confirmed SARS-CoV-2 infection, excluding suspected but undiagnosed cases from the analysis. Including as many patients as possible from the southeast and other cities in Gabon would provide a better understanding of the SARS-CoV-2 infection. Secondly, more detailed patient data, including clinical outcomes, were not available at the time of analysis. Nevertheless, this study offers a near real-time assessment of the epidemiological characteristics of SARS-CoV-2 in the Haut-Ogooué region.

In conclusion, COVID-19, a novel viral infection, has emerged as a significant public health challenge. The rapid rise in patient numbers during 2020-2021 in Haut-Ogooué was largely attributed to community spread. Notably, transmission surged in the Passa department of Franceville and neighboring areas like Lebombi-Leyou (Moanda-Mounana). Consequently, while most COVID-19 cases are mild, it is crucial to vigilantly monitor the elderly and those with pre-existing health conditions. This study indicates that the progression of near-real-time monitoring of SARS-CoV-2 infections is vital in the ongoing fight against COVID-19.

Authors' Contributions

PNSOE and JBLD designed the study. PNSOE, SELD, GM, AN, SB, SD, ND managed the data. PNSOE, GM and JBLD carried out the statistical analysis. All the authors collaborated in interpreting the results and writing and revising the report.

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Ethical Approval

The data presented in this study were obtained as part of national surveillance efforts for which ethical approval is not required under Gabonese law on the surveillance of notifiable diseases.

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Declaration of interests

Authors declare no competing interests.

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