Epidemiological, clinical Characteristics and mortality of patients Infected with SARS-CoV-2 Admitted to Kinshasa University Hospital (KUH), the Democratic Republic of the Congo from March 24th, 2020, to January 30th, 2021: Two waves, two faces?

Caractéristiques épidémiologiques, cliniques et mortalité des patients infectés par le SRAS-CoV-2 admis aux Cliniques Universitaires de Kinshasa, République démocratique du Congo du 24 mars 2020 au 30 janvier 2021 : Deux vagues, deux visages ?

Madone Ndona Mandina[1], Jean-Robert Rissassy Makulo[1], Roger Di-Mosi Wumba[1], Ben Bepouka[1], Jerome Ossam Odio[1], Aliocha Natuhoyila Nkodila[2], Murielle Mashi Longokolo[1], Nadine Ngongo Mayasi[1], Donatien Mangala[1], Guyguy Kamwiziku[1], Auguy Luzayadio Longo[1], Guillaume Mpia[1], Yamin Kokusa[1], Hervé Keke[3], Marcel Mabimbi Mbula[1], Hippolyte Nani Tuma Situakibanza[1], Ernest Kiswaya Sumaili[1], Jean-Marie Ntumba Kayembe[1,3]

Corresponding author
Ben Bepouka, MD
Courriel : ben.bepouka@unikin.ac.cd

Résumé

Contexte et objectif. Comme toutes les épidemies, la pandémie à COVID-19 sévit en plusieurs vagues très diversifiées. L'étude a comparé les caractéristiques démographiques et cliniques ainsi que la mortalité des patients entre la 1ère et la 2ème vague de COVID-19. *Méthodes*. Il s'agissait d'une étude de suivi historique réalisée aux Cliniques Universitaires de Kinshasa entre mars 2020 et janvier 2021. Le test de χ^2 a permis la comparaison des proportions, et la la survie a été étudiée par la méthode de Kaplan Meier. L'identification dess prédicteurs indépendants de la mortalité a été déterminée par la régression de Cox. *Résultats*. Des 411 patients enrôlés, ceux de la 2ème vague étaient beaucoup plus âgés ((58,1 ±15,7 vs 52,4 ±17,5 ; p=0,026). La 1ère vague a été plus meurtrière que la seconde (p=0,009). La survie était plus réduite dans la première vague par rapport à la seconde. Les facteurs prédictifs de mortalité présents à la fois dans la première et la deuxième vague étaient la détresse respiratoire et le stade COVID-19 sévère. *Conclusion*. La 1ère vague était plus meutrière que la 2ème avec comme prédicteurs indépendants la détresse respiratoire et le stade COVID-19 sévère dans les deux vagues. Le renforcement du système de santé et la sensibilisation sur les mésures préventives dont la vaccination devraient continuer à maintenir les gains.

Mots-clés : SRAS-COV-2, mortalité, République démocratique du Congo, 2 vagues
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1 KUH, University of Kinshasa, DRC
2 Unit of Vaccinology, WHO, DRC
3 Technical Secretariat against Covid-19, DRC

Summary

Context and objective. Like all epidemics, the COVID-19 pandemic occurs in several highly diverse waves. The objective of the present study was to compare the demographic and clinical characteristics and mortality of patients between the first and second waves of COVID-19. *Methods*. This was a historical follow-up study conducted at the Kinshasa University Hospital (KUH) between March 2020 and January 2021. We used the χ^2 test to compare proportions. Survival was described by the Kaplan Meier method. Cox regression was used to identify independent predictors of mortality. *Results*. A total of 411 COVID-19 patients were enrolled. Compared to wave 1 patients, wave 2 patients were significantly older (52.4 ±17.5 vs. 58.1 ±15.7; p=0.026). The death rate of patients in the first wave was higher than in the second wave (p=0.009). Survival was more reduced in the first wave compared with the second wave. Predictors of mortality present in both the first and second waves were respiratory distress and severe COVID-19 stage. *Conclusion*. The first wave was more lethal than the second wave with respiratory distress and severe COVID-19 stage as independent predictors in both waves. Strengthening the health system and raising awareness of preventive measures including vaccination should continue to sustain gains.

Keywords: SARS-COV-2, mortality, Democratic Republic of Congo, 2 waves

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Introduction

Beginning in December 2019 in China, the coronavirus disease 2019 (COVID-19) caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has spread rapidly around the world and was declared a pandemic on March 11th, 2020 (1). By the end of January 2021, there had been 103500950 confirmed cases worldwide, including 2240771 deaths, with a lethality rate of 2.2%. Africa was largely spared by the pandemic initially, unlike the countries of the West. However, since December 2020, the COVID-19 seems to have hit harder in a hitherto relatively untouched Africa. Indeed, the number of infected people and deaths has increased since the beginning of December 2020. At the end of January 2021, there were officially a total of 3.3 million infected people on the continent, 700000 more than three weeks ago, according to data from World Health Organization WHO (2). However, the number of infections and mortality was still much lower than in Europe or the United States (3).

The Democratic Republic of Congo (DRC) recorded its first confirmed case on March 10, 2020, and, undoubtedly, by a simple coincidence, the day after the declaration of this first case, the disease was officially declared a "pandemic" by the WHO (1). On March 24th, the DRC proclaimed a state of emergency, which included travel limitations, and on April 6th, the initial COVID-19 hotspot, Gombe, an affluent health zone in Kinshasa, and other designated sections of the country were placed under lockdown (4). Since then, the number of COVID-19 cases has risen to 4,258 as of June 11th, 2020, with 90 deaths (case fatality rate of 2.1%) (5). For obvious reasons of economic constraints linked to poor countries, total containment as applied in the West could not be recommended (6). In the first wave, the studies conducted showed that the median age of the patients was around 50 years. The most frequent comorbidities were hypertension, diabetes, and obesity. Fever, cough, and shortness of breath were the most frequent symptoms on admission. Severe patients were older and more likely to have comorbidities than mild patients. The in-hospital mortality rate ranged from 13-30 % (7-8). In November 2020, an upward trend in cases was observed in the following months, confirming a second wave of the pandemic linked to COVID-19, similar to that observed in Europe (9).

Among the COVID-19 Treatment Centers (COTCs) in the City province of Kinshasa, the COTC of the Kinshasa University Hospital (KUH) opened in March 2020, which, in the meantime, has seen its technical facilities improve considerably with better-prepared staff. The following question is recurrent and rather legitimate: what is the difference between these two waves? As the context and the strategies implemented at the country and COTC levels are not the same, comparing the two waves could yield interesting information. The objective of the present study is to establish a comparison between the first and the second waves of demographic and clinical characteristics as well as mortality and its determinants.

Methods

Study design and period

We studied a series corresponding to all cases of COVID-19 hospitalized in a treatment center in the City of Kinshasa, the epicenter of COVID-19 in the DRC between March 24th, 2020, and January 31st, 2021. All patients admitted up to June 30th were considered to be in the first wave and all those admitted on or after July 1st were in the second wave. Every wave lasted three and a half months. This retrospective cohort study was conducted in a large COTC located at the KUH, a hospital attached to the country's largest university, the University of Kinshasa (UNIKIN). This COTC has a capacity of 50 beds with a permanent staff specializing in Intensive Care and Infectious Diseases and has a medical biology laboratory capable of diagnosis by RT-PCR. The COVID-19 center can also provide emergency hemodialysis, interventional endoscopies, and chemotherapy to COVID-19 patients with cancer.

Study population

The study population included all patients admitted at the COTC during the study period. The criteria for hospitalization of patients were: to have a positive COVID-19 test with a moderate to severe or critical form evaluated according to World Health Organization (WHO) interim guideline (10), a very suggestive clinical context with a pathological CT scan in the case of a negative test. All cases of benign COVID-19 were treated at home.

Inclusion criteria: this study included all patients with a COVID-19 confirmed by a positive test. The cases with a negative COVID-19 test were not included.

Information related to demographic data, clinical characteristics, treatment, and outcomes of patients was collected retrospectively.

Operational definitions

Any patient with clinical indications and/or visual signs on chest CT that are suggestive of COVID-19 is a suspected case of COVID-19.

Any symptomatic patient with RT-PCR and/or IgM or IgG positive is a confirmed case.

In the present study, we use the WHO classification of the COVID-19 (Table 1).

Table 1. The WHO clinical classification of the COVID-19 (9)

Mild case	Moderate	Severe	Critically severe
Mild clinical manifestations, no imaging performed	Fever, dyspnea, Appearance of pneumonia on X-ray or CT	Meet any of the following: Respiratory distress, RR ≥ 30/min Oxygen saturation ≤ 93% $PaO_2/FiO_2 \leq 300$ mmHg	Respiratory failure requires enhanced respiratory support, which may be combined with shock or other organ dysfunction, patients need intensive care monitoring and treatment

The criteria for hospital discharge: were defined by the absence of fever for at least 3 days, clinical remission of symptoms, and/or a negative RT-PCR test on the 12th day of hospitalization (11).

Statistical analysis

All statistical analyses were performed with SPSS Statistics Software (version 21; IBM, New York, USA). Data are given as numbers and percentages or means and standard deviations. Statistical comparisons between two groups were made using the $\chi 2$ test (categorical variables) or the student’s t-test. Kaplan Meier's method described survival from the first day of hospitalization until death (complete data) to the end of the study (censored data). Log Rank test was used to compare the survival curves between the two waves. The Cox regression was fitted to identify independent predictors of mortality. Statistical significance was set at $p < 0.05$.

Ethical considerations

The study was approved by the School of Public Health’s Ethics Committee of the University of Kinshasa (ESP/CE/179/2020). The data was collected anonymously and confidentially. The privacy and personality of the patients were safeguarded. Because of the retrospective nature of the study and the minimal risk posed by it, obtaining informed consent was not considered necessary.

Results

General characteristics of the study population

During the study period, 411 patients with confirmed COVID-19 were admitted to the hospital (Table 2).

Table 2. General characteristics of 411 patients admitted to the COVID-19 treatment center of the Kinshasa University Hospital between March 24th, 2020, and January 31st, 2021

Variables	All N=411	wave 1 n=215	wave 2 n=196	p
Sex				0.334
Male	280(68.1)	149(69.3)	131(66.8)	
Female	131(31.9)	66(30.7)	65(33.2)	
Age (years)	55.1±16.9	52.4±17.5	58.1±15.7	0.026
< 40	77(18.7)	47(21.9)	30(15.3)	
40-59	144(35.0)	82(38.1)	62(31.6)	
≥60	190(46.2)	86(40.0)	104(53.1)	
Admission procedure				<0.001
First admission	219(53.3)	136(63.3)	83(42.3)	
Reference	192(46.7)	79(36.7)	113(57.7)	
Comorbidities				0.175
No	182(44.3)	90(41.9)	92(46.9)	
Yes	229(55.7)	125(58.1)	104(53.1)	
Hypertension	147(35.8)	75(34.9)	72(36.7)	0.387
Diabetes mellitus	79(19.2)	40(18.6)	39(19.9)	0.418
Asthma	9(2.2)	5(2.3)	4(2.0)	0.557
Cardiovascular diseases	12(2.9)	10(4.7)	2(1.0)	0.026
Tuberculosis	6(1.5)	3(1.4)	3(1.5)	0.613
Pregnant women	4(1.0)	4(1.9)	0(0.0)	
Obesity	2(0.5)	2(0.9)	0(0.0)	
Reason for admission				
Headache	41(10.0)	26(12.1)	15(7.7)	0.043
Coma	18(4.4)	8(3.7)	10(5.1)	0.329
Fever	200(48.7)	118(54.9)	82(41.8)	0.005
Vomiting	16(3.9)	11(5.1)	5(2.6)	0.138
Diarrhea	13(3.2)	6(2.8)	7(3.6)	0.432
Abdominal pain	8(1.9)	6(2.8)	2(1.0)	0.175
Anorexia	12(2.9)	5(2.3)	7(3.6)	0.324
Chest pain	15(3.6)	8(3.7)	7(3.6)	0.574
Curvature	17(4.1)	9(4.2)	8(4.1)	0.578
Nausea	7(1.7)	4(1.9)	3(1.5)	0.551
Asthenia	75(18.2)	34(15.8)	41(20.9)	0.113
Cough	196(47.7)	121(56.3)	75(38.3)	<0.001
Throat pain	40(9.7)	31(14.4)	9(4.6)	<0.001
Anosmia	4(1.0)	1(0.5)	3(1.5)	0.278
Dyspnea	41(10.0)	1(0.5)	2(1.0)	0.465
Respiratory distress				
Oxygen saturation on room air (%)	84.4±13.8	83.2±15.2	85.6±12.0	< 0.001
SaO_2 category				0.014
90-95	78 (19.0)	52(24.2)	45(23.0)	
80-89	117 (28.5)	32(14.9)	46(23.5)	
70-79	57(13.9)	62(28.8)	55(28.1)	
60-69	32(7.8)	32(14.9)	25(12.8)	
50-59	16(3.9)	13(6.0)	19(9.7)	
<50	14(3.4)	12(5.6)	4(2.0)	
Sign of respiratory distress	103(25.1)	82(38.1)	21(10.7)	<0.001
Illness stage				0.153
Mild	93(22.6)	50(23.3)	43(21.9)	
Moderate	84(20.4)	36(16.7)	48(24.5)	
Severe	234(56.9)	129(60.0)	105(53.6)	

Variables	All N=411	wave 1 n=215	wave 2 n=196	p
Dialysis	17(4.1)	12(5.6)	5(2.6)	0.097
Corticosteroid therapy	186(45.3)	34(15.8)	152(77.6)	<0.001
Anticoagulant	206(50.1)	52(24.2)	154(78.6)	<0.001
Oxygen therapy	240(58.4)	132(61.4)	108(55.1)	0.117
CPAP	4(1.0)	3(1.4)	1(0.5)	0.347
Intubation	9(2.2)	5(2.3)	4(2.0)	0.557
Ventilation invasive	6(1.5)	3(1.4)	3(1.5)	0.613
ATB	172(41.8)	44(20.5)	128(65.3)	<0.001

CPAP: continuous positive airway pressure ATB: antibiotherapy

The number of patients admitted was 215 in the first wave and 196 in the second wave. The average age of patients in the 2nd wave was higher than in the first wave (52.4 ±17.5 vs 58.1 ±15.7, p=0.026). The age group over 60 years was the most common among patients and was more prevalent in the second wave than in the first. Most patients came directly from their home. The number of patients coming from home in the first wave was higher than in the second wave. Heart disease was more common in the first wave than in the second.
Patients in the first wave differed from those in the second wave in that they had a higher frequency of headaches, fever, coughs, and throat pain. The average saturation was lower in the first wave than in the second. Patients with very low oxygen saturation (< 50 %) were more frequently encountered in the first wave. Signs of respiratory distress were more common in the first wave than in the second. Corticosteroids, anticoagulants, and antibiotics were prescribed more in the second wave than it was in the first one (Table 2). Patients with anemia and high urea levels were more frequently encountered in the first wave (Table 3).

Table 3. Biologic characteristics of 411 patients admitted to the COVID-19 treatment center of the Kinshasa University Hospital between March 24, 2020 and January 31, 2021

Variables	N	Total	Wave 1	Wave 2	p
Glycemia S (mg/dl)	157	164.8±50.1	157.1±84.6	171.9±94.9	0.304
Potassium (mmol/l)	116	4.0±0.9	4.01±0.9	4.0±0.95	0.894
Leucocytes (/mm$^{3)}$	115	12379.5±940.6	12182.2±727.1	12531.3±108.2	0.845
Hb (g/dl)	119	181.3±4.1	11.5±2.9	12.9±3.2	0.016
pH	80	7.7±2.8	8.0±3.8	7.4±0.14	0.358
P CO_2 (mmHg)	79	39.8±10.9	40.7±9.7	38.9±12.2	0.479
PO_2 (mmHg)	411	11.5±2.6	10.8±2.5	12.3±2.7	0.563
HCO3 (mmol/l)	77	23.5±7.8	23.8±6.9	23.12±8.8	0.740
Platelet (/mm^3)	59	220799.7±163.2	228530.4±17471.5	212802.5±125313.8	0.715
Lymphocytes (%)	58	20.6±6.4	22.8±9.3	18.1±12.1	0.278
Monocytes (%)	44	6.2±2.2	6.8±2.3	5.7±2.2	0.408
Neutrophiles (%)	57	71.9±17.2	71.3±19.9	72.7±13.5	0.760
Urea (mg/dl)	92	62.4±6.6	91.9±7.3	31.7±4.2	< 0.001
Creatinin (mg/dl)	117	3.9±0.5	4.5±1.8	3.2±1.7	0.142
D-dimères(ɥg/l)	12	873.4±18.7	398.5±76.2	2298.1±32.9	0.109
CRP (mg/l)	62	95.7±8.2	91.7±28.5	100.7±24.0	0.671
ALAT (UI/l)	64	61.2±7.3	55.9±9.4	64.2±6.3	0.667
ASAT (UI/l)	66	92.3 ±10.4	84.5±11.3	96.7±10.0	0.652

Hb: hemoglobin CRP: C-reactive protein ALAT: alanin aminotransferase ASAT: aspartate aminotransferase

A vital outcome of patients by wave

Death of patients in the first wave was higher than patients in the second wave (p=0.009) (Figure 1).

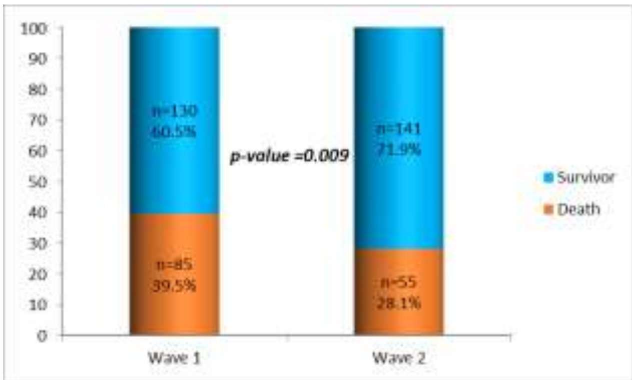

Figure 1. A vital outcome of patients by wave

Survival of COVID-19 patients

The overall survival of both waves is illustrated in figure 2.

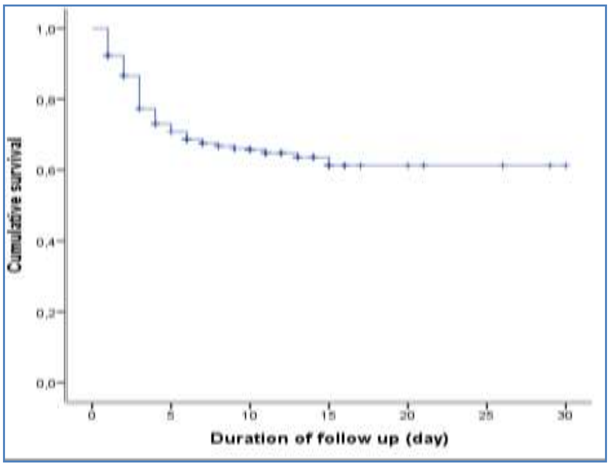

Figure 2. Overall survival of both waves

Day 0=100 %
Day 1=92.2 %
Day 3=77.6 %
Day 5=71.3 %
Day 10=66.9 %
Day 20=65.9 %
Median overall survival is 9 (8-10) in living 10 (8-11), deceased 3 (1-4)

Survival according to wave

Survival was reduced in the first wave compared to the second wave. At 15 days of follow-up, about 40 % of the patients in the first wave had died, while in the second wave it was about 30 % (figure 3).

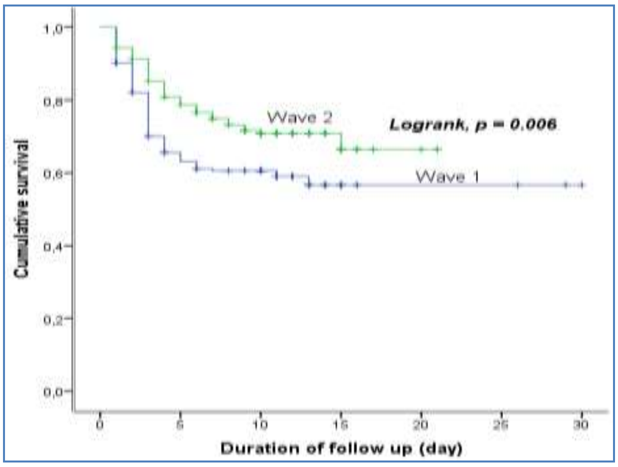

Figure 3. Survival according to waves

Predictors of Mortality in COVID-19 Patients

In this present study, predictors of mortality in all patients were age greater than or equal to 60 years, presence of coma, low oxygen saturation (≤ 89 %), and severe stage of COVID-19. In the first wave, age over 60 years, respiratory distress, low oxygen saturation (≤ 89 %), and severe COVID-19 stage emerged as factors associated with death, whereas in the second wave it was mainly respiratory distress, desaturation (≤ 89 %) and severe stage. The predictors of mortality present in both the first and second waves were respiratory distress and severe COVID-19 stage (Table 4).

Table 4. Independent predictors of mortality in COVID-19 patients admitted to the COVID-19 treatment center of the Kinshasa University Hospital between March 24th, 2020, and January 31st, 2021

Variables	All		Wave 1		Wave 2	
	aHR (CI 95 %)	P-value	aHR (CI 95 %)	P-value	aHR (CI 95%)	P-value
Age (years)						
< 40	1		1		1	
40-59	0.9(0.54-1.72)	0.902	1.2(0.63-2.51)	0.525	0.9(0.31-2.91)	0.932
≥ 60	1.89(1.21-2.74)	**0.016**	2.02(1.06-3.87)	**0.034**	1.3(0.47-3.75)	0.592
Admission procedure						
First admission	1		1		1	

Variables	All		Wave 1		Wave 2	
	aHR (CI 95 %)	P-value	aHR (CI 95 %)	P-value	aHR (CI 95%)	P-value
Reference	0.97(0.68-1.38)	0.865	1.19(0.65-2.17)	0.579	1.6(0.85-3.21)	0.135
Comorbidities						
No	1		1		1	
Yes	1.00(0.69-1.44)	0.998	1.03(0.56-1.91)	0.915	1.0(0.57-2.01)	0.839
Respiratory distress						
No	1		1		1	
Yes	1.12(0.57-1.65)	0.572	2.50(1.17-5.33)	**0.018**	2.8(1.39-4.20)	**0.005**
Coma						
No	1		1			
Yes	1.99(1.03-3.84)	**0.040**	1.96(0.78-4.91)	0.150	2.5(1.91-6.88)	**0.016**
Oxygen saturation (%)						
>95	1		1		1	
90-95	1.27(0.06-142)	0.124	2.63(0.86-8.05)	0.090	1.1(0.9-1.41)	0.919
80-89	1.53(1.03-476)	**0.033**	2.03(1.04-3.09)	**<0.001**	1.2(0.63-2.48)	0.884
70-79	2.91(1.52-5.56)	**0.022**	2.45(1.72-5.38)	**<0.001**	1.3(0.42-2.47)	0.781
60-69	3.89(1.92-7.85)	**0.008**	2.88(1.30-9.58)	**<0.001**	1.3(0.44-309)	0.419
50-59	4.52(2.17-9.40)	**<0.001**	3.9(2.05-9.99)	**<0.001**	1.4(0.50-3.48)	0.358
<50	8.50(3.89-18.56)	**<0.001**	4.6(2.96-13.17)	**<0.001**	1.6(0.15-8.31)	0.275
Severity of the disease						
Mild	1		1		**1**	
Moderate	3.16 (0.76-5.07)	0.113	14.1(3.38-59.17)	**<0.001**	1.8 (0.4-6.6)	0.905
Severe	4.42 (1.87-8.55)	**0.004**	24.3 (7.4-79.42)	**<0.001**	12.0(1.3-22.5)	**0.029**

Discussion

When comparing the 2 waves of COVID-19 in the present study, the average age was higher in the second wave, while comorbidities including heart disease and clinical signs (fever, headache, cough, sore throat, respiratory distress) were more common in the first wave. The essential therapeutic approaches in COVID-19, including corticosteroid therapy and anticoagulation, were used more in the second wave. The mortality rate was higher in the first wave. The factors predicting mortality that emerged in both waves were respiratory distress and the severe stage of COVID-19.

In the present study, patients were older in the second wave than in the first wave. By contrast, elsewhere, patients admitted in the second wave were younger (12-13). There were fewer deaths in the second wave, which is in agreement with the results reported by previous research in several countries (12-14). The present study did not find differences in the frequency of concomitant diseases between the two waves, with results similar to those of other studies elsewhere (15). The clinical signs most encountered in the first wave were fever, headache, cough, throat pain, and respiratory distress. There were more severe cases of the disease in the first wave than in the second. Changes in social policy due to COVID-19, such as changes in the admission criteria for patients with mild symptoms, strongly influenced the characteristics of patients who were admitted to the KUH COTC. In the first wave, all mild cases were admitted, while in the second wave, mild cases were admitted only if they had comorbidities, taking into account the criterium of frailty.

Treatment approaches were strengthened in the second wave. Most patients in the second wave were on corticosteroids and anticoagulants. We noted that early in the coronavirus pandemic, deaths due to COVID-19 were partly attributed to blood clot formation that led to more serious thrombotic events such as pulmonary failure, heart attack, and stroke. These were quite common in patients with severe cases of COVID-19. The paper published in the British Medical Journal showed that patients who received preventive doses of anticoagulants within the first 24 hours of hospitalization for COVID-19 had a 30% lower mortality rate than patients who did not receive this drug (16). A study by Zhang *et al.* showed higher mortality in COVID-19 patients with thromboembolism (17). Another study by Tang *et al.* found significantly higher d-dimer levels at admission in the non-survivor group, indicating a worse prognosis in patients with new-onset coronavirus pneumonia with coagulopathy (18). A meta-analysis by Malas *et al.* reported overall arterial thromboembolism (ATE) rate of 2%, a venous thromboembolism rate of 21%, a venous thrombosis rate of 20%, and a pulmonary embolism rate of 13% in those infected with SARS-COV-2 (19). They also reported that the odds of mortality were significantly increased by thromboembolism (up to 74%). In contrast, Hippensteel *et al.* found no significant difference in mortality among critically ill patients, although they did find a higher prevalence of venous thromboembolism in critically ill patients with COVID-19 (20). Corticosteroids were used more in the second wave than in the first. The first published randomized trial of the use of corticosteroids in covid patients is a preliminary analysis of the ongoing RECOVERY trial in the UK. This is a controlled, open-label trial that randomized hospitalized patients with clinically suspected or laboratory-confirmed SARS-CoV-2 infection between usual care without corticosteroids and usual care with dexamethasone. Dexamethasone was administered orally or intravenously at a dose of 6 mg/day for up to 10 days, or until hospital discharge. Patients requiring invasive mechanical ventilation (IVM) and receiving dexamethasone had a reduced death rate than those receiving standard treatment alone (29.3 % vs. 41.4%, rate ratio ¼ 0.64: CI 95%: 0.51-0.81), as well as in those receiving supplemental oxygen without IVM (23.3% vs. 26.2%, rate ratio ¼ 0.82, CI 95 %: 0.72-0.94) (21). Based on these convincing results, the same dosage of dexamethasone was routinely used in the present study of patients with severe COVID-19 in the second wave, which may also be a factor for improved management and low mortality in the COTC of KUH.

The mortality rate was higher in the first wave than in the second. The present study proposes the following hypotheses that may contribute to the lower-case fatalities in the second wave. First, the decrease in case fatalities in the second wave compared to the first wave could be a harvesting effect. In other words, a large number of elderly people and people with comorbidities (the vulnerable groups) probably died in the first wave, especially in countries with high infection rates. Second, testing capacity, improved case management, and health system strengthening were better reinforced in the second wave. Third, in several countries, the age structure of those infected may have changed between the first and second waves. The covid-19 had involved more young and healthy people in many countries (22). This was not the case in the present study where the average age was higher in the second wave than in the first. This improvement in the outcome of admitted patients could be related to the fact that the health care system in the DRC, as in many other countries, had become better prepared with more experience and better treatments. More diagnostic tests were possible, which allowed early detection of serious cases followed by effective treatments. In this regard, in the second wave, patients were treated more frequently with dexamethasone, as suggested by the RECOVERY study. In addition, the number of health care providers was higher in the second wave compared to the first wave (23).

The predictors of mortality in both waves were respiratory distress and severe COVID-19 stage. For patients over 60 years, respiratory distress, desaturation (≤ 89 %), and severe COVID-19 stage emerged as factors associated with death in the first wave whereas in the second wave it was mainly respiratory distress, desaturation (≤ 89 %), and severe stage. Age was no longer associated with mortality in the second wave as clinicians have drawn particular attention to the elderly as previous studies had already emphasized age as a mortality factor (7- 8, 22-24). Severe stage and desaturation still remained a great challenge in the management of COVID-19, especially when the patient consulted late. Indeed, patients in the first wave often came late to the consultation, with saturation below 50% in greater numbers than in the second wave.

Limitations

Our study has some limitations. First, because of the retrospective study design, not all laboratory tests were performed in all patients, including d-dimer, IL-6, troponin, lactate dehydrogenase, and serum ferritin. Therefore, their role may be underestimated in predicting in-hospital death. Second, missing data, especially in laboratory parameters, could lead to bias in the final analysis.

Conclusion

The mean age was higher in the second wave. The essential therapeutic approaches in COVID-19, including corticosteroid therapy and anticoagulation, were more used in the second wave. Mortality was higher in the first wave. The factors predicting mortality that emerged in both waves were respiratory distress and severe stage of COVID-19, whereas age no longer emerged as a factor in mortality in the second wave. Health system improvement and education of those at high risk of mortality should be pursued to continue to reduce the mortality of patients hospitalized with COVID-19.

Conflict of interest

The authors declare that there is no conflict of interest

Data availability:

Datasets used and analyzed during the current study are available from the corresponding author on request.

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Author's contributions

Design, write a manuscript: Madone Mandina and JR Makulo.

Collect of data and statistical analysis: Madone Mandina, JR Makulo, Ben Bepouka and Ossam Odio

Intrepratation of results: Madone Mandina, JR Makulo, Ben Bepouka and Ossam Odio

Writing – Original Draft: Madone Mandina, Jean-Robert Makulo, Roger Wumba, Ben Bepouka, Jerome Odio, Aliocha Nkodila, Murielle Longokolo, Nadine Mayasi, Donatien Mangala, Guyguy Kamwiziku, Auguy Luzayadio Longo, Guillaume Mpia, Yamin Kokusa, Hervé Keke, Marcel Mbula, Hippolyte Situakibanza, Ernest Sumaili, Jean-Marie Kayembe

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