Factors associated with mortality among the COVID-19 patients treated at Gulu Regional Referral Hospital: A retrospective study

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Abstract

Background: The advent of the novel coronavirus disease 2019 (COVID-19) has caused millions of deaths worldwide. There is a lack of data on the outcome of hospitalized African patients suffering from COVID-19.

This study aimed at identifying factors associated with hospital mortality in patients who suffered from COVID-19 at Gulu Regional Referral Hospital in Northern Uganda from March 2020 to October 2021.

Methods: This was a single-center, retrospective study in patients hospitalized with confirmed COVID-19 at Gulu Regional Referral Hospital in Northern Uganda. Socio-demographic characteristics, clinical presentations, comorbidities, duration of hospital stay, and treatment were analyzed, and factors associated with increased odds of mortality were determined.

Results: Of the 664 patients treated, 661(99.5%) were unvaccinated, 632(95.2%) recovered and 32(4.8%) died. Mortality was highest in diabetics 11(34.4%), cardiovascular diseases 12(37.5%), hypertensive 10(31.3%), females 18(56.3%), $\geq$ 50-year-olds 19(59.4%), no formal education 14(43.8%), peasant farmers 12(37.5%) and those who presented with difficulty in breathing/shortness of breath and chest pain 32(100.0%), Oxygen saturation ($Sp0_2$) <80 4(12.5%), general body aches and pains 31(96.9%), tiredness 30(93.8%) and loss of speech and movements 11(34.4%). The independent factors associated with mortality among the COVID-19 patients were females AOR=0.220,95%CI:0.059-0.827;p=0.030; Diabetes mellitus AOR=9.014, 95%CI:1.726-47.067;p=0.010; tiredness AOR=0.059,95%CI:0.009-0.371; p=0.0000; general body aches and pains AOR=0.066,95%CI:0.007-0.605; p=0.020; loss of speech and movement AOR=0.134,95%CI:0.270-0.660;p=0.010 and other comorbidities AOR=6.860, 95%CI:1.309-35.957;p=0.020.

Conclusion: The overall hospital mortality was 4.8%. Older age, people with diabetics, females, other comorbidities, severe forms of the disease, and those admitted to HDU were significant risk factors associated with hospital mortality. More efforts should be made to provide *"Enhanced shielding"* to the most vulnerable population to avoid preventable morbidity and mortality of COVID-19 in Northern Uganda.

Introduction

Coronavirus disease 2019 (COVID-19) caused by SARS-CoV-2 first emerged in Hubei Province, China in December 2019 [1]. Since then, not only has COVID-19 been considered a public health emergency of international concern, but it has been declared a global pandemic [1]. COVID-19 is an infectious disease caused by a new coronavirus that can be transmitted from one infected person to an average of 3 other people in a population [2]. This emerging disease is epidemiologically like severe acute respiratory syndrome (SARS) and the Middle East Respiratory Syndrome (MERS), which were previously epidemic [3]. Although most infected persons develop mild symptoms, some may develop respiratory failure, arrhythmia, shock, renal failure, cardiovascular injury, hepatic failure, and sometimes death [4, 5].

At present, there is no effective antiviral treatment; only supportive care may be useful, for example, mechanical ventilation, extracorporeal membrane oxygenation (ECMO) to patients with refractory hypoxemia, or ECMO to patients with refractory hypoxemia [5]. The overall Case Fatality Rate (CFR) is 3.8% in COVID-19 worldwide [5]. CFR in patients with cardiovascular diseases, diabetes, hypertension, respiratory diseases, and cancers is estimated to be 13.2%, 9.2%, 8.4%, 8.0%, and 7.6%, respectively [6]. Several studies focusing on factors affecting the mortality of COVID-19 have been published in medical journals [4–6].

Even though most African countries have fragile health systems, the Case Fatality Rate (CFR) for COVID-19 in Africa is surprisingly lower than the global trend [7]. Lower testing rates, a younger population, humid temperatures, and the possibility of a pre-existing immunity are some of the postulated factors associated with this difference [7].

Although the SARS-CoV-2 virus predominantly targets the respiratory system, its associated mortality involves multiple organ systems [8]. An increasing understanding of the disease throughout the pandemic has reduced hospital mortality rates, especially in well-resourced and high-income countries [9, 10, 11]. In contrast, hospital mortality remains comparatively high in Africa [12]. This has been attributed to the burden of underlying comorbidities and resource deficits [12]. Reports globally have indicated that increasing age [13, 14, 15], comorbidities (cardiovascular diseases and diabetes) [13, 16, 17], and obesity [18, 19] are associated with adverse outcomes. In addition, certain demographic characteristics [14–16, 20] and laboratory parameters [21–23] have also been associated with the severe form of COVID-19 and increased mortality.

The objective of this study was to identify factors associated with hospital mortality in patients who suffered from COVID-19 at Gulu Regional Referral Hospital in Northern Uganda from March 2020 to October 2021.

Materials And Methods

Study design

A retrospective data review and abstraction of all COVID-19 hospital admissions registered in the Gulu Health Management Information System (HMIS) database and other tools was conducted. The period of the review was from March 2020 to October 2021. HMIS is a database established by the Ugandan Ministry of Health as a primary source of information on COVID-19 hospital admissions and deaths. COVID-19 notification is compulsory in Uganda, and the emergency operations Centre at the Uganda National Public Health Institute receives reports on patients admitted to both public and private hospitals with COVID-19.

Study site

This study was conducted at Gulu Regional Referral Hospital in Northern Uganda, covering admissions of COVID-19 patients from March 2020 to October 2021. Gulu Hospital is a Regional and Referral Centre for patients from mid-northern Uganda., However, it receives patients from neighboring countries, for example, South Sudan and the Democratic Republic of Congo (DR Congo). It is also a teaching hospital for Gulu University Medical School and many other health training institutions in the region. It is a 394-bed capacity hospital with outpatient and inpatients services estimated at 120,000 patients per year. The hospital has specialized units such as internal medicine, surgery, pediatrics, reproductive health, TB, HIV, cardiac, chest, dental, dermatology, sickle cell disease, diabetes, hypertension, Ear, Nose and throat, nutrition, accident and emergency, laboratory, ophthalmology, mental health, and orthopedic clinics that consultants manage from Gulu Hospital and Gulu University.

Gulu Regional Referral hospital was designated by the Ugandan Ministry of Health as a treatment center for COVID-19 patients in March 2020 when COVID-19 was declared a pandemic. A particular treatment unit for the management of COVID-19 (Gulu CTU) was established with a fully-fledged high dependency unit (HDU), with Oxygen supply and staff to manage the center. The COVID-19 isolation unit is housed in a separate building from other patients and comprises the general isolation ward and the COVID-19 Critical Care Unit (CCU). The CCU is split into a quasi-intensive care unit (ICU) and the high dependency unit (HDU). The general isolation ward consisted of two separate wards (one for females and another for males) with 12 beds. The COVID-19 CCU has a two-bed ICU and four-bed HDU. A multidisciplinary team of physicians, medical officers, nurses, and laboratory technicians saw the COVID-19 patients. The HDU and quasi-ICU were managed by an interdisciplinary team, including a full-time critical care specialist, primary physician, medical officers, physiotherapist, mental health specialists, and dietician. The ICU could not provide invasive procedures such as invasive mechanical ventilation, invasive hemodynamic monitoring, and inotropic support. All patients that required invasive procedures were transferred to Mulago National Referral Hospital. The HDU served as a step-down unit for the quasi-ICU and housed critically ill patients requiring high-flow oxygen. Patients requiring hemodialysis were transferred to Mulago National Referral Hospital in a separate designated dialysis unit. The ICU and HDU had round-the-clock coverage with a physician, a team of medical and clinical officers from various specialties such as internal medicine and emergency medicine. The nurse-to-patient ratio for ICU and HDU was 1:1 and 1:5, respectively. The team leader for the Gulu CTU was a consultant physician who managed all the COVID-19 patients admitted to the unit. Additional support for the management of the COVID-19 patients at the Centre was provided by the Ugandan Ministry of Health and World Health Organization experts using standard protocols developed and practiced in Uganda.

Sources of data

For the period of this study, COVID-19 patients admitted to Gulu Regional Referral Hospital with COVID-19 were estimated at 900. For each patient registered in the Gulu Hospital HMIS database, information on individual's socio-demographic characteristics, self-reported symptoms, signs, co-morbidities, COVID-19 Treatment Unit (CTU) admissions, HDU admissions, ICU admissions, and ventilatory support, dates of symptom onset, date of hospital admission, date of discharge, duration of hospital stay, reported

circumstances when the disease was contracted, vaccination status and hospital outcomes (deaths, referrals, and releases/discharges) were included.

HMIS datasets were accessed, which were already de-identified and publicly available documents. Following ethically agreed principles on open data access, this review did not require stringent ethical approval in Uganda as we mainly worked on medical records with no identifiers included. However, we obtained ethical and administrative clearance from the Gulu Regional Referral Hospital Institution and Ethical Review Committee to access the archived Gulu Hospital datasets on COVID-19 patients.

Selection Criteria

Inclusion criteria

The following were the inclusion criteria for participants (i) Confirmed cases of COVID-19 with RT-PCR results as positive (ii) patients 12 years and above (iii) completed information on the chart and other medical tools (iv) admission records

Exclusion criteria

We excluded (i) incomplete records, (ii) records with no RT-PCR results (iii) participants below 12 years.

Selection of records

The medical records for the COVID-19 patients in the archives of Gulu Hospital were accessed. The choice of the COVID-19 patients' files was conducted consecutively and reviewed by the research team. The selection criteria were applied to each admission file, and a total of 664 files were included in the participating medical records for this study.

Sample size

The sample size for the study population was determined after using the selection criteria on the medical records. Six hundred and sixty-four (664) records were included as the sampled population.

Training of research assistants

To obtain excellent and clean information from the COVID-19 patients' files, the research team trained the research assistants who were four in number (Two medical officers, one clinical officer, and one nurse) on how to use the selection criteria, accurately record data from the admission forms and exclude forms that were considered incomplete. The research teams were trained on infection, prevention, and control of COVID-19 and were required to use facemasks, eye shields, and sanitizers during and after reviewing documents. The corresponding author supervised the data collection exercise from the beginning to the end, ensuring that every file was checked to confirm the completeness of the data collected.

Data collection procedures

Registered COVID-19 patients treated at Gulu Regional Referral Hospital with a positive quantitative RT-PCR test result for SARS-CoV-2 admitted to Gulu Hospital were consecutively reviewed. SARS-CoV-2 diagnostic tests followed national and international standards. They were done in certified laboratories of Gulu Regional Referral Hospital and Uganda Virus Research Institute (UVRI) as required by the Ugandan Ministry of Health and World Health Organization (WHO) protocols.

Variables for the study

The dependent variables for this study were treatment outcomes (alive or dead). The independent variables were the socio-demographics of the COVID-19 patients (age, sex, occupation, religion, tribe, districts, and level of education), comorbidities and treatments used, oxygen saturation at admission, dates of discharges from the hospital, duration of hospital stay, disease severity, and others), clinical presentations (signs and symptoms), vaccination status, residences, and circumstances under which the patient contracted the virus.

Data analysis

The analysis period was from the epidemiological week (starting month and date of March 2020) to the epidemiological week (until month and date of October 2021). The analysis was pre-specified and defined before reading the medical data in the Gulu Regional Referral Hospital records. The sample size was all patients (aged ≥12 years) with COVID-19 diagnosis who were admitted and registered to the Gulu Regional Referral Hospital HMIS database between the epidemiological weeks of March 2020 to October 2021.

Means, frequencies, standard deviations, bar graphs, histograms, and percentages were used to summarize continuous variables, while frequencies and proportions were calculated for categorical variables. Age-adjusted and sex-adjusted rates for each district were calculated by the direct method using the estimated Ugandan population for 2020 as reference.

We used the Chi-Square tests to observe associations between independent and dependent variables at 95% Confidence Intervals. Factors with p-values less or equal to 0.2 were entered into a multivariable regression analysis to determine factors associated with mortality among COVID-19 patients treated at Gulu Regional Referral Hospital. However, the Gulu Hospital HMIS database contained many missing variables, such as reported symptoms, medicines used, and comorbidities. We used additional Gulu Regional Referral Hospital records to fill in the missing data. Also, in the post hoc analysis, we evaluated the missing data pattern and conducted a sensitivity analysis via multiple imputations by chained equations, generating 30 imputed datasets. All studies were performed with SPSS version 25.0. Multiple imputations were performed with SPSS following the STROBE guideline recommendations. In addition, Adjusted Odds Ratios (AoR) for independent variables associated with mortality were calculated for the COVID-19 patients treated at the Gulu Regional Referral Hospital from March 2020 to October 2021.

Ethical considerations

This retrospective data review of COVID-19 patients' medical files at the Gulu Regional Referral Hospital was approved by the Gulu Hospital Institutional, Ethics, and Review Committee.

Results

The study showed that during the period of study from March 2020, when the COVID-19 was declared a pandemic and Gulu Regional Referral Hospital became a treatment center, 32(4.8%) COVID-19 patients died at the center. Most patients who died were females AOR=0.220, 95%CI:0.059-0.827; p=0.030; Diabetes mellitus AOR=9.014, 95%CI:1.726-47.067; p=0.010; and comorbidities for example cardiovascular diseases, hepatitis B, liver failure and HIV and AIDS AOR=6.860, 95%CI:1.309-35.957; p=0.020. Similarly, COVID-19 patients who presented with symptoms for example tiredness AOR=0.059, 95%CI:0.009-0.371; p=0.0000; general body aches and pains AOR=0.066, 95%CI:0.007-0.605; p=0.020, and loss of speech and movement AOR=0.134, 95%CI:0.270-0.660; p=0.010 died. Nevertheless, most COVID-19 patients treated at the Gulu Regional Referral Hospital were majorly unvaccinated 661(99.5%) against the virus and recovered from the disease at a rate of 632(95.2%).

Table 1
The socio-demographic characteristics of COVID-19 mortality at Gulu Regional Referral Hospital

Variables	Frequency	Percent (%)
Gender		
Male	14	43.7
Female	18	56.3
Age (years)		
<20	0	0.0
20-29	3	9.4
30-39	1	3.1
40-49	9	28.1
≥50	19	59.4
Tribes		
Acholi	25	78.1
Lango	1	3.1
Baganda	0	3.1
Madi	1	3.1
Others	4	12.5
Religion		
Catholics	13	40.6
Protestants	5	15.6
Born Again	1	3.1
Muslims	3	9.4
Others	10	31.3
The highest level of education attained		
No formal education	14	43.0
Primary	0	0.0
Secondary	0	0.0
Certificates	5	15.6

Variables	Frequency	Percent (%)
Diploma	3	9.4
Degrees	5	15.6
Postgraduate degrees	2	6.3
Occupation		
Business	2	6.3
Civil Servants	2	6.3
Health workers	3	9.4
Teachers	1	3.1
Uniformed security forces	0	0.0
Peasant Farmers	12	37.5
Others	12	37.5
Districts		
Agago	1	3.1
Amuru	2	6.3
Gulu	15	46.9
Kitgum	1	3.1
Lamwo	0	0.0
Nwoya	2	6.3
Omoro	6	18.8
Pader	1	3.1
Others	4	12.5
Number of COVID-19 patients who died	32	4.8

Table 1 shows that most COVID-19 mortality at Gulu Regional Referral Hospital from March 2020 to October 2021 were females 18(56.3%), age group ≥50 years 19(59.4%); no formal education 14(43.0%), Acholi 25(78.1%), Catholics 13(40.6%), Peasant farmers 12(37.5%) and from Gulu District 15(46.9%).

Table 2
Factors associated with mortality at the bivariate analysis on the COVID-19 patients treated at Gulu Regional Referral Hospital from March 2020 to October 2021

Variables	Freq n=32(%)	Chi-Square	df	p-value
Fever	9(28.1)	3.143	1	0.076
Cough	25(78.1)	10.639	1	0.000
Tiredness	30(93.8)	119.828	1	0.000
Body aches and pains	31(96.9)	75.543	1	0.000
Diarrhea	4(12.5)	10.336	1	0.001
Difficulty in breathing/shortness of breath/Chest pain	32(100.0)	96.929	1	0.000
Loss of speech and movement	11(34.4)	113.202	1	0.000
Headache	19(59.4)	9.705	1	0.002
Sore throat	8(25.0)	1.251	1	0.263
Rashes on the skin and discoloration of toes and fingers	1(3.1)	3.579	1	0.059
Loss of Smell	0(0.0)	2.328	1	0.127
Loss of Taste	1(3.1)	0.669	1	0.413
Diabetes Mellitus	11(34.4)	51.156	1	0.000
COPD	1(3.1)	1.041	1	0.307
Other CVDs	12(37.5)	34.819	1	0.000
Hypertension	10(31.3)	10.807	1	0.001
Obesity	0(0)	0.153	1	0.696
Asthma	1(3.1)	0.113	1	0.737
Cancer	1(3.1)	3.565	1	0.059
HIV and AIDS	7(21.9)	6.488	1	0.011
Symptomatic	28(87.5)	2.170	1	0.141
Oxygen saturation ($Sp0_2$)(<80) 4(12.5)		62.074	2	0.0000
Duration of hospital stay (0-1 week) 25(78.1)		67.776	1	0.0000
Duration of symptoms (1-7 days) 19(59.4)		1.101	3	0.8970

Key: COPD= Chronic obstructive pulmonary diseases; CVDs=cardiovascular diseases.

Variables	Freq n=32(%)	Chi-Square	df	p-value
Systolic Blood pressure (mmHg)				
≤120	13(40.6)			
121-140	12(37.5)	2.920	2	0.232
>140	7(21.9)			
Diastolic Blood Pressure (mmHg)				
≤80	22(68.8)			
81-120	4(12.5)	4.214	2	0.122
121-140	6(18.8)			
Duration of symptoms (days)				
1-7	19(59.4)			
8-14	10(31.3)	1.101	4	0.894
15-21	3(9.4)			
22-28	0(0.0)			
Ages of participants (years)				
<20	0(0.0)			
20-29	3(9.4)			
30-39	1(3.1)			
40-49	9(28.1)			
≥50	19(59.4)	40.601	4	0.000
The highest level of education attained				
No formal education	14(43.8)	39.213	8	0.000
Primary level	0(0.0)			
Secondary level	0(0.0)			
Certificates	5(15.6)			
Diploma	3(9.4)			
Degrees	5(15.6)			

Key: COPD= Chronic obstructive pulmonary diseases; CVDs=cardiovascular diseases.

Variables	Freq n=32(%)	Chi-Square	df	p-value
Postgraduate degree	2(6.3)			
Tribes				
Acholi	25(78.1)	9.511	7	0.2180
Langi	0(0.0)			
Baganda	1(3.1)			
Lugbara	1(3.1)			
Others	4(12.5)			
Occupation				
Peasant Farmers	12(37.5)	33.235	8	0.0000
Business	2(6.3)			
Uniformed security	0(0.0)			
Civil Servants	2(6.3)			
Teachers	1(3.1)			
Health workers	3(9.4)			
Others	12(37.5)			
Religion				
Born Again	1(3.1)			
Catholic	13(40.6)	28.691	5	0.0000
Moslems	3(9.4)			
Protestants	5(15.6)			
Others				
Districts				
Agago	1(3.1)			
Amuru	2(6.3)			
Gulu	15(46.9)	21.827	12	0.040
Kitgum	1(3.1)			

Key: COPD= Chronic obstructive pulmonary diseases; CVDs=cardiovascular diseases.

Variables	Freq n=32(%)	Chi-Square	df	p-value
Lamwo	0(0.0)			
Nwoya	2(6.3)			
Omoro	6(18.8)			
Pader	1(3.1)			
Others	4(12.5)	107.107	69	0.002
Gender				
Females	18(56.3)	7.986	1	0.005
Males	14(43.7)			
Key: COPD= Chronic obstructive pulmonary diseases; CVDs=cardiovascular diseases.				

In Table 2, factors associated with mortality at bivariate analysis were cough χ^2=10.639; p=0.000; Tiredness χ^2=6.488; p=0.000; Age ($\geq$50 years) χ^2=40.601; p=0.000; No formal education χ^2=39.213; p=0.000; Peasant Farmer χ^2= χ^2=119.828; p=0.000; Body aches and pains χ^2=75.543; p=0.000; Diarrhoea χ^2=10.336; p=0.001; Difficulty in breathing/shortness of breath/Chest pain χ^2=96.929; p=0.000; Loss of speech and movement χ^2=113.202; p=0.001; Headache χ^2=9.705; p=0.002; Diabetes Mellitus χ^2=51.156; p=0.000; Other CVDs χ^2=34.819; p=0.000; Hypertension χ^2=10.807; p=0.000; HIV and AIDS χ^2=6.488; p=0.011; Oxygen saturation (Sp0$_2$)<80) χ^2=62.074; p=0.000; Duration of Hospital stay (0-1 week) 33.235; p=0.000; Catholics χ^2=28.691; p=0.000; Gulu district χ^2=21.827; p=0.040 and Females χ^2=7.986; p=0.005

Table 3
The adjusted Odds Ratios for factors associated with mortality among COVID-19 patients treated at Gulu Regional Referral Hospital

Variables	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
							Lower	Upper
Symptomatic (1)	0.749	0.792	0.893	1	0.345	2.114	0.448	9.990
Sex (Female)	-1.514	0.676	5.025	1	**0.030**	**0.220**	**0.059**	**0.827**
Diabetes Mellitus (1)	2.199	0.843	6.799	1	**0.010**	**9.014**	**1.726**	**47.067**
Chronic obstructive pulmonary disease (COPD)(1)	-0.818	1.69	0.234	1	0.628	0.441	0.016	12.106
Other Cardiovascular Diseases (CVD) (1)	1.953	1.874	1.086	1	0.297	7.050	0.179	277.547
Fever (1)	-0.172	0.72	0.057	1	0.811	0.842	0.205	3.454
Cough (1)	1.220	0.885	1.898	1	0.168	3.386	0.597	19.192
Tiredness (1)	-2.835	0.941	9.078	1	**0.000**	**0.059**	**0.009**	**0.371**
Aches and pains (1)	-2.714	1.128	5.786	1	**0.020**	**0.066**	**0.007**	**0.605**
Sore throat (1)	-0.737	0.748	0.972	1	0.324	0.478	0.110	2.073
Vomiting (1)	0.189	1.068	0.031	1	0.859	1.209	0.149	9.804
Diarrhea (1)	1.153	1.109	1.080	1	0.299	3.167	0.360	27.853
Conjunctivitis (1)	14.818	40193	0.000	1	1.0000	2725229	0.000	.
Loss of speech or movement (1)	-2.008	0.812	6.112	1	**0.010**	**0.134**	**0.027**	**0.660**
Hypertension (HT) (1)	-1.273	1.913	0.443	1	0.506	0.2800	0.007	11.886
Obesity (1)	0.033	45730	0.000	1	1.0000	1.0330	0.000	.
Asthma (1)	-0.870	1.651	0.277	1	0.598	0.4190	0.016	10.664
Cancer (1)	0.379	2.152	0.031	1	0.860	1.4610	0.022	99.174
HIV (1)	1.112	0.785	2.007	1	0.157	3.0410	0.653	14.166
Other comorbidities (1)	1.926	0.845	5.191	1	**0.020**	**6.860**	**1.309**	**35.957**
Age (years)								

Variables	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
							Lower	Upper
<20 years	-17.04	8584.01	0.000	1	0.998	0.0000	0.0000	.
20-29 years	-15.37	8584.01	0.000	1	0.999	0.0000	0.0000	.
30-39 years	-18.53	8584.01	0.000	1	0.998	0.0000	0.0000	.
40-49 years	-19.39	8584.01	0.000	1	0.998	0.0000	0.0000	.
Duration of Symptoms			0.121	4	0.998			
1-7 days	-0.036	0.621	0.003	1	0.954	0.965	0.286	3.26
8-14 days	0.352	1.112	0.100	1	0.751	1.422	0.161	12.564
15-21 days	18.985	21812.1	0.000	1	0.999	1.8E+08	0.0000	.
22-28 days	18.553	27748.4	0.000	1	0.999	1.1E+08	0.0000	.
The highest level of education attained			4.790	8	0.780			
No formal education	19.173	7639.02	0.000	1	0.998	2.1E+08	0.0000	.
Primary level	18.541	6963.22	0.000	1	0.998	1.1E+08	0.0000	.
Secondary level	0.455	0.773	0.347	1	0.556	1.576	0.3470	7.166
Certificate	1.547	1.053	2.157	1	0.142	4.698	0.5960	37.023
Diploma	1.557	0.895	3.026	1	0.080	4.746	0.8210	27.44
Degree	1.797	1.172	2.351	1	0.125	6.029	0.6070	59.93
Postgraduate	20.64	40193	0.000	1	1.000	9.2E+08	0.0000	.
Constant	15.97	46528.6	0.000	1	1.000	8623109		

In Table 3, the Adjusted Odds Ratios (AOR) of factors associated with mortality among COVID-19 patients treated at Gulu Regional Referral Hospital were; Females AOR=0.220, 95%CI:0.059-0.827; p=0.030; Diabetes mellitus AOR=9.014, 95%CI:1.726-47.067; p=0.010; Tiredness AOR=0.059, 95%CI:0.009-0.371; p=0.0000; Body aches and pains AOR=0.066, 95%CI:0.007-0.605; p=0.020; Loss of speech and movement AOR=0.134, 95%CI:0.270-0.660; p=0.010 and other comorbidities AOR=6.860, 95%CI:1.309-35.957; p=0.020.

Table 4
Factors associated with female gender among the COVID-19 patients

Variables	Chi-square	df	p-value
Crosstabulations between duration of symptoms (days) and other variables			
Symptomatic patients	10.301	4	**0.036**
Age of patients	14.585	16	0.555
Female patients	6.284	4	0.179
The highest level of education attained	30.42	32	0.547
Crosstabulations between Diabetes Mellitus and other variables			
Symptomatic patients	5.314	1	**0.021**
Age of patients	22.66	4	**0.000**
Female patients	0.016	1	0.901
The highest level of education attained	32.532	8	**0.000**
Crosstabulations between Chronic obstructive pulmonary diseases (COPDs) and other variables			
Symptomatic patients	0.014	1	0.905
Age of patients	6.195	4	0.185
Female patients	6.346	1	**0.032**
The highest level of education attained			
Crosstabulations between Other cardiovascular diseases (CVDs) and other variables			
Symptomatic patients	4.462	1	**0.035**
Age of the patients	22.562	1	**0.000**
Female patients	4.996	1	**0.025**
The highest level of education attained	22.451	8	**0.004**
Crosstabulations between Hypertension and other variables			
Symptomatic patients	3.045	1	0.081
Age of the patients	35.169	4	**0.000**
Female patients	1.187	1	0.276
The highest level of education attained	21.624	8	**0.006**
Crosstabulations between obesity and other variables			

Variables	Chi-square	df	p-value
Symptomatic patients	0.173	1	0.678
Age of patients	1.272	4	0.866
Female patients	1.512	1	0.219
The highest level of education attained	2.083	8	0.978
Crosstabulations between Asthma and other variables			
Symptomatic patients	0.0920	1	0.762
Age of patients	3.7700	4	0.438
Female patients	2.8110	1	0.094
The highest level of education attained	10.3790	8	0.239
Crosstabulations between Cancer and other variables			
Symptomatic patients	1.2200	1	0.269
Age of patients	1.7470	4	0.782
Female patients	3.1440	1	0.076
The highest level of education attained	12.6480	8	0.125
Crosstabulations between HIV and AIDS and other variables			
Symptomatic patients	0.070	1	0.791
Age of patients	8.515	4	0.074
Female patients	3.646	1	0.056
The highest level of education attained	2.107	8	0.978

In Table 4, the female COVID-19 patients were statistically and significantly associated with cardiovascular diseases (χ^2 = 4.996; p=0.025) and Chronic Obstructive Pulmonary Diseases (COPDs) χ^2 = 6.346; p=0.032 and with close to significant associations with HIV and AIDS (χ^2 = 3.646; p=0.056) and Cancers χ^2 = 3.144; p=0.076).

Discussions

The mortality rate among COVID-19 patients treated at Gulu Regional Referral Hospital was 4.8% (Table 1). This mortality rate was much lower than the average mortality rates reported in Africa [6, 12, 24] but slightly higher than the global average amongst hospitalized patients at 3.8% [6, 24]. Authors suggest the low mortality rates were attributable to the mild nature of the COVID-19 disease and relatively fewer patients admitted to the Gulu Regional Referral Hospital with comorbidities. This was shown by the

clinical presentations where most patients had oxygen saturation (SpO_2) more than 96, and one-fourth of the patients were asymptomatic. At the same time, symptomatic cases were mild, and most patients presented early in the course of the disease (Table 2).

The study identified several risk factors associated with mortality among hospitalized patients with COVID-19 in the Ugandan setting. Our study found females, Diabetes mellitus, comorbidities (cardiovascular diseases, hepatitis B, HIV and AIDS, Chronic Obstructive pulmonary diseases (COPDs), liver failure, and severe malaria), and severe illnesses as shown by symptoms such as tiredness, general body aches, and pains, and loss of speech and movements as the main factors associated with higher odds of mortality (Table 3). This was similarly observed in other studies [6, 13, 16, 17].

Furthermore, this study found a higher chance of death in COVID-19 patients with diabetes mellitus (Table 3). Studies found that hyperglycemia secondary to Diabetes mellitus leads to immune dysfunction by impairing humoral and cellular functions and the antioxidant system [25, 26]. In addition, studies showed that diabetic patients were more susceptible to nosocomial infections [25, 26]. These factors may have contributed to the higher chances of death in diabetic patients with COVID-19, which we observed in our study population.

Although the age group of 50 years and above 19(59.4%) were the majority among those who died, it did not reach statistical significance in this current study (Table 2). Previous studies had shown that adults were more likely to suffer from severe forms of the disease [8, 27, 28]. In many studies, the median age of hospitalized patients with COVID-19 ranged from 49 to 56 years [8, 27, 28]. This was consistent with reports published globally and comparable to other African studies [12, 29].

Furthermore, these authors argue that although the older age group in our study did not reach statistical significance between age and increased odds of mortality, the association between the older age group with higher levels of angiotensin-converting enzyme 2 (ACE2), which is a cell surface receptor for SARS-CoV-2 were plausible explanations [30].

Studies have shown that the elderly and males were at increased mortality risks [8, 27, 28]. This contrasts with our study, where middle-aged persons and females were the most affected (Table 3). This information requires further explanation as females in Northern Uganda suffered more mortalities from COVID-19 than males (Table 1 and Table 3), yet more males were admitted with the disease. Authors have found that the female gender in Northern Uganda had statistically significant associations with cardiovascular diseases (χ^2 = 4.996; p=0.025) and chronic obstructive pulmonary diseases (COPDs) χ^2 = 6.346; p=0.032, with close significant associations with HIV and AIDS (χ^2 = 3.646; p=0.056) and Cancers χ^2 = 3.144; p=0.076). Cardiovascular diseases are comorbidities that lead to severe illness, hospitalization, and death from the COVID-19 [13, 16, 17]. These authors further argue that the high prevalence of HIV and AIDS and cancers among females in Northern Uganda may have contributed to the high mortality rates observed in the current study.

Recent studies from Northern Uganda showed a higher prevalence of HIV and AIDS among female gender in Northern Uganda at 17% compared to males at 9% [31]. Similarly, most cancer prevalence was higher in Northern Uganda than in the rest of the country, especially breast and cervical cancers [32]. These authors argue that these three factors (cardiovascular diseases, chronic obstructive pulmonary diseases (COPDs), HIV and AIDS, and Cancers) may have singly or collectively contributed to the increased mortality risks of COVD-19 among females in Northern Uganda.

In addition, tiredness, general body aches, body pains, headache, loss of speech and movement, vomiting, dyspnea, and cough were the symptoms found in the COVID-19 mortality at Gulu Regional Referral Hospital. This is supported by studies that showed that these symptoms and signs were more frequent in SARS cases and cases of death [27–29, 33].

Dyspnea is the main symptom of SARS, a severe form of the COVID-19 disease where more chances of death occur [33]. At the same time, other reported symptoms, such as headache, general body aches, body pains, diarrhea, loss of speech and movements, and tiredness, were associated with higher chances of death among this cohort (Table 2 and Table 3). However, loss of smell and taste, sore throat, rashes on the skin, toes, nails, and runny nose were not associated with death in this current study (Table 2 and Table 3). This contrasts with Patrícia Rezende do Prado *et al.*, which reported dyspnea as a factor related to COVID-19 death, while cough, fever, and other symptoms were protective factors [33].

Taking these results, it can be concluded that this study analyzed the epidemiological characteristics and mortality risk factors in individuals diagnosed with COVID-19 due to SARS-CoV-2 at Gulu Regional Referral Hospital in Northern Uganda. High-risk groups need special attention, especially the elderly and those with comorbidities such as diabetes mellitus, cancers, HIV and AIDS, cardiovascular diseases, hepatitis B, and liver failure. Particular attention should be accorded to patients with dyspnea, general body pains and aches, loss of speech and movement, tiredness, headache, vomiting, and diarrhea. Some symptoms were more frequent in mild cases of COVID-19 and should be better elucidated in future studies. The female gender had more mortality risks in this current study due to comorbidities (cardiovascular diseases, chronic obstructive pulmonary diseases (COPDs), HIV and AIDS, and cancers) (Table 4). It is proposed that special care be accorded to females who contract COVID-19 to screen out for comorbidities in the early management phases so that the morbidity and mortality are averted.

Strengths and limitations of this study

This study was a retrospective review of datasets from the COVID-19 medical records at Gulu Regional Referral Hospital from March 2020 to October 2021. The study has limitations on how the Gulu Regional Referral Hospital handled records and record keeping. In addition, vital information, such as weight, height, and BMI of COVID-19 patients, was not recorded due to the emergency handling of the cases at the beginning of the pandemic in March 2020. The missing variables in the Hospital HMIS records got some files excluded from the participating records for this study. In this, authors have suggested a need for a prospective or longitudinal assessment of the COVID-19 cases in the future, ensuring that all data were measured and recorded appropriately.

This data is vital as it is one of the well-documented completed data for over 664 cases of COVID-19 treated in a Regional Referral Hospital in Uganda. Findings from this study show tremendous and good clinical practices at the Gulu Regional Referral Hospital despite the logistical challenges faced during the pandemic.

Generalizability of the results

These findings should be cautiously interpreted and generalized to regional hospital findings in low-resource settings such as Uganda.

Conclusion

Conclusion

The overall hospital mortality was 4.8%. Older age groups, diabetics, females, and those with comorbidities, severe forms of the disease, and admitted to HDU were significant risk factors associated with hospital mortality. More efforts should be made to shield the most vulnerable from the public from COVID-19 to avoid preventable morbidity and mortality in Northern Uganda.

Declarations

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