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Clinical characteristics and outcomes of confirmed COVID-19 patients in the early months of the pandemic in Tanzania: a multicenter cohort study

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ABSTRACT

Background: A prospective cohort study of the clinical presentations and management outcomes of laboratory-confirmed COVID-19 patients in the early months of the pandemic was performed at two hospitals in Dar es Salaam, Tanzania.

Methods: Between April 1 and May 31, 2020, laboratory-confirmed COVID-19 patients seen at two tertiary facilities were consecutively enrolled in the study and followed up for 21 days.

Results: 121 COVID-19 patients were enrolled; 112 (92.6%) were admitted while nine (7.4%) were seen as outpatients. The median (IQR) age of patients was 41 (30–54) years; 72 (59.5%) were male. The median (IQR) reported days from hospital admission to recovery and to death were 10 (6–18) and 5.5 (3–9), respectively. Forty-four (36.4%) patients had at least one underlying condition. Of the 112 admissions, 17 (15.2%) went to ICU, of whom 14 (82.3%) died. At the end of follow-up, 93 (76.9%) recovered, 18 (14.9%) died, seven (5.8%) remained asymptomatic, and one (0.8%) remained ill.

Conclusion: Three-quarters of all COVID-19 patients were less than 60 years, reflecting Africa's young population . High ICU admissions and mortality were observed.

Introduction

Coronavirus disease 2019 (COVID-19), first reported in Wuhan, China (Phelan et al., 2020), is caused by a highly contagious novel coronavirus named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) (Gorbalenya et al., 2020). The outbreak was declared as a pandemic by the World Health Organization (WHO) on March 11, 2020 (WHO, 2020d). By the end of 2021, more than 273 million cases, including at least 5.3 million deaths had been reported worldwide (WHO, 2021). Sub-Saharan Africa, including Tanzania (Mfinanga et al., 2021), which has the most vulnerable populations due to the high prevalence of HIV/AIDS, tuberculosis, and malnutrition, coupled with a weak health system compared with other regions, had reported < 0.05% of all cases worldwide (WHO, 2021); this highlights the need for more scientific evidence to explain the nature of the pandemic.

Although most people infected with SARS-CoV-2 develop only mild/asymptomatic or uncomplicated illnesses, approximately 14% develop a severe disease requiring hospitalization and oxygen support,

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with increased fatality rates (WHO, 2020a). Individuals infected with SARS-CoV-2 have been reported to exhibit a broad spectrum of clinical features (Cascella et al., 2020; Chen et al., 2020; Huang et al., 2020; Pan et al., 2020; Wang et al., 2020); these have been changing from mild to more life threatening as a result of emerging and highly transmissible variants (Guan et al., 2020; Lai et al., 2020; Wu et al., 2020).

People with underlying conditions such as hypertension, chronic lung disease, diabetes, and cardiovascular diseases have compromised immune systems, and are more likely to suffer from severe disease and a high fatality rate (CDC COVID-19 Response Team, 2020; WHO, 2020a). The risk for serious adverse outcomes increases with the number of underlying conditions; those with three or more underlying conditions suffer the most (Ye et al., 2020). Similarly, findings from Europe and America have shown that COVID-19 infection in individuals over 60 years is associated with severe adverse outcomes (Bonanad et al., 2020; WHO, 2020a). The proportion of severe or fatal infections has also been reported to vary by geographical region/location. Our study present findings on the clinical characteristics and management outcomes of 121 laboratory-confirmed COVID-19 patients in the early months of the pandemic in Tanzania.

Methods

Study sites and participants

This was a prospective follow-up study conducted at two hospitals, Amana Referral Hospital and Hindu Mandal Hospital, both located in Dar es Salaam, Tanzania. Amana Referral Hospital is a public hospital, which on April 15, 2020 was designated COVID-19 Centre and closed to non-COVID-19 patients. Consequently, Amana managed COVID-19 cases from across Dar es Salaam city. Hindu Mandal is a private, not-for-profit hospital that generally serves an older and wealthier population.

COVID-19 cases were identified under the coordination of the National Surveillance System, Ministry of Health, Community Development, Gender, Elderly, and Children (MoHCDGEC). Only laboratory-confirmed cases were enrolled in the study. Individuals who presented at the hospitals with suggestive symptoms were tested, and those who were confirmed positive were invited to enroll in the study. Patients were consecutively recruited between April 1 and May 31, 2020, and followed up for 21 days to monitor clinical outcomes. In cases of death, the cause of death was determined and documented by the certifying physician. The study protocol was approved by the National Health Research Ethics Committee under the National Institute for Medical Research, Tanzania, and written informed consent/assent was obtained from study participants or from parents/guardians for minors.

Diagnosis and laboratory procedures

Under the Tanzanian MoHCDGEC, the National Rapid Response Team was responsible for sample collection and transportation for COVID-19 testing. Sample handling was as per the previously described protocol (WHO, 2020c). Laboratory confirmation of SARS-CoV-2 was performed using real-time PCR at the National Public Health Laboratory located in Dar es Salaam, as per the previously described protocol (Guan et al., 2020). Serum samples were collected from cases as soon as possible after laboratory confirmation. Laboratory tests were performed at Muhimbili National Hospital, Dar es Salaam; these included renal function tests (RFTs), full blood counts with differentials (FBC), liver function tests (LFTs), C-reactive protein (CRP), ferritin, erythrocyte sedimentation rate (ESR), D-dimer, prothrombin time (PT), partial thromboplastin time (PTT), and international normalized ratio (INR). Pneumonia was diagnosed by chest X-ray examination, which was performed only when requested by the attending physician. Diagnosis of acute respiratory distress syndrome (ARDS) was based on the acuteness of respiratory symptoms, bilateral opacities observed on chest X-ray, and impaired oxygenation, as per the WHO guidelines on clinical management of severe acute respiratory infection in COVID-19 patients (WHO, 2020b). Underlying conditions were self-reported by patients based on the previous diagnosis, or were reported on referral notes for referred cases.

Data management and analysis

Data were collected on sociodemographic characteristics, symptoms, exposure history, and pre-existing medical conditions using standardized data collection forms that were adopted from those developed by the World Health Organization (WHO). Attending physicians conducted interviews with patients, or with their relatives in the case of minors, the severely/critically ill, or deceased patients. Blood samples were taken immediately after the patient was diagnosed with COVID-19. Within an hour of collection, samples were transported in cooler boxes spiked with ice packs to the Central Pathology Laboratory at Muhimbili National Hospital for laboratory analysis. Data were managed using Go.Data open-source software (https://www.who.int/godata).

Bivariate analyses were conducted to compare the associations between symptoms, pre-existing conditions, and sociodemographic characteristics and mortality rate. Associations between explanatory and response variables were performed using chi-square. The relationships between the explanatory variables (symptoms, age, sex, and comorbidities) and death rate over a follow-up period of 21 days were analyzed using the Cox regression model. Association was deemed significant if the *p*-value was less than 5%.

Results

Sociodemographic characteristics

In total, 121 people positive for COVID-19 were recruited. The majority were male and ≤ 60 years old. Seven were children, while four were pregnant women (Table 1).

Presenting symptoms and signs

Table 2 shows the sociodemographic characteristics and presenting symptoms found among patients. The majority of patients presented with headache (54.6%), cough (48.8%), fever (47.8%), shortness of breath (46.3%), fatigue (45.5%), and chest pain (41.3%). The median time from onset of symptoms to reporting to the hospitals was 3 (IQR 1–6) days. Seven (5.8%) patients were asymptomatic[1], including one adult (a 35-year-old female) and six children (aged 3–12 years). These patients were among individuals who were isolated as a result of an outbreak on the oncology ward at Muhimbili National Hospital. On arrival, 56/121 (46.3%) patients had oxygen saturation < 94% (IQR 60–93%). Of the 121 patients, 44 (36.4%) had underlying conditions. The prevalences of underlying conditions were as follows: heart disease 16/121 (13.2%), diabetes 13/121 (10.7%), obesity 10/121 (8.3%), and cancer 5/121 (4.1%). Bivariate analysis showed that shortness of breath, altered consciousness, muscle pain, and neurological signs were significantly associated with mortality in COVID-19 patients (Table 2). Physical examination revealed that 58 (48%) patients were febrile, 48 (40%) had dyspnea and tachypnea, 18 (14.9%) had abnormalities on lung auscultation, 13 (10.7%) had pharyngeal exudates, three (2.5%) had seizure, one (0.8%) was in coma, and one (0.8%) had conjunctival injection.

[1] Following an outbreak in the pediatric oncology ward, all patients and caregivers were tested for COVID-19. Six children and one adult (mother of one of the children) were found positive, though had no symptoms, and were therefore transferred to the designated COVID-19 hospital — Amana Regional Referral Hospital. These patients remained asymptomatic after 21 days of follow-up.

Table 1
Socio-demographic and clinical characteristics of cases (n = 121)

Characteristics	Patients, n (%)
Age (years)	
Median (IQR)	41 (30–54)
Minimum	2
Maximum	97
Age group (years)	
< 29	28 (23.2)
30–59	73 (60.3)
60+	20 (16.5)
Sex	
Female	49 (40.5)
Male	72 (59.5)
Site	
Hindu Mandal Hospital	8 (6.6)
Amana Regional Referral Hospital	113 (93.4)
Time from onset to recovery (days)	
Median (IQR)	14 (9—22)
Time from onset to death (days)	
Median (IQR)	10.5 (8–13)
Time from onset to hospitalization/admission (days)	
Median (IQR)	3.0 (1–6)
Time from admission to recovery (days)	
Median (IQR)	10 (6–18)
Time from admission to death (days)	
Median (IQR)	5.5 (3–9)
Pregnancy (female)	
Yes	4 (8.2)
No	43 (91.8)
Occupation	
Employed	36 (29.8)
Self-employed	62 (51.2)
Unemployed	18 (14.9)
Farmer/peasant/fishermen	5 (4.1)
Patients' exposure (14 days before the onset of symptoms)	
Travel domestically	3 (2.5)
Contact with case	5 (4.1)
Attended mass gathering*	20 (16.5)
Contact with person with similar illness	10 (8.3)
Attended inpatient care	32 (26.5)
Attended outpatient care	43 (35.5)
Comorbidity status	
COVID-19 only, i.e. no comorbidity	77 (63.7)
One comorbidity condition (COVID-19 + one NCD condition)	24 (19.8)
Two comorbidities (COVID-19 + two NCD conditions)	13 (10.7)
Three or more comorbidities	7 (5.8)
Magnitude of symptoms	
Asymptomatic	7 (5.8)
1 symptom	6 (5.0)
2 symptoms	4 (3.3)
3 symptoms	17 (14.1)
4 symptoms	13 (10.7)
≥ 5 symptoms	74 (61.1)
Complications	
No complications	113 (93.4)
One complication	5 (4.1)
Two complications	2 (1.7)
Three or more complications	1 (0.8)
Types of complication	
Mechanical ventilation	7 (5.8)
Acute renal failure	2 (1.7)
Cardiac failure	2 (1.7)
Consumptive coagulopathy	1 (0.8)

*Funerals, weddings, concerts, and worship gatherings

Table 2
Prevalence of mortality among cases with and without symptoms, pre-existing conditions, and complications (n = 121); adjusted for comorbidities

Symptom	Responses	N (%)	Mortality, n (%)	p-value
Fever	No	54 (44.6)	8 (14.8)	0.986
	Yes	67 (55.4)	10 (14.9)	
Sore throat	No	89 (73.6)	10 (11.2)	0.061
	Yes	32 (26.4)	8 (25.0)	
Runny nose	No	93 (76.9)	14 (15.1)	0.920
	Yes	28 (23.1)	4 (14.3)	
Cough	No	56 (46.3)	6 (10.7)	0.232
	Yes	65 (53.7)	12 (18.5)	
Shortness of breath	No	56 (46.3)	1 (1.8)	< 0.001
	Yes	65 (53.7)	17 (26.2)	
Chills	No	96 (79.3)	13 (13.5)	0.419
	Yes	25 (20.7)	5 (20.0)	
Vomiting	No	111 (91.7)	17 (15.3)	0.651
	Yes	10 (8.3)	1 (10.0)	
Nausea	No	111 (91.7)	17 (15.3)	0.651
	Yes	10 (8.3)	1 (10.0)	
Diarrhea	No	113 (93.4)	17 (15.0)	0.845
	Yes	8 (6.6)	1 (12.5)	
Headache	No	48 (39.7)	7 (14.5)	0.942
	Yes	73 (60.3)	11 (15.1)	
Rash	No	119 (98.4)	18 (15.1)	0.551
	Yes	2 (1.6)	0 (0.0)	
Conjunctivitis	No	120 (99.2)	18 (15.0)	0.675
	Yes	1 (0.8)	0 (0.0)	
Muscle aches	No	69 (57.0)	4 (5.8)	0.001
	Yes	52 (43.0)	14 (26.9)	
Joint aches	No	76 (62.8)	10 (13.2)	0.490
	Yes	45 (37.2)	8 (17.8)	
Loss of appetite	No	75 (62.0)	8 (10.7)	0.097
	Yes	46 (38.0)	10 (21.7)	
Nosebleed	No	119 (98.4)	17 (14.3)	0.159
	Yes	2 (1.6)	1 (50.0)	
Fatigue	No	64 (52.9)	4 (6.3)	0.005
	Yes	57 (47.1)	14 (24.5)	
Seizures	No	117 (96.7)	18 (15.4)	0.395
	Yes	4 (3.3)	0 (0.0)	
Altered consciousness	No	113 (93.4)	13 (11.5)	<0.001
	Yes	8 (6.6)	5 (62.5)	
Neurological signs	No	118 (97.5)	16 (13.6)	0.011
	Yes	3 (2.5)	2 (66.7)	
Chest pain	No	65 (53.7)	9 (13.9)	0.732
	Yes	56 (46.3)	9 (16.1)	
Loss of taste	No	96 (79.3)	14 (14.6)	0.859
	Yes	25 (20.7)	4 (16.0)	
Loss of sense of smell	No	97 (80.2)	15 (15.5)	0.715
	Yes	24 (19.8)	3 (12.5)	
Palpitations	No	96 (79.3)	13 (13.5)	0.419
	Yes	25 (20.7)	5 (20.0)	

Disease severity and clinical outcomes

Of the 121 patients, nine (7.0%) were seen as outpatients, and the remainder (112; 93%) were hospitalized. Of the hospitalized patients 17/112 (15.2%) were admitted to ICU, and 14 (five female) died, giving an ICU death rate of 82.4%. Of the 95 patients who were admitted to the medical ward, four (4.2%) died. Of all 112 hospitalized patients, 84 (75%) recovered, as did all nine (100%) outpatients. All seven (5.8%) asymptomatic patients remained asymptomatic at the end of the follow-up. The death rate for all admissions was 16.1% (18/112), while the overall death rate for all COVID-19 patients (including those seen as outpatients) was 14.9% (18/121) (Figure 1). Out of 44 patients with underlying conditions, 12 died (mortality rate = 27.3%). Among the remaining 77 patients without underlying conditions, six died (mortality rate = 8.0%). All children in this cohort survived. The median (IQR) age of patients who died was 58.0 (54–61) years. Median times from onset of symptoms to hospital admission, recovery, and death were 3 (1–6) days, 14 (9–22), and 10.5 (8–13) days, respectively (Table 1).

Underlying conditions and complications

In total, seven patients had complications at the time of recruitment, including two with acute renal failure, two with cardiac failure, two with hypertension requiring vasopressors, and one with consumptive coagulopathy (Table 3). Overall, 44 (36.4%) patients had one or more underlying condition, including 24 (19.8%) with a single underlying condition, 13 (10.7%) with two underlying conditions, and seven (5.8%) had three or more underlying conditions. The cause of death was determined and documented by the certifying doctor. COVID-19 was the primary cause

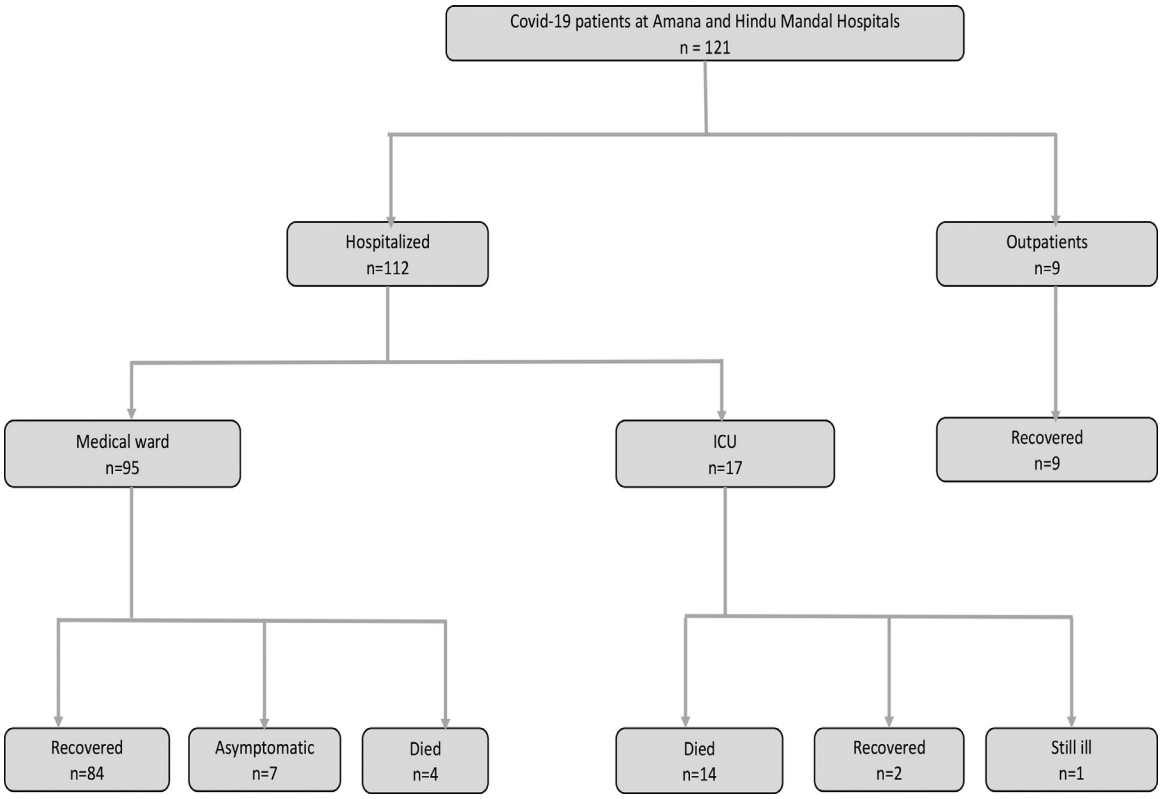

Figure 1. Patient admission and outcomes at 21-day follow-up

Table 3
Pre-existing conditions and their effect on mortality

Variable	Response	*N*	Mortality (%)	*p*-value	Unadjusted risk ratio (95% CI)
Obesity	Yes	10	30	0.161	2.1 (0.6–7.2)
	No	111	13.5		Ref
Cancer	Yes	5	0	0.34	Empty
	No	116	15.5		Ref
Diabetes	Yes	10	30	0.161	2.1 (0.6–7.1)
	No	111	13.5		Ref
HIV	Yes	4	50	0.045	3.0 (0.7–13.2)
	No	117	13.7		Ref
Heart disease	Yes	16	37.5	0.006	3.7 (1.4–10.0)
	No	105	11.4		Ref
Chronic liver disease	Yes	1	100	0.016	4.6 (0.6–36.1)
	No	120	14.2		Ref
Hematology cal disorder	Yes	2	0	0.551	Empty
	No	119	15.1		Ref
Kidney disease	Yes	4	25	0.563	1.5 (0.2–11.6)
	No	117	14.5		Ref

of death in three patients and secondary/contributing for 15 patients. The immediate cause of death for all 18 fatalities was respiratory failure following severe acute respiratory distress syndrome.

Of those who died, 12/18 (66.7%) had at least one comorbidity. of the twelve, four had two or more comorbidities and six had heart disease, three had diabetes, and two had HIV. Of the survivors, 32 (31.1%) had at least one comorbidity, including 10 (31.3%) with heart disease, seven (21.9%) with diabetes, two (6.3%) with HIV, and seven (21.9%) who were obese. Among the survivors with comorbidities, 16 (50.0%) had two or more comorbidities. Bivariate analyses showed that heart disease and HIV were significantly associated with mortality in COVID-19 patients (Table 3). In addition, both unadjusted and adjusted analyses showed an association of mortality with comorbidity, shortness of breath, fatigue, muscle pain, altered consciousness, and age (Tables 4 and 5). The death rate recorded at 6 weeks was 0.4 for COVID-19 patients with comorbidity and 0.125 for patients without comorbidity from the date of onset of symptoms. The last death was recorded at week 3 for patients with comorbidity and week 5 for patients without comorbidity (Figure 2).

Laboratory findings

Low levels of hemoglobin were present in 26/64 (40.6%) patients. Among renal function parameters, 22/63 (35.5%) patients had high levels of potassium and 28/62 (44.4%) had low levels of BUN. Liver function parameters were within normal levels in the majority of patients. Liver enzymes ALT and AST were elevated in 10/62 (16.1%) and 23/61 (37.7%) patients, respectively. Inflammatory markers ESR and ferritin were raised in many patients — ESR in 29/54 (53.7%) and ferritin in 24/59 (40.7%). A low level of CRP was observed in 40/59 (67.8%) patients. Coagulation indices PT and INR were both reduced in 5/18 (27.8%) patients. The majority of patients had elevated levels of D-dimer (31/49; 63.3%). Decreased PTT was observed in 11/18 (61.1%) patients (Table 6).

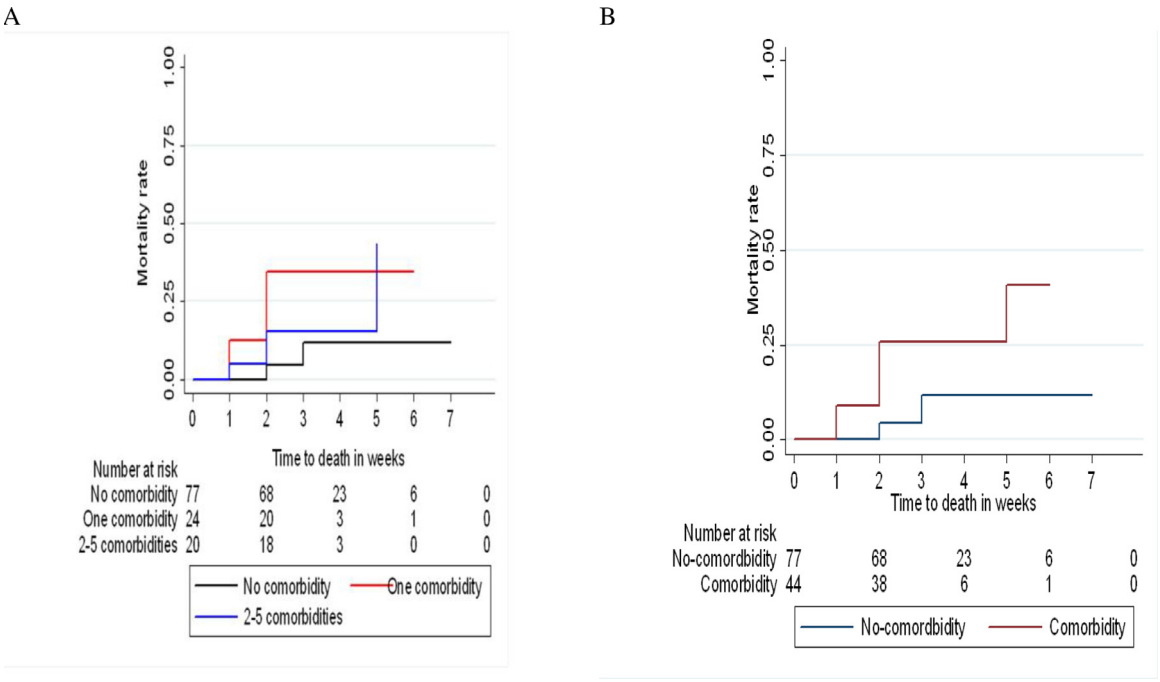

Figure 2. Kaplan–Meier survival curves showing cumulative mortality rates among patients with underlying conditions against those with no underlying conditions from the date of onset of symptoms

Table 4
Factors associated with mortality among COVID-19 cases (Cox proportional-hazards model)

Variable	UHR (95% CI)	*p*-value	AHR (95% CI)	*p*-value
Demographic				
Age				
< 60 years	Ref		Ref	
60+ years	3.6 (1.4–9.2)	0.009	2.7 (1.02–7.2)	0.045
Sex				
Male	2.0 (0.7–5.5)	0.200	2.0 (0.7–5.6)	0.191
Female	Ref		Ref	
Symptoms				
Shortness of breath				
No	Ref		Ref	
Yes	15.6 (2.1–117.5)	0.008	13.2 (1.8–99.9)	0.012
Muscle aches				
No	Ref		Ref	
Yes	4.2 (1.4–1.9)	0.011	3.5 (1.1–10.8)	0.030
Fatigue				
No	Ref		Ref	
Yes	3.9 (1.3–11.9)	0.016	4.4 (1.4–13.3)	0.010
Altered consciousness				
No	Ref		Ref	
Yes	6.4 (2.3–18.3)	<0.001	5.4 (1.9–15.5)	0.002
Neurological signs				
No	Ref		Ref	
Yes	5.0 (1.1–22.1)	0.032	3.8 (0.8–17.1)	0.083
Comorbidity status				
Comorbidity				
No	Ref		Ref	
Yes	3.6 (1.4–9.8)	0.012	3.1 (1.1–8.5)	0.028

UHR: unadjusted hazard ratio; AHR: adjusted hazard ratio. Comorbidity was adjusted for age and sex; all symptoms were adjusted for comorbidity; comorbidity was adjusted for age and sex; age and sex were adjusted for comorbidity.

Table 5
Factors associated with mortality among COVID-19 cases (Cox proportional-hazards model)

Variable	UHR (95% CI)	*p*-value	AHR (95% CI)	*p*-value
Demographic				
Age				
≤ 50 years	Ref		Ref	
> 50 years	8.4 (2.8–25.6)	<0.001	6.7 (2.1–21.2)	0.001
Sex				
Male	2.0 (0.7–5.5)	0.200	2.0 (0.7–5.6)	0.191
Female	Ref		Ref	
Symptoms				
Shortness of breath				
No	Ref		Ref	
Yes	15.6 (2.1–117.5)	0.008	13.2 (1.8–99.9)	0.012
Muscle aches				
No	Ref		Ref	
Yes	4.2 (1.4–1.9)	0.011	3.5 (1.1–10.8)	0.030
Fatigue				
No	Ref		Ref	
Yes	3.9 (1.3–11.9)	0.016	4.4 (1.4–13.3)	0.010
Altered consciousness				
No	Ref		Ref	
Yes	6.4 (2.3–18.3)	<0.001	5.4 (1.9–15.5)	0.002
Neurological signs				
No	Ref		Ref	
Yes	5.0 (1.1–22.1)	0.032	3.8 (0.8–17.1)	0.083
Comorbidity status				
Comorbidity				
No	Ref		Ref	
Yes	3.6 (1.4–9.8)	0.012	3.1 (1.2–8.2)	0.025

Un-Adjusted Hazard Ratio (UHR) and Adjusted Hazard Ratio (AHR), Comorbidity was adjusted for age and sex, all symptoms were adjusted for comorbidity, comorbidity was adjusted for age and sex, age and sex were adjusted for comorbidity

Chest X-ray was performed in 24 patients on admission, with radiographs showing eight with bilateral atypical pneumonia, eight with bilateral pneumonia, two with ground-glass opacities, one with bilateral interstitial lung disease, and one with unilateral interstitial lung disease. The remaining four patients had a normal chest X-ray.

Discussion

This study provided insights into the clinical characteristics and outcomes of SARS-CoV-2 infection during the early stage of the COVID-

Table 6
Laboratory results for 121 patients infected with SARS-CoV-2

Parameters	*N*	Reference	Normal, *n* (%)	Decreased, *n* (%)	Increased, *n* (%)
WBC (K/μL)	64	4–10	43 (67.2)	15 (23.4)	6 (9.4)
Neutrophils abs (K/μL)	63	2–6.9	35 (55.6)	16 (25.4)	12 (19.0)
Neutrophils (%)	55	40–80	36 (65.5)	12 (21.8)	7 (12.7)
Lymphocytes abs (K/μL)	63	0.6–3.4	55 (87.2)	4 (6.4)	4 (6.4)
Lymphocytes (%)	55	20–40	21 (38.2)	15 (27.3)	19 (34.5)
Monocytes abs (K/μL)	55	0–0.9	50 (90.0)	0 (0.0)	5 (9.1)
Monocytes (%)	55	2–10	35 (63.6	4 (7.3)	16 (29.1)
Eosinophils abs (K/μL)	63	0–0.7	58 (92.1)	0 (0.0)	5 (7.9)
Eosinophils (%)	55	1–6	23 (41.8)	32 (55.2)	0 (0.0)
Basophils abs (K/μL)	63	0–2	63 (100)	0 (0.0)	0 (0.0)
Basophils (%)	55	0.02–0.1	0 (0.0)	0 (0.0)	55 (100)
RBC (M/μL)	56	3.8–4.8	27 (48.2)	6 (10.7)	23 (41.1)
HB (g/dl)	64	12–15	32 (50.0)	26 (40.6)	6 (9.4)
Platelet count (K/μL)	64	150–410	59 (92.2)	2 (3.1)	3 (4.7)
BUN M (mol/L)	62	2.5–6.7	34 (54.8)	22 (35.5)	6 (9.7)
Creatinine (μmol/L)	63	50.4–98.1	50 (79.4)	2 (3.2)	11 (17.5)
Potassium (mmol/L)	63	3.5–5.1	33 (52.4)	2 (3.2)	28 (44.4)
Sodium (mmol/L)	63	136–145	41 (65.1)	16 (25.4)	6 (9.5)
Chloride (mmol/L)	64	98–107	49 (76.6)	10 (15.6)	5 (7.8)
Uric acid (mmol/L)	56	0.15–0.35	45 (80.4)	3 (5.4)	8 (14.3)
Calcium-ionized (mmol/L)	61	2.1–2.55	39 (63.9)	11 (18.0)	11 (18.0)
Magnesium (mmol/L)	63	0.66–1.07	45 (71.4)	6 (9.5)	12 (19.1)
ALT (SGPT) (U/L)	62	0–55	52 (83.9)	0 (0.0)	10 (16.1)
AST (SGOT) (U/L)	61	5–34	38 (62.3)	0 (0.0)	23 (37.7)
Alkaline phosphatase (U/L)	42	40–150	37 (88.1)	3 (7.1)	2 (7.8)
Total bilirubin (μmol/L)	54	3.4–20.5	50 (92.6)	2 (3.7)	2 (3.7)
Direct bilirubin (μmol/L)	47	0–8.6	45 (95.7)	0 (0.0)	2 (4.3)
Albumin (g/dl)	60	35–50	52 (86.7)	8 (13.3)	0 (0.0)
ESR (Westergren) (Mm/hr)	54	0–20	25 (46.3)	0 (0.0)	29 (53.7)
Ferritin (ng/mL)	59	10–250	31 (52.5)	4 (6.8)	24 (40.7)
C-reactive protein (mg/L)	59	0–5	19 (32.2)	40 (67.8)	0 (0.0)
PT (s)	18	9.4–12	12 (66.7)	5 (27.8)	1 (5.6)
PTT (s)	18	25.4–36.9	7 (38.9)	11 (61.1)	0 (0.0)
INR (s)	18	0.8–1.2	12 (66.7)	5 (27.8)	1 (5.6)
D-dimer (ng/mL)	49	0–198	18 (36.7)	0 (0.0)	31 (63.3)

19 pandemic in Tanzania. Generally, patients infected with SARS-Cov-2 presented with symptoms similar to those described previously (Cascella et al., 2020; Chen et al., 2020; Guan et al., 2020; Huang et al., 2020; Lai et al., 2020; Pan et al., 2020; Wang et al., 2020; Wu, 2020). Three-quarters were aged ≤ 60 years, and high rates of comorbidity, hospital mortality, and admission to ICU were observed. Quantitative D-dimer levels were elevated in three-fifths of those tested, with decreased PTT (3/5) and PT (3/10) also observed. These indicators suggest the existence of a thromboembolic process, which includes disseminated intravascular coagulation — pathogenesis that is consistent with COVID-19.

Most of the COVID-19 patients were male, which was in line with prior studies on COVID-19 patients (Goyal et al., 2020; Grasselli et al., 2020; Guan et al., 2020) and those with other respiratory infectious diseases. The median age of the participants was 41 years; this was similar to that reported in South Africa (Kaswa et al., 2021), but lower than those reported in China (47 years) (Guan et al., 2020), Libya (56) (Elhadi et al., 2021), New York (62.2 years) (Goyal et al., 2020), and Italy (63) (Grasselli et al., 2020). Moreover, the majority of COVID-19 patients were aged ≤ 60 years, reflecting the demographic structure of sub-Saharan Africa, which is dominated by a younger population in comparison with other regions of the world. A young population can be considered as a protective factor against the disease severity.

Our study reported a case fatality rate of 15%, which was higher than those reported in Europe and America (Chen et al., 2020; Guan et al., 2020; Huang et al., 2020). However, the hospital death rate was lower (16.1%) in comparison with those reported in Europe (22.9%) and America (22.23%) (Goel et al., 2020). The admission rate to ICU was 14%, with previous studies reporting rates ranging from 5% to 26% (Immovilli et al., 2020; Richardson et al., 2020; Wang et al., 2020; WHO, 2020a; C. Wu et al., 2020). In our study, the mortality rate among those admitted to ICU was high, at 82%, which corroborates results described in previous studies (Auld et al., 2020; Bhatraju et al., 2020). Previous studies have demonstrated that individuals aged over 60 years and those with underlying conditions are at the highest risk for severe disease and poor clinical outcomes, including mortality (CDC COVID-19 Response Team, 2020; WHO, 2020a).

Our findings suggested that clinical manifestations of COVID-19, ranging from asymptomatic or mild to acute respiratory failure or even death were consistent with those published previously (Cascella et al., 2020; Chen et al., 2020; Guan et al., 2020; Huang et al., 2020; Lai et al., 2020; Pan et al., 2020; Wang et al., 2020; Wu et al., 2020). ARDS is a common clinical manifestation of severe COVID-19; 17% of patients in our cohort developed ARDS. Abnormal chest X-ray radiographs were observed in 20/24 patients, of which 16 were suggestive of pneumonia.

Variations in prevalences of symptoms and disease severity in our study can be attributed to geographical factors and/or merely to chance. For example, in our study, headache was the most common complaint among COVID-19 patients, while in China and New York cough was the most presenting symptom reported (Auld et al., 2020; Guan et al., 2020). Children represented a small portion of the participants in our study (5.8%; 7/121), of whom six did not develop symptoms and remained asymptomatic for 21 days of follow-up. This observation was consistent with previous studies, which have reported a high prevalence of asymptomatic and mild COVID-19 cases among children (Arons et al., 2020; Miri et al., 2020). The presence of a large percentage of mild and asymptomatic cases may imply that many cases are going unnoticed, especially in sub-Saharan Africa, where poor healthcare-seeking behaviour is common. This might be contributing to the virus spread, thus highlighting the need for rigorous case identification in order to halt the transmission.

Our analyses focusing on renal and liver function and hematological parameters demonstrated that inflammatory markers were elevated in most COVID-19 patients, suggesting the presence of damage in these

vital organs. Previous COVID-19 studies have reported effects in almost all the body's primary organs, including damage (Auld et al., 2020; Chen et al., 2020; Tang et al., 2020).

Conclusion

This study was the first to report on clinical characteristics and outcomes in patients infected with COVID-19 in the Tanzanian context. The majority of COVID-19 patients were aged ≤ 60 yrs, with a high prevalence of comorbidities. The mortality rate reported in this study was comparable with other published hospital-based studies.

Contributions

NPM, CL, EN, SGM, GK, and MS conceived the idea and codesigned the study. CL, GK AZ, SJ, and SGM supervised the study. CL and MS coordinated data collection. NPM, CL, EN, and GBK analyzed the data. NPM, CL, and EN drafted the manuscript. EN, GK, GBK, SB, AM, PK, NO, JMM, KR, AZ, SJ, and SGM revised the manuscript, while NPM compiled the final version. All authors approved the final version for publication.

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Declaration of Competing Interest

All authors declare no competing interests.

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