**Clinical characteristics and outcomes of confirmed COVID-19 patients in the early months of the pandemic in Tanzania: A multicentre cohort study**

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Running tittle: Clinical outcomes of COVID-19 patients in Tanzania

**Abstract**

**Background:** Data on demographic, clinical features, and outcomes of patients with COVID-19 admitted to hospitals in Tanzania are scanty. We performed a prospective cohort study of the clinical presentations and management outcomes of laboratory-confirmed COVID-19 patients in the early months of the pandemic at 2 hospitals in Dar es Salaam, Tanzania.

**Methods:** Between April 1 - May 31, 2020, laboratory confirmed COVID-19 patients seen at two tertiary facilities (Amana Regional Referral Hospital –and Hindu Mandal Hospital) were consecutively enrolled in the study and followed up for 21 days.

**Results:** We enrolled 121 COVID-19 patients; 112 (92.6%) were admitted while 9 (7.4%) were seen as outpatients. The median (IQR) age of patients was 41 (30-54) years; 72 (59.5%) were male. Patients infected with SARS-Cov-2 presented with similar symptoms as the rest of the world. The median (IQR) reported days from hospital admission to recovery and death was 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 which 14 (82.3%) died. Overall, at the end of follow-up, of the 121 patients, 93(76.9%) recovered and 18 (14.9%) died, 7 (5.8%) remained asymptomatic and 1 (0.8%) was still ill. Common complications were acute respiratory distress syndrome [17.5%]) and Mechanical ventilation 7(5.8).

**Conclusion:** Three-quarters of all COVID-19 patients were aged less than 60 years reflecting the young population structure in Africa. High admission rate to ICU (15.2%) and death rate (14.9%) were observed.

**Keywords:** SARS-Cov-2; COVID-19; Clinical outcomes

**Introduction**

Coronavirus Disease 2019 (COVID-19) was first reported in Wuhan, China [1], caused by a highly contagious novel coronavirus named Severe Acute Respiratory Syndrome-Coronavirus 2 (SARS-CoV-2) [2]. The outbreak was declared the as pandemic by the World Health Organization (WHO) on March 11, 2020 [3], and as of July 17, 2021, more than 189 million cases including at least 4 million death had been reported worldwide [4]. Sub-Saharan Africa, which has the most vulnerable populations due to the high prevalence of HIV/AIDS, tuberculosis, and malnutrition coupled with a weak health system compared to other continents, had notified only <0.05% of all cases worldwide, augments 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 illness, approximately 14% develop severe disease that requires hospitalization and oxygen support with increased fatality rates [5]. Individuals infected with SARS-CoV-2 have been reported to exhibit a varying spectrum of the clinical features ranging [6–10] and that have been changing from mild to more life-threatening as a result of the emerging highly transmissible variants [11–13].

People with underlying conditions such as hypertension, chronic lung disease, diabetes, and cardiovascular diseases have compromised immune system, and are more likely to suffer from severe disease, and high fatality rate [5,14]. The risk for serious adverse outcomes increases with the number of underlying conditions; those with three or more underlying conditions suffer the most [15]. Similarly, findings from Europe, and America have shown that COVID-19 infection in individuals aged over 60 years [5,16] is associated with serious adverse outcomes. The proportion of severe or fatal infections have also been reported to vary by geographical region/location. Here, we 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 and Hindu Mandal Hospital, both located in Dar es Salaam, Tanzania. Amana Referral Hospital is a public hospital and on April 15, 2020, it was designated COVID-19 Centre and closed to non-COVID-19 patients. Thus, Amana managed COVID-19 cases from across Dar es Salaam city. Hindu Mandal is a private not-for-profit hospital that generally sees 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 enrol into the study. Patients were consecutively recruited between April 1-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 parents/guardians for minors.

**Diagnosis and laboratory procedures**

The National Rapid Response Team under the MoHCDGEC, Tanzania was responsible for sample collection and transportation for COVID-19 testing. Sample handling was as per the protocol described previously [17]. Laboratory confirmation of SARS-CoV-2 was done using real-time PCR at the National Public Health Laboratory located in Dar es Salaam, as per the protocol described previously [13]. Serum samples were collected from cases as soon as possible after laboratory confirmation. Laboratory tests were performed at Muhimbili National Hospital, Dar es Salaam: Renal function tests (RFTs), Full blood count with differentials (FBC), Liver function tests (LFTsC-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. Chest X-ray was performed only when requested by the attending physician. Diagnosis of acute respiratory distress syndrome (ARDS) was based on acuteness of respiratory symptoms, bilateral opacities observed on chest X-ray, and impaired oxygenation as per the WHO guideline on clinical management of severe acute respiratory infection in COVID-19 patients [18]. Underlying conditions were self-reported by patients based on the previous diagnosis or were reported on referral note for referred cases.

**Data management and analysis**

We collected data on socio-demographic characteristics, symptoms, exposure history, and pre-existing medical conditions using standardized data collection forms that were adopted from the World Health Organization (WHO) forms. Attending physicians, conducted interviews with patients or their relatives in the case of minors, severely/critically ill, or deceased patients. Blood samples were taken immediately after the patient was diagnosed with COVID-19 and 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 (<https://www.who.int/godata>) open-source software.

Bivariate analysis to compare the association between symptoms, pre-existing conditions, and socio-demographic characteristics against mortality rate were conducted. Association between explanatory and response variables was done using Chi-square. The relationship between the explanatory variables (symptoms, age, sex, and comorbidity) against death rate over a follow-up period of 21 days was analyzed using the Cox regression model. Association was valid if the *p*-value was less than 5%.

**Results**

**Sociodemographic characteristics**

A total of 121 people positive with COVID-19 were recruited. The majority were male and ≤ 60 years old. Seven were children while 4 were pregnant woman (see Table 1).

**Presenting symptoms and signs**

Table 2 shows sociodemographic characteristics and presenting symptoms 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]](#footnote-1); 1 adult (35 years old female) and six children (aged 3 - 12 years). These patients were among individuals who were isolated as a result of an outbreak at the oncology ward at the 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 prevalence of underlying conditions was as follows: heart diseases (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, 3 (2.5%) had seizure, 1 (0.8%) was in coma and 1 (0.8%) had conjunctival injection.

Above you are combining children and adults – e.g., when presenting heart disease or diabetes.

**Disease severity and clinical outcomes**

Of the 121 patients, 9 (7.0%) were seen as outpatients and the reminder 112 (93%) were hospitalized. 17/112 (15.2%) of hospitalized patients were admitted to ICU and 14 (5 were female) died which translates to an ICU death rate of 82.4%. Of the 95 patients who were admitted to the medical ward, 4 (4.2%) died. Of all 112 hospitalized patients, 84 (75%) recovered as did for all 9 (100%) outpatients. All 7 (5.8%) asymptomatic patients remained asymptomatic at the end of the follow up. The death rate for all admissions was 16.07% (18/112) and 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, 6 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 time from onset of symptoms to; hospital admission was 3.0 (1-6), recovery (14 [9-22]), death (10.5 [8-13]) (Table 1).

Underlying condition and complications

A total of 38 patients had complications at the time of recruitment; ARDS (21), pneumonia evident on chest x-ray (16), acute renal failure (2), cardiac failure (2), hypertension requiring vasopressors (2) and 1 had consumptive coagulopathy (Table 3). Overall, 46 (38.3%) patients had one or more underlying conditions, 24 (19.8%) had a single underlying condition, 13 (10.7%) had 2 underlying conditions while 7 (5.8%) had 3 or more underlying conditions. COVID-19 was the primary cause of death in 3 patients, and secondary/contributing for 15 patients. The cause of death was determined and documented by the certifying doctor. 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 while 4 had two or more comorbidities; 6 had heart diseases, 3diabetes, and 2 HIV. Of the survivors, 32 (31.1%) had at least one comorbidity, 10 (31.3%) heart disease, 7 (21.9%) diabetes, 2 (6.3%) HIV and 7 (21.9%) were obese. Among survivors with comorbidity, 16 (50.0%) had two or more comorbidities. Bivariate analysis showed that heart disease and HIV were significantly associated with mortality in COVID-19 patients (Table 3).

In addition, both unadjusted and adjusted analysis showed association of mortality with: comorbidity, shortness of breath, fatigue, muscles pain, altered consciousness and age (Table 4 and 5). The death rate recorded at 6-week was 0.4 for COVID-19 patients with co-morbidity and 0.125 for patients without comorbidity from the date of onset of symptoms. Last death was recorded at week 3 for patients with co-morbidity 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%) had a high level of Potassium and low levels of BUN (28/62 [44.4%]). 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 reduced by 27.8% each. The majority had elevated levels of D – dimer (31/49 [63.3%]). Decreased PTT was also observed in the majority of patients (11/18 (61.1%)) (Table 6).

Chest x-ray was done in 24 patients on admission and radiographs showed that 8 had bilateral atypical pneumonia, 8 bilateral pneumonia, 2 ground-glass opacities, 1 bilateral interstitial lung disease, and 1 unilateral interstitial lung disease. The remaining 4 patients had a normal chest X-ray.

**Discussion**

This study provides insights into the clinical characteristics and outcomes of SARS-CoV-2 infection at the early of the pandemic 2020, first report in Tanzania. Generally, patients infected with SARS-Cov-2 presented with symptoms similar to those described previously [6–13], and three-quarters were aged ≤60 years), high co-morbidities, hospital mortality, and admission to ICU were observed. Quantitative D-dimer levels were elevated in three-fifths and decreased PTT (3/5) and PT (3/10) were observed. These indicators suggest the existence of thromboembolic process which includes disseminated intravascular coagulation; a pathogenesis that is consistent with COVID-19.

Males constituted most of the COVID-19 patients, these findings are constituent with prior-studies in COVID-19 patients [13,19,20] and other respiratory infectious diseases. The median age of the participants was 41 years, equivalent to that reported in South Africa [21] relatively lower than those reported in China (47 years) [13], Libya (56) [22], New York (62.2 years) [19], and Italy (63) [20]. Also, the majority of COVID-19 patients were aged ≤ 60 years, which reflects the demographic structure of sub-Saharan Africa that is dominated by a younger population as compared to other regions of the world. The young population can be considered as a protective factor against the disease severity. Our findings reported case fatality rate of 15% that was relative higher than those reported in Europe and America [8,10,13]. However, Hospital death rate was lower (16.1%) compared to that reported in Europe (22.9%) and America (22.23%) [23]. In the present study, the admission rate to ICU was 14% and previous studies have reported that rates for patients requiring admission to ICU ranges from 5% to 26% [5,6,24–26]. In this study, the mortality rate among those admitted to ICU was high at 82%, corroborates with those described in the previous studies [27,28]. 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 high mortality [5,14]. ARDS and pneumonia were the complications identified in this study, and cox regression analysis suggested that at any time point, eleventh-folds as many patients succumbed proportionally to those without complications. However, it should be noted that none of the 4 pregnant women died or developed complications during the illness.

Our findings suggest that clinical manifestations of COVID-19 that range from asymptomatic, mild to acute respiratory failure and even death, were consistent with those published previously [6–13]. Variation in proportions of symptoms and disease severity in this study can be attributed to geographical factors and/or merely by 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 [13,28] in COVID-19 patients. Children represented a small portion of the participants (5.8, N=7), of which 6 children did not develop symptoms and remained asymptomatic for 21 days of follow-up. This observation is consistent with previous studies which have reported a high prevalence of asymptomatic and mild COVID-19 cases among children [29,30]. 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 health-seeking behaviour is common and this might be contributing to the virus spread, thus, a call for rigorously case finding to halt the transmission.

Our basic analysis focusing on renal and liver function, and hematological parameters demonstrated inflammatory markers were elevated in most COVID-19 patients and abnormal chest radiograph was observed in 20 patients, suggesting presence of damage in these vital organs. Previous studies have reported COVID-19 to affect nearly all of the body's primary organs and causes damage [8,28,31].

In conclusion, we have presented a first report on clinical characteristics and outcomes in patients infected with COVID-19 in Tanzanian context. The majority of COVID-19 patients were aged ≤60 with a high proportion of comorbidities. The mortality rate reported in this study is comparable to other hospital based studies and the ARDS was the main cause of death.

**Contributors:** NPM, CL, EN, SGM, GK, and MS conceived the idea and co-designed 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.

**Declaration of Interest:** All authors declare no competing interests.

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**Legends**

**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 condition) | 13(10.7) |
| Three and 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 complication | 83(68.6) |
| One complication | 23(19.0) |
| Two complications | 7(5.8) |
| Three and more | 8(6.6) |
| **Types of complications** |  |
| Mechanical ventilation | 7(5.8) |
| ARDS | 21(17.4) |
| Acute Renal Failure | 2(1.7) |
| Cardiac Failure | 2(1.7) |
| Consumptive coagulopathy | 1(0.8) |
| \*Funerals, wedding, concerts, and worship gathering | |

Table 2: Proportion of mortality among cases with and without symptoms, pre-existing conditions and complications (n=121): adjusted for comorbidity

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Symptom** | **Responses** | **N(%)** | **Mortality n(%)** | **P-values** |
| 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) |  |
| Diarrhoea | 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) |  |
| 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) |  |

**Table 3**: Pre-existing conditions and its effect on mortality

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variable** | **Response** | **N** | **Mortality (%)** | **P-values** | **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 diseases | Yes | 16 | 37.5 | 0.006 | 3.7(1.4-10.0) |
|  | No | 105 | 11.4 |  | Ref |
| Chronic Liver diseases | Yes | 1 | 100 | 0.016 | 4.6(0.6-36.1) |
|  | No | 120 | 14.2 |  | Ref |
| Haematology Cal disorder | Yes | 2 | 0 | 0.551 | Empty |
|  | No | 119 | 15.1 |  | Ref |
| Kidney diseases | Yes | 4 | 25 | 0.563 | 1.5(0.2-11.6) |
|  | No | 117 | 14.5 |  | Ref |

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 |
| Muscles 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 |

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

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 |
| Muscles 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

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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Parameters** | **N** | **Reference** | **Normal n(%)** | **Decreased n(%)** | **Increased n(%)** |
| WBC (K/uL) | 64 | 4 – 10 | 43(67.2) | 15(23.4) | 6(9.4) |
| Neutrophils abs (K/uL) | 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/uL) | 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/uL) | 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/uL) | 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/uL) | 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/uL) | 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/uL) | 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 (umol/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 (umol/L) | 54 | 3.4 – 20.5 | 50(92.6) | 2(3.7) | 2(3.7) |
| Direct Bilirubin (umol/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) |



Figure 1: Patients' admission and outcomes at 21-day follow-up.

|  |  |
| --- | --- |
| B | A |

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

**References**

[1] Phelan AL, Katz R, Gostin LO. The Novel Coronavirus Originating in Wuhan, China: Challenges for Global Health Governance. JAMA - J Am Med Assoc 2020;323:709–10. https://doi.org/10.1001/jama.2020.1097.

[2] Gorbalenya AE, Baker SC, Baric RS, Groot RJ De, Gulyaeva AA, Haagmans BL, et al. The species and its viruses – a statement of the Coronavirus Study Group. Biorxiv (Cold Spring Harb Lab 2020:1–15. https://doi.org/10.1101/2020.02.07.937862.

[3] WHO Timeline - COVID-19 n.d. https://www.who.int/news-room/detail/27-04-2020-who-timeline---covid-19 (accessed May 29, 2020).

[4] WHO. WHO Coronavirus (COVID-19) Dashboard | WHO Coronavirus (COVID-19) Dashboard With Vaccination Data 2021. https://covid19.who.int/ (accessed April 26, 2021).

[5] WHO. Clinical management of severe acute respiratory infection when novel coronavirus (nCoV) infection is suspected 2020;2019.

[6] Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, et al. Clinical Characteristics of 138 Hospitalized Patients with 2019 Novel Coronavirus-Infected Pneumonia in Wuhan, China. JAMA - J Am Med Assoc 2020;323:1061–9. https://doi.org/10.1001/jama.2020.1585.

[7] Cascella M, Rajnik M, Cuomo A, Dulebohn SC, Di Napoli R. Features, Evaluation and Treatment Coronavirus (COVID-19). StatPearls Publishing; 2020.

[8] Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. Lancet 2020;395:507–13. https://doi.org/10.1016/S0140-6736(20)30211-7.

[9] Pan L, Mu M, Yang P, Sun Y, Wang R, Yan J, et al. Clinical Characteristics of COVID-19 Patients With Digestive Symptoms in Hubei, China. Am J Gastroenterol 2020;115:766–73. https://doi.org/10.14309/ajg.0000000000000620.

[10] Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet 2020;395:497–506. https://doi.org/10.1016/S0140-6736(20)30183-5.

[11] Lai C-C, Shih T-P, Ko W-C, Tang H-J, Hsueh P-R. Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and corona virus disease-2019 (COVID-19): the epidemic and the challenges. Int J Antimicrob Agents 2020:105924.

[12] Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention. Jama 2020.

[13] Guan W, Ni Z, Hu Y, Liang W, Ou C, He J, et al. Clinical characteristics of coronavirus disease 2019 in China. N Engl J Med 2020;382:1708–20. https://doi.org/10.1056/NEJMoa2002032.

[14] CDC COVID-19 Response Team. Preliminary Estimates of the Prevalence of Selected Underlying Health Conditions Among Patients with Coronavirus Disease 2019 - United States, February 12-March 28, 2020. MMWR Morb Mortal Wkly Rep 2020;69:382–6. https://doi.org/10.15585/mmwr.mm6913e2.

[15] Ye C, Zhang S, Zhang X, Cai H, Gu J, Lian J, et al. Impact of comorbidities on patients with COVID‐19: A large retrospective study in Zhejiang, China. J Med Virol 2020;92:2821–9. https://doi.org/10.1002/jmv.26183.

[16] Bonanad C, García-Blas S, Tarazona-Santabalbina F, Sanchis J, Bertomeu-González V, Fácila L, et al. The Effect of Age on Mortality in Patients With COVID-19: A Meta-Analysis With 611,583 Subjects. J Am Med Dir Assoc 2020;21:915–8. https://doi.org/10.1016/j.jamda.2020.05.045.

[17] The World Health Organization. Laboratory testing for the 2019 novel Corona virus (2019-nCoV) in suspected human cases 2020:2. https://www.who.int/publications-detail/laboratory-testing-for-2019-novel-coronavirus-in-suspected-human-cases-20200117.

[18] WHO. Clinical management of severe acute respiratory infection when novel coronavirus (nCoV) infection is suspected 2020;2019:12.

[19] Goyal P, Choi JJ, Pinheiro LC, Schenck EJ, Chen R, Jabri A, et al. Clinical Characteristics of Covid-19 in New York City. N Engl J Med 2020. https://doi.org/10.1056/nejmc2010419.

[20] Grasselli G, Zangrillo A, Zanella A, Antonelli M, Cabrini L, Castelli A, et al. Baseline Characteristics and Outcomes of 1591 Patients Infected with SARS-CoV-2 Admitted to ICUs of the Lombardy Region, Italy. JAMA - J Am Med Assoc 2020;323:1574–81. https://doi.org/10.1001/jama.2020.5394.

[21] Kaswa R, Yogeswaran P, Cawe B. Clinical outcomes of hospitalised COVID-19 patients at Mthatha Regional Hospital, Eastern Cape, South Africa: A retrospective study. South African Fam Pract 2021;63. https://doi.org/10.4102/SAFP.V63I1.5253.

[22] Elhadi M, Momen AA, Alsoufi A, Msherghi A, Zaid A, Ali Senussi Abdulhadi OM, et al. Epidemiological and clinical presentations of hospitalized COVID-19 patients in Libya: An initial report from Africa. Travel Med Infect Dis 2021;42:102064. https://doi.org/10.1016/J.TMAID.2021.102064.

[23] Goel S, Jain T, Hooda A, Malhotra R, Johal G, Masoomi R, et al. Clinical Characteristics and In-Hospital Mortality for COVID-19 Across The Globe. Cardiol Ther 2020;9:553–9. https://doi.org/10.1007/s40119-020-00189-0.

[24] Immovilli P, Morelli N, Antonucci E, Radaelli G, Barbera M, Guidetti D. COVID-19 mortality and ICU admission: The Italian experience. Crit Care 2020;24:228. https://doi.org/10.1186/s13054-020-02957-9.

[25] Richardson S, Hirsch JS, Narasimhan M, Crawford JM, McGinn T, Davidson KW, et al. Presenting Characteristics, Comorbidities, and Outcomes Among 5700 Patients Hospitalized With COVID-19 in the New York City Area. JAMA 2020;323:2052. https://doi.org/10.1001/jama.2020.6775.

[26] Wu C, Chen X, Cai Y, Xia J, Zhou X, Xu S, et al. Risk Factors Associated With Acute Respiratory Distress Syndrome and Death in Patients With Coronavirus Disease 2019 Pneumonia in Wuhan, China. JAMA Intern Med 2020;180:934. https://doi.org/10.1001/jamainternmed.2020.0994.

[27] Covid-19 in Critically Ill Patients in the Seattle Region — Case Series | NEJM n.d. https://www.nejm.org/doi/full/10.1056/nejmoa2004500# (accessed July 19, 2020).

[28] Auld SC, Caridi-Scheible M, Blum JM, Robichaux C, Kraft C, Jacob JT, et al. ICU and Ventilator Mortality Among Critically Ill Adults With Coronavirus Disease 2019. Crit Care Med 2020;Publish Ah:1–6. https://doi.org/10.1097/ccm.0000000000004457.

[29] Miri SM, Noorbakhsh F, Mohebbi SR, Ghaemi A. Higher prevalence of asymptomatic or mild COVID‐19 in children, claims and clues. J Med Virol 2020:jmv.26069. https://doi.org/10.1002/jmv.26069.

[30] Arons MM, Hatfield KM, Reddy SC, Kimball A, James A, Jacobs JR, et al. Presymptomatic SARS-CoV-2 Infections and Transmission in a Skilled Nursing Facility. N Engl J Med 2020. https://doi.org/10.1056/nejmoa2008457.

[31] Tang N, Li D, Wang X, Sun Z. Abnormal coagulation parameters are associated with poor prognosis in patients with novel coronavirus pneumonia. J Thromb Haemost 2020;18:844–7. https://doi.org/10.1111/jth.14768.

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 therefore transferred to the designated COVID-19 hospital- Amana Regional Referral hospital. These patients remained asymptomatic after 21 days follow-up. [↑](#footnote-ref-1)