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Incidence and predictors of mortality among COVID-19 patients admitted to treatment centers in North West Ethiopia; A retrospective cohort study, 2021

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ABSTRACT

Background: Currently, coronavirus disease 2019 (COVID-19) is the leading cause of death and the rate of mortality is rapidly increasing over time. There is a paucity of information regarding the incidence and predictors of mortality among COVID-19 patients from low-income countries, particularly in Ethiopia.
Objective: To assess incidence and predictors of mortality among COVID-19 patients admitted to treatment centers in North West Ethiopia.
Methods: An institution-based retrospective cohort study was conducted among 552 laboratory-confirmed COVID-19 cases at Debre Markos University and Tibebe Ghion Hospital COVID-19 treatment centers in North West Ethiopia from March 2020 to March 2021. Data were collected from patients' medical records using a structured data extraction tool. Cox-proportional hazards regression models was fitted to identify significant predictors of mortality.
Result: The overall mortality rate of COVID-19 was 4.7, (95 % CI: 3.3–6.8) per 1000 person day observations. Older age (AHR: 4.9; 95% CI: 1.8, 13.5), rural residence (AHR: 0.18; 95% CI: 0.05, 0.64), presence of hypertension (AHR: 3.04; 95% CI: 1.18, 7.8), presence of diabetes mellitus (AHR: 8.1; 95% CI: 2.9, 22.4) and cardiovascular disease (AHR: 5.2; 95% CI: (1.69, 16.2) were significantly associated with mortality.
Conclusions: The rate of mortality among hospitalized COVID-19 patients in this study was low. COVID-19 patients from urban residences, older patients, and patients with comorbidity have a high risk of death. These high risk groups should be prioritized for COVID-19 vaccinations, and early screening and appropriate intervention should be established on presentation to health facility.

1. Background

Coronavirus is one of the major pathogens that mainly target the respiratory system of humans. Previous outbreaks of coronaviruses were recorded in history as Severe Acute Respiratory Syndrome (SARS) and the Middle East Respiratory Syndrome (MERS) (GeoPoll, 2020). The coronavirus disease 2019 (COVID-19) remains the worst global public health challenge starting from March 2020, the day it was declared as a pandemic (Cucinotta & Vanelli, 2020). According to the Worldometer report, the COVID-19 is affecting more than 220 countries. More than 170 million cases and 3.5 million deaths happened due to COVID-19 (Du et al., 2020; Worldometer, 2021). The new coronavirus identified as the cause of the acute respiratory disease since the end of December 2019, later labeled as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) by the World Health Organization (WHO) is a different strain of coronavirus from SARS and MERS coronaviruses. The difference is genetic make-up, clinical presentations, case fatality, and the rate of spread across the world. SARS-CoV2, the virus that causes COVID-19, has become the newest virus to cause global health fear (Chen et al., 2020; Nuwagira and Muzoora, 2020).

Death due to COVID-19 is defined as a death resulting from a clinically compatible illness, in a probable or confirmed COVID-19 case or a

Abbreviations: COVID-19, Coronavirus Disease 2019; DMU, Debre Markos University; ICU, Intensive Care Unit; RT-PCR, Real-Time Reverse Transcriptase-Polymerase Chain Reaction; SARS-CoV-2, Severe Acute Respiratory Syndrome Coronavirus 2; TGH, Tibebe Ghion Hospital WHO: World Health Organization.

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death due to COVID-19 may not be attributed to another disease (WHO, 2020). Currently, COVID-19 is the 12th leading cause of global death and the 6th leading cause of death in developed countries (Kirenga & Byakika-Kibwika, 2021). United States of America (USA) is the region where the highest death rate due to COVID-19 was observed followed by India and Mexico (Dyer, 2021). The incidence rate of mortality due to COVID-19 was 61.4 per 1,000,000 Korean (Lai et al., 2020), and a global result of systematic review and *meta*-analysis showed the burden of mortality due to COVID-19 was 18.8% (Noor & Islam, 2020).

A study conducted on the African continent showed that the continent accounts for only 3% of the global COVID-19 related mortality (Bamgboye et al., 2021). However, the number of confirmed cases in Africa is increasing rapidly (Kirenga & Byakika-Kibwika, 2021). If the spread of the disease is not well managed, its impact on the African economy will be extensive. Africa's already fragile health systems, coupled with a high burden of COVID-19 would cost the continent greatly. The speed with which countries can detect, report, and respond to outbreaks can be a reflection of their wider institutional capacity (Ikhaq, Riaz, Bashir, & Ijaz, 2020; Olapegba et al., 2020). A preliminary report of WHO from 21 African countries showed that 66% reported inadequate critical care capacity, 24% reported burnout among health workers and 15 countries reported low oxygen production which is crucial for severely ill COVID-19 patients (Lawal, 2021).

Studies reported that being elderly, and having co-morbidities such as Diabetes Mellitus, hypertension, and lung disease were found to be factors increasing the risk of mortality due to COVID-19 (Albitar, Ballouze, Ooi, & Ghadzi, 2020; Noor & Islam, 2020). The coexistence of chronic non-communicable disease with COVID-19 is the major contributing factor for the increased severity and mortality from COVID-19 (Prado-Galbarro, Sanchez-Piedra, Gamiño-Arroyo, & Cruz-Cruz, 2020; Muniyappa & Gubbi, 2020); Corrao et al., 2020). Similar studies identified that kidney disease, late presentation to health facilities, dementia, and reduced peripheral oxygen saturation were factors that are positively associated with COVID-19 mortality (Becerra-Muñoz et al., 2021; García-Posada et al., 2021).

According to the Ministry of Health Ethiopia, the number of infected cases has surpassed 273, 678 and more than 4000 deaths due to COVID-19 were reported (Worldometer, 2021). In a developing country like Ethiopia, where trained human resources and equipment for the treatment of COVID-19 are scarce, the rate of death is under-reported. The government of Ethiopia has declared a state of emergency to stop the spread of the disease. These include the implementation of staying home, banning social gatherings, closure of schools, and avoiding close contact with others. In addition, more than 10,975,194 vaccine doses have been administered (WHO, 2022). Despite all these efforts done by the government, still, the rate of death is rapidly increasing over time. However, there is a paucity of information regarding the incidence and predictors of mortality among COVID-19 patients from low-income countries, particularly in Ethiopia. Therefore, this study aimed to assess incidence and predictors of mortality among COVID-19 patients admitted to treatment centers in North West Ethiopia.

2. Methods

2.1. Study area and period

This study was conducted in Debre Markos University (DMU) and Tibebe Ghion Hospital (TGH) COVID-19 treatment centers. These centers are found in Debre Markos and Bahir Dar towns; 299 and 565 Kilometers far from North West of Addis Ababa respectively. Data extraction was conducted from April to May 2021 among records of patients admitted from March 2020 to March 2021.

2.2. Study design

A one-year institution-based retrospective cohort study design was employed.

2.2.1. Source population

All laboratory-confirmed COVID-19 patients who were admitted to DMU and TGH COVID-19 treatment centers.

2.2.2. Study population

laboratory confirmed COVID-19 patients who were admitted to DMU and TGH COVID-19 treatment centers whose records were available.

2.3. Eligibility criteria

2.3.1. Inclusive criteria

COVID 19 patients who were 18 years or older and admitted to the treatment centers during the study period.

2.3.2. Exclusion criteria

COVID-19 patients with incomplete medical records (patients with unknown outcomes) were excluded from the study.

2.3.3. Sample size determination and sampling procedure

To calculate sample size, the general formula for time to event data was used in STATA version 14 by considering proportional hazard assumption, the equal allocation between two groups in log-rank method (0.5) by taking ICU admission (AHR = 1.38) as a predictor from the previous study conducted on survival and predictors of deaths of patients due to COVID-19 in Brazil (Santos, 2020).

$$\text{Sample size} = \frac{\text{Number of event (E)}}{\text{Probability of event (PE)}}$$

where $\text{Number of event} = \frac{(Z\alpha/2 + Z\,\beta)\,2}{\pi 1 \pi 2(\log \text{HR})\,2}$ and the probability of event is calculated as 1- $(\pi 1 S_1\,(t) + \pi 2 S_2\,(t))$.

The sample size of the study was determined by considering the following parameters;

- $\mathbf{Z_{\alpha/2}} = 1.96$ at $\alpha = 0.05$ significance level
- $\mathbf{Z_{\beta}} = 0.8$ power
- $\boldsymbol{\pi 1 = \pi 2}$**:** proportion of population allocated to the exposed and non-exposed group = 0.5
- **HR**: Hazard Ratio = 1.38
- $\mathbf{S_1}$ **(t):** Survival function at time t1 = 0.5
- $\mathbf{S_2}$ **(t)**: Survival function at time t2 = 0.38

And hence the sample size for this study was determined as 552.

A total of 1272 COVID-19 patients were treated in the treatment centers (449 from DMU and 823 from TGH) during the study period. Proportional allocation of samples was made for each treatment center and patients were selected (195 from DMU and 357 from TGH) using a simple random sampling technique using medical record numbers as a sampling frame.

2.4. Variables of the study

2.4.1. Dependent variable

- Time to death

2.4.2. Independent variables

- **Socio-demographic variables:** (age, sex, marital status, residence, and occupation)
- **Comorbidity:** (Hypertension, asthma, HIV/AIDS, tuberculosis
- **Admission signs:** include headache, coma, fever, vomiting, diarrhea, chest pain, cough, throat pain, runny nose, signs of respiratory distress.

- **Vital signs:** Heart rate, respiratory rate, blood pressure, temperature, O_2 saturation

2.4.3. Operational definition

- **Comorbidity:** The co-occurrence of any of concomitant diseases with COVID-19 at the time of diagnosis admission.
- **Confirmed case:** was defined by the positive findings in reverse-transcriptase- polymerase-chain-reaction (RT-PCR) assay of throat swab specimens.
- **Event:** COVID-19 patients whose treatment outcome was death during the follow-up period.
- **Censored:** COVID-19 patients recovered from the disease, discharged alive or unknown treatment outcome during the study period.

2.5. Data collection tools and procedures

Patients' medical records which were registered from March 1, 2020, to March 31, 2021, were retrieved using a data extraction checklist adapted from different studies (Khamis et al., 2021; Abraha et al., 2021; van Halem et al, 2020; Santos, 2020; Tolossa, et al., 2021; Zhou et al., 2020). The data extraction checklist consists of socio-demographic factors (age, sex, marital status, residence, and occupation), co-morbidity, vital signs (heart rate, respiratory rate, blood pressure, body temperature,) and clinical signs at admission **(see supportive file**). All selected medical records were retrieved and a death certificate was supplemented for events.

2.6. Data quality assurances

The training was given for data collectors and supervisors about the objective of the study and the method of data collection. A pretest was done on 5% of the sample size to keep consistency and modification of the checklist was done (items that are not available from patients' medical records were omitted from the checklist). Close supervision was provided during the data collection process.

2.7. Data processing and analysis

Data were entered using Epi-Data version 3.1 and analysis was done using STATA 14 statistical software. Data were cleaned and edited before analysis. Descriptive statistics were computed and cross-tabulation was used for categorical data. The outcome of each participant was dichotomized into censored or event. The Life table, the Kaplan Meier survival curve, and log-rank test were used to estimate cumulative survival probabilities, survival time and to compare survival status respectively. Bivariable Cox-proportional hazard regression model was fitted for each explanatory variable. Stepwise backward variable selection was used. Moreover, those variables having a p-value ≤ 0.25 in the bivariable analysis were fitted to the multivariable Cox-proportional hazards regression model. The log-likelihood ratio test was used to select the best model. Proportionality hazard assumption was tested using global goodness of fit test and graphically using log–log plot of survival and the overall model fitness was checked using Cox-Snell residual graph. Hazard ratio with its 95% confidence interval was used to measure the strength of association and a p-value < 0.05 was considered as a statistically significant association.

2.8. Ethical considerations

Ethical clearance was obtained from the institutional review board (IRB) of Bahir Dar University, college of medicine and health sciences (Ref. No. 087/2021). A formal letter was submitted to DMU and TGH treatment centers and permission was assured. As secondary data were used, informed consent from patients was not requested. All information collected from patients' cards was kept strictly confidential and names and medical record numbers of the patients were not included in the checklist.

3. Results

3.1. Socio-demographic characteristics of COVID-19 patients

This study included a total of 552 laboratory-confirmed COVID-19 cases hospitalized at DMU and TGH treatment centers. The mean age of participants was 41 ± 13 years ranging from 18 to 87 years and more than half of the participants were males **(**Table 1**).**

3.2. Clinical characteristic of COVID-19 patients

Majority of COVID-19 patients (94%) presented with at least one clinical sign at admission. Of the total participants, 95%, 84%, and 40% had normal body temperature, heart rate, and respiratory rate respectively. Eight percent of COVID-19 cases had one or more comorbidity at admission **(**Table 2**).**

Of all study participants, 78%, 67%, 56%, and 54% of patients presented with headache, cough, chest pain, and fever respectively. All patients who died presented with oxygen saturation of < 90%. The most frequently observed comorbidity was diabetes mellitus followed by hypertension and cardiovascular disease (Table 3**).**

3.3. The incidence rate of mortality among COVD-19 patients

From 552 study participants, 29 (5.3%) of patients developed an event and the rest 523 (94.7%) patients were censored observations. The lowest and the highest length of follow-up were 1 and 30 days respectively, and the total person-time risk was 6155 person day observations. Twenty percent of mortality occurred with the first day of admission and 76% of deaths occurred within the first week of hospitalization. The overall mortality rate of COVID-19 was 4.7, (95 % CI: 3.3–6.8) per 1000 person day observations. The mortality rate among male and female patients was 6.8 and 2.4 per 1000 person day observations respectively.

Table 1
Socio-demographic characteristics of COVID-19 patients in North West Ethiopia, 2021.

Variable	Category	Outcome		Total frequency (%)
		Died (frequency)	Censored (frequency)	
Age (years)	18–44	2	367	369(66.9)
	45–64	12	129	141(25.5)
	≥65	15	27	42(7.6)
Sex	Male	22	280	302(54.7)
	Female	7	243	250(45.3)
Residence	Urban	26	295	321(58.1)
	Rural	3	228	231(41.9)
Marital status	Single	4	180	184(33.3)
	Married	21	329	350(63.4)
	Widowed	4	14	18(3.3)
Occupation	Gov't employed	14	162	176(31.9)
	Self-employed	8	172	180(32.6)
	Farmer	3	114	117(21.2)
	Student	2	57	59(10.7)
	Housewife	0	13	13(2.4)
	Other	2	5	7(1.3)

Table 2
Clinical characteristics of COVID-19 patients in North West Ethiopia, 2021.

Variable	Category	Outcome		Total frequency (%)
		Died (frequency)	Censored (frequency)	
Admission sign	Yes	28	490	518(93.8)
	No	1	33	34(6.2)
Temperature (°C)	35–37.4	10	517	527(95.5)
	37.5–38.4	15	4	19(3.4)
	≥38.5	4	2	6(1.2)
Heart rate	60–100	14	451	465(84.2)
	>100	15	72	87(15.8)
Respiratory rate	12–20	1	221	222(40.2)
	≥21	28	302	330(59.8)
Oxygen saturation (%)	<90	29	52	81(14.7)
	≥90	0	471	471(85.3)
Comorbidity	Yes	24	22	46(8.3)
	No	5	501	506(91.7)

Table 3
Clinical features and co-morbidities of COVID-19 patients in North West Ethiopia, 2021.

Variable	Frequency (n = 552)	Percentage (%)
Signs		
Headache	430	77.9
Respiratory distress	82	14.9
Fever	298	54.0
Cough	372	67.4
Chest pain	311	56.3
Throat pain	119	21.6
Runny nose	61	11.1
Diarrhea	64	11.6
Vomiting	12	2.2
Coma	8	1.5
Co-morbidities		
Hypertension	21	3.8
Retroviral infection	15	2.7
Diabetes mellitus	22	4.0
Cardiovascular disease	18	3.3
Asthma	10	1.8
Others	6	1.1

Others include tuberculosis and neurological disease.
Some patients had multiple features at admission.

The rates of mortality among urban and rural residents were 7.3 and 1.2 per 1000 person day observations respectively. Older patients (≥65 years) had a higher rate of mortality (38.9) as compared to younger ones (<65 years) (2.4) per 1000 person day observations.

The mortality rate of COVID-19 patients varied across different categories of clinical characteristics of patients. The incidence of mortality among patients presented with and without comorbidity was 61.8 and 0.9 per 1000 person day observations respectively. In addition, patients who had respiratory distress at admission revealed a higher mortality rate (37) than their counterparts (0.5) per 1000 person day observations.

3.4. Survival status of COVID-19 patients

The Kaplan-Meier survival curve was used to estimate the survival status of COVID-19 patients. The curve tends to decrease slowly in the first twenty days and sustained thereafter indicating that the majority of deaths occurred within the first 10 days (Fig. 1). The cumulative

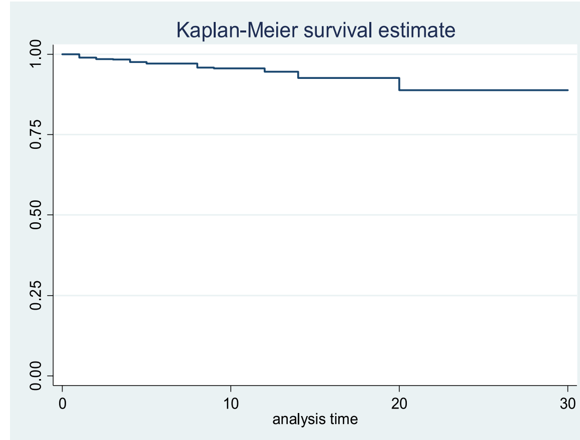

Fig. 1. Kaplan-Meier survival curve estimating the overall survival probability of COVID-19 patients in North West Ethiopia.

survival probability of COVID-19 patients at 10 days of admission was 95% and at the end of the follow-up period was 87%. The log-rank test at a 5% significance level was used to compare the survival status of COVID-19 patients. The log-rank test estimate together with the Kaplan-Meier survival curve revealed that the survival pattern of mortality among COVID-19 patients was varied significantly with age, sex, and co-morbidity (Figs. 2–4).

3.5. Predictors of mortality among COVID-19 patients

Socio-demographic predictors (age, sex, residence), clinical signs at admission (fever and chest pain), and co-morbidity (hypertension, diabetes mellitus, asthma, HIV, and cardiovascular disease) were selected through the stepwise backward elimination approach at a p-value of ≤ 0.25 level of significance in the bivariable Cox regression model. In the final multivariable Cox regression model, ten predictors were analyzed and five predictors (age, residence, hypertension, diabetes mellitus, and cardiovascular disease) were significantly associated with mortality at a p-value of 0.05 levels of significance.

After adjusting other covariates, the age of COVID-19 patients was an independent socio-demographic predictor of mortality. Older COVID-19 patients (≥65 years) were 4.9 times more likely to die as compared to their counterparts (AHR: 4.9; 95% CI: 1.8, 13.5). The mortality rate of COVID-19 patients from the rural residences was decreased by 82% as compared to those patients from urban residences (AHR: 0.18; 95% CI: 0.05, 0.64). The risk of mortality among COVID-19 patients with hypertension was 3 times higher than those without hypertension (AHR:

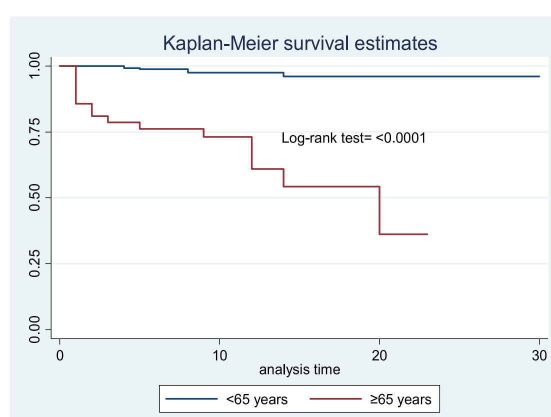

Fig. 2. Kaplan-Meier survival curve estimating the survival probability of COVID-19 patients by age in North West Ethiopia.

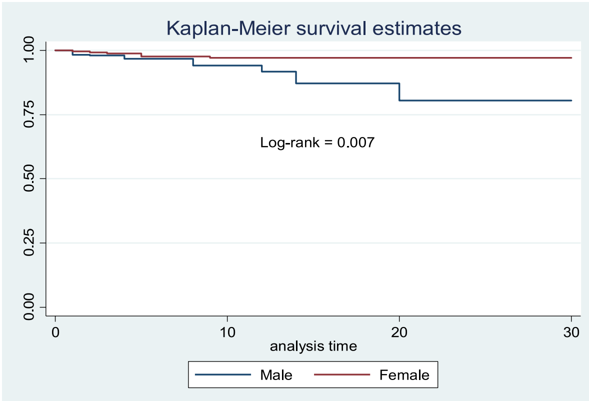

Fig. 3. Kaplan-Meier survival curve estimating the survival probability of COVID-19 patients by sex in North West Ethiopia.

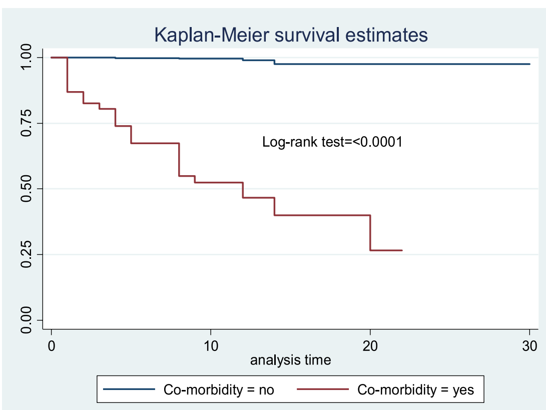

Fig. 4. Kaplan-Meier survival curve estimating the survival probability of COVID-19 patients by co-morbidity in North West Ethiopia.

3.04; 95% CI: 1.18, 7.8). COVID-19 patients who had diabetes mellitus have 8 times the higher hazard of mortality as compared to patients without diabetes mellitus (AHR: 8.1; 95% CI: 2.9, 22.4). The rate of mortality among patients admitted with cardiovascular disease was 5 times higher as compared to those patients who had no cardiovascular disease during admission (AHR: 5.2; 95% CI: (1.69, 16.2) (Table 4).

3.6. *Proportional Hazard (PH) assumption and model goodness of fit*

The Cox Proportional Hazard assumption was tested both graphically and statistically for each covariate all of which holds the assumption. The overall model fitness for the final model was checked using the Cox-Snell residual graph which indicates that the model fitted to the data adequately (Fig. 5).

4. Discussion

This study provided comprehensive evidence on the incidence as well as predictors of mortality among COVID-19 patients admitted to treatment centers in North West Ethiopia. The study demonstrated that the incidence rate of mortality among COVID-19 patients admitted in treatment centers in North West Ethiopia was 4.7 per 1000 person day observations or 5.2%. This finding is approximately similar to the studies conducted among hospitalized COVID-19 patients in South Korea (7.4%) (Acharya, Lee, Lee, Lee, & Moon, 2020) and Wuhan China (3.7%) (Zhang et al., 2020), 4.3% (Wang, Bo, & Hu, 2020.) university hospitals. This could be due to the relative similarity of the clinical characteristics of study participants included in the studies. However,

Table 4
Multivariable Cox regression analysis of mortality among COVID-19 patients in North West Ethiopia, 2021.

Covariate	Category	CHR(95%CI)	AHR(95%CI)	P-value
Age (years)	<65		1	
	≥65	15.3 (7.3–31.7)	4.9(1.8–13.5)	0.002*
Sex	Male		1	
	Female	0.32 (0.13–0.77)	0.8(0.3–2.1)	0.6
Residence	Urban		1	
	Rural	0.15 (0.04–0.52)	0.18 (0.05–0.64)	0.008*
Fever	Yes	4.1(1.6–9.9)	2.3(0.74–7.3)	0.14
	No		1	
Chest pain	Yes	1.3 (0.65–2.94)	0.6 (0.22–1.57)	0.29
	No		1	
Hypertension	Yes	11.1 (5.1–24.4)	3.04 (1.18–7.8)	0.02*
	No		1	
Diabetes mellitus	Yes	35.1 (16.8–73.5)	8.1(2.9–22.4)	< 0.001*
	No		1	
Asthma	Yes	10.2 (3.5–29.4)	1.8 (0.48–6.95)	0.37
	No			
HIV	Yes	3.7(1.1–12.5)	0.3(0.04–2.2)	0.25
	No		1	
Cardiovascular disease	Yes	17.6 (7.6–40.8)	5.2 (1.69–16.2)	0.004*
	No		1	

CHR: Crude Hazard Ratio; AHR: Adjusted Hazard Ratio.
* Statistically significant at 0.05.

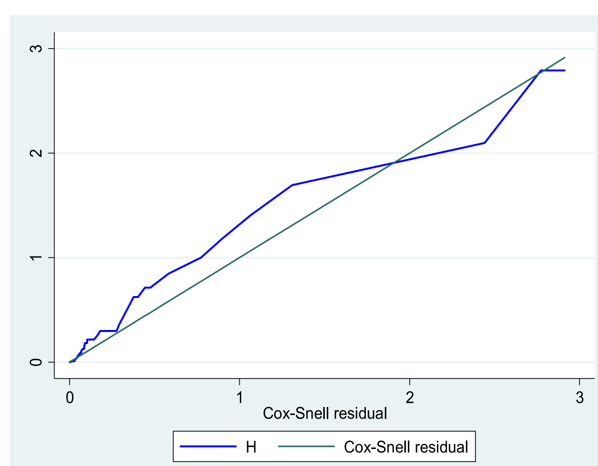

Fig. 5. Cox-Snell residual graph showing the overall model goodness of fit.

the current finding is lower than the study done at Millennium COVID-19 Care Center, Addis Ababa, Ethiopia in which the incidence of mortality was 10.5% (Leulseged et al., 2021). This finding is also lower than the findings of previous studies from the Democratic Republic of Congo (29%) (Bepouka et al., 2020), Wuhan hospitals, China; 8.9% (Wang B et al., 2020), 11.7% (Du et al., 2020), Royal hospital, Muscat, Oman (26%) (Khamis et al., 2021) and 28% (Zhou et al., 2020), pooled *meta*-analysis reports in various countries 8.8% (Kim, Han, & Lee, 2020), 15% (Abate, Checkol, & Mantefardo, 2021) and 18.8% (Noor & Islam, 2020). The possible reason for the observed discrepancy might be due to the difference in sample size, study setting, socioeconomic characteristics, the severity of the disease, and the methodology of studies. Study findings are showing that the more severe the disease condition, the higher the risk of mortality (Wang B et al., 2020).

The present study showed that age is an independent predictor of mortality from coronavirus disease; the rate of mortality was higher among older patients. This finding is consistent with previous study findings from Ethiopia; Millennium COVID-19 Care Center, Addis Ababa, (Leulseged et al., 2021), and Tigray (Abraha et al., 2021). It is in line with retrospective cohort studies conducted in Brazil (Santos et al., 2020) and Wuhan (Xiaochen Li, 2020). Moreover, this finding is also supported by previous studies from Wuhan Pulmonary Hospital (Du et al., 2020), Wuhan, China (Chen et al., 2020; Fang Wang et al., 2020; Huang, Wang, & Li, 2020; Wang D et al., 2020), Royal hospital, Muscat, Oman (Khamis et al., 2021), and Belgium (van Halem et al, 2020) that reported older patients were more likely to die. This might be because of the higher severity progression of the disease among older COVID-19 patients that results in death (Abraha et al., 2021; Tolossa, et al., 2021; Xiaochen Li, 2020).

In this study, residence was found to be significantly associated with COVID-19 related mortality. Rural residents with COVID-19 were less likely to die than patients from urban areas. This might be because people living in rural areas of Ethiopia have a healthy lifestyle; perform regular exercise and are less likely to be affected by comorbidities that facilitate the fatality of the disease (Mengesha, Roba, Ayele, & Beyene, 2019; Moniruzzaman et al., 2016; Padrão, Damasceno, Silva-Matos, Prista, & Lunet, 2012).

This study has also revealed that COVID-19 patients hospitalized with preexisting comorbidity had a higher rate of mortality than their counterparts. COVID-19 patients with hypertension, diabetes mellitus, and cardiovascular disease were 3, 8, and 5 times respectively more likely to die than those patients admitted without comorbidity. This finding is in line with study findings from Brazil (Santos et al., 2020). In addition, this finding is supported by previous studies conducted in Wuhan, China (Wang D et al., 2020; Xiaochen Li, 2020), Royal hospital; Muscat, Oman (Khamis et al., 2021) which reported that comorbidities such as hypertension, diabetes mellitus, and cardiovascular disease increase COVID-19 related mortality. This is due to the fact that the coexistence of hypertension and COVID-19 results in difficulties of blood pressure regulation and the development of multiple organ failure (Driggin, Madhavan, & Bikdeli, 2020; Wang B et al., 2020). Moreover, when diabetic patients are affected by COVID-19, they are at risk of developing complications due to compromised immune systems and more susceptible to an inflammatory storm, which in turn causes rapid deterioration resulting in death (Acharya et al., 2020; Wang B et al., 2020; Zhu, She, & Cheng, 2020).

4.1. Limitation of the study

As the study used secondary data, it did not include biomedical profiles and medication-related variables which could be potential predictors of mortality. In addition, although the adjusted analysis was used, potential confounders could be considered as a limitation.

5. Conclusions

The rate of mortality among hospitalized COVID-19 patients in this study was low as compared to findings of other studies (Bepouka et al., 2020; Wang B t al., 2020; Kim et al., 2020; Leulseged et al., 2021). COVID-19 patients from urban residences, older patients, and patients with hypertension, diabetes mellitus, and cardiovascular disease have a high risk of death. Patients with advanced age (≥65 years), hypertension, diabetes mellitus, and cardiovascular disease need careful observation and early intervention of cases is crucial to prevent the potential COVID-19 related mortality. In addition, these high-risk groups should be prioritized for COVID-19 vaccinations, and early screening and appropriate intervention should be established on presentation to health facilities. [34].

Authors' contributions

BM and ZA conceived, designed and performed formal the analysis of the study; ZA collected the clinical information; BM and TT wrote the original draft of the manuscript and all authors reviewed, read and approved the final manuscript.

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Ethics approval and consent to participate

Ethical clearance was obtained from the institutional review board (IRB) of Bahir Dar University, college of medicine and health sciences (Ref. No. 087/2021). A formal letter was submitted to DMU and TGH treatment centers and permission was assured. As secondary data were used, informed consent from patients was not requested. All information collected from patient's cards was kept strictly confidential and names and medical record numbers of the patients were not included in the checklist.

Consent for publication

Not applicable

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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