

Epidemiological and Clinical Characteristics of COVID-19 Patients in Northern Ethiopia: A Retrospective Cohort Study

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Purpose: COVID-19, caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), is an emerging global public health problem. The disease is believed to affect older people and is accompanied by clinical features such as fever, shortness of breath, and coughing. Currently, there is a lack of information regarding the characteristics of COVID-19 patients in Ethiopia. Thus, this paper aims to evaluate the epidemiological and clinical features of COVID-19 patients in Tigray, Northern Ethiopia.

Patients and Methods: A total of 6,637 symptomatic and asymptomatic COVID-19 patients collected from six isolation and treatment centers in Tigray between May 7 and October 28, 2020 were retrospectively analyzed. Chi-square test or Fisher's exact test was used to compare the epidemiological and clinical characteristics of COVID-19 patients as appropriate. A *p*-value <0.05 was considered statistically significant.

Results: The mean age of the patients was 31.3±12.8. SARS-CoV-2 infects men more than women with a ratio of 1.85:1. About 16% of the patients were symptomatic, of which 13.3% (95% CI=11.3–15.4%) were admitted to intensive care units and 6.1% (95% CI=4.5–7.6%) were non-survivors. The mortality rate was increased up to 40.3% (95% CI=32.1–48.4%) among patients with severe illness. A higher proportion of deaths were observed in men (73.2%) and 55.4% were in the age group of ≥50 years. About 4.3% (282 of 6,637) had one or more coexisting comorbidities; the most common being cardiovascular diseases (30.1%) and diabetes mellitus (23.8%). The comorbidity rate in the non-survivor group was significantly higher than in the survivor group (*p*-value <0.001).

Conclusion: The proportion of symptomatic patients was low. Non-survival was linked with old age and the existence of comorbidities. The findings of this study can help in the design of appropriate management strategies for COVID-19 patients, such as giving due emphasis to COVID-19 patients who are old and with comorbidities.

Keywords: COVID-19, comorbidity, symptomatic, mortality rate

Introduction

COVID-19, a severe acute respiratory infection (SARI) that emerged in early December 2019 in Wuhan, China, has continued to be a global threat.¹ It is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which belongs to a group of single stranded and enveloped RNA viruses.² The outbreak has rapidly spread out across the global and was declared an emergency public health problem and pandemic on January 30, 2020 and March 11, 2020, respectively, by the World Health Organization.³

At the end of March 2020, a report on COVID-19 from 199 countries indicated over 800,000 cases and 39,000 deaths, with the United States, Italy, Germany, Great Britain, Spain and France experiencing high levels of COVID-19 cases and death rates and later Brazil, Iran, Russia, India, and other nations faced the burden of the disease.⁴ Now, the number of

cases and deaths exceeds 525 and 6.2 million, respectively.⁵ In Ethiopia, the first COVID-19 confirmed case was detected on March 13, 2020. Following the identification and documentation of the first case, the pandemic spread-out to other regions of the country, including Tigray region, wherein this research was conducted. On October 19, 2020 Tigray region had a total of 6,188 COVID-19 confirmed cases and 38 deaths.⁶

COVID-19 is transmitted by close contact and droplets and is found to have a mean incubation period of 3–9 days.^{7–11} In most circumstances, about 20% of cases remain asymptomatic.^{12–14} A number of studies have revealed that asymptomatic patients have the potential to infect others.^{15,16} COVID-19 symptoms have a tendency to disappear after 10 days though viral shedding continues.^{17,18} Infection with SARS-CoV-2 primarily attacks individuals in the age category of 30–80 years.^{1,19} Moreover, the highest comorbidities rates are seen among COVID-19 cases with existing disease states of hypertension, diabetes mellitus, and cardiovascular diseases.^{20–23} Mild symptoms of fever, cough, sore throat, and myalgia are commonly experienced by most COVID-19 cases. Severe clinical conditions such as multiple organ failure, acute respiratory distress syndrome, pulmonary edema, and pneumonia are also observed in some cases.²¹

In Ethiopia and particularly in the Tigray region, COVID-19 management efforts were in place. There had been quarantine/isolation and treatment centers and vast information about cases were documented. However, the epidemiology and clinical features of the cases managed in the region’s isolation and treatment centers have not yet been synthesized, analyzed, and presented for comprehension by policy- and decision-makers. This study, therefore, aims at presenting the epidemiology and clinical characteristics of COVID-19 patients in Tigray region, Northern Ethiopia.

Materials and Methods

Study Design and Area

A retrospective cohort study design that involved 6,637 COVID-19 cases (Figure 1A) was conducted from six COVID-19 isolation and treatment centers of Tigray region, namely: Mekelle, Maichew, Axum, Adigrat, Shire, and Humera centers. The centers were designated to manage COVID-19 positive cases where all laboratory confirmed cases were admitted for isolation, care, and support. To enhance the identification of COVID-19 cases, the government of Tigray regional state

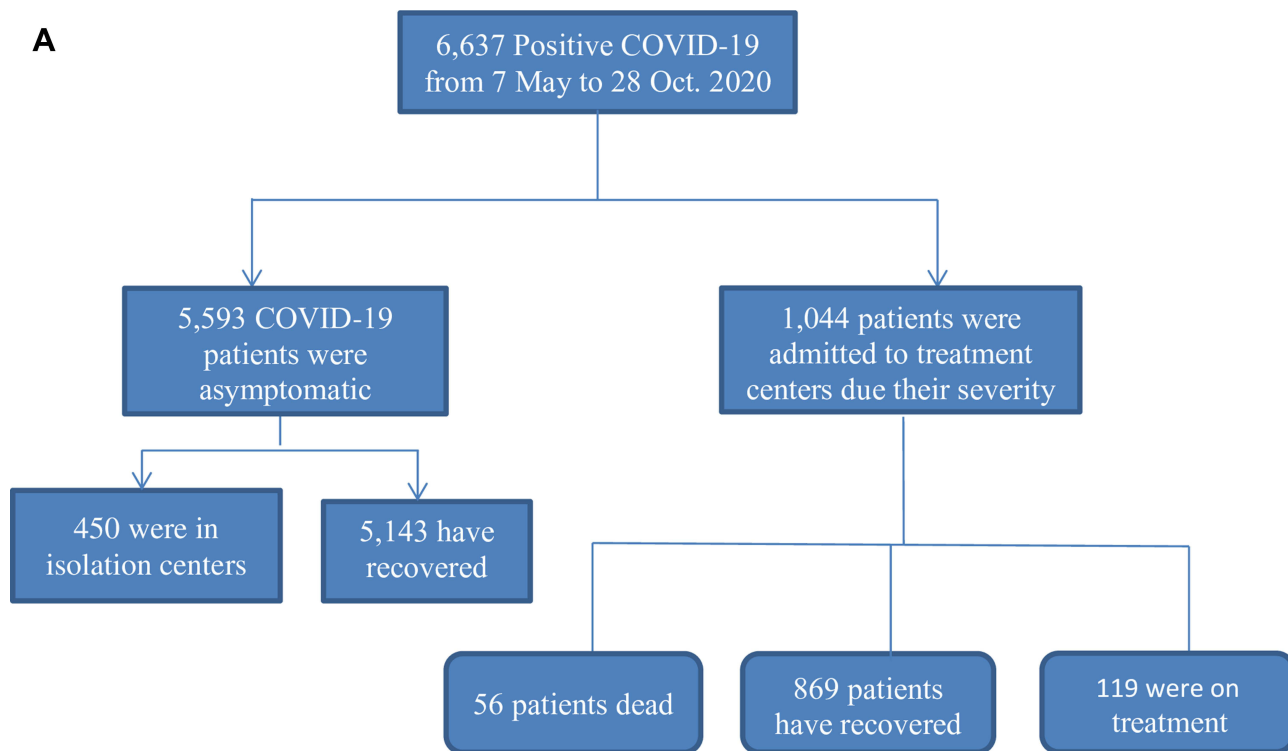


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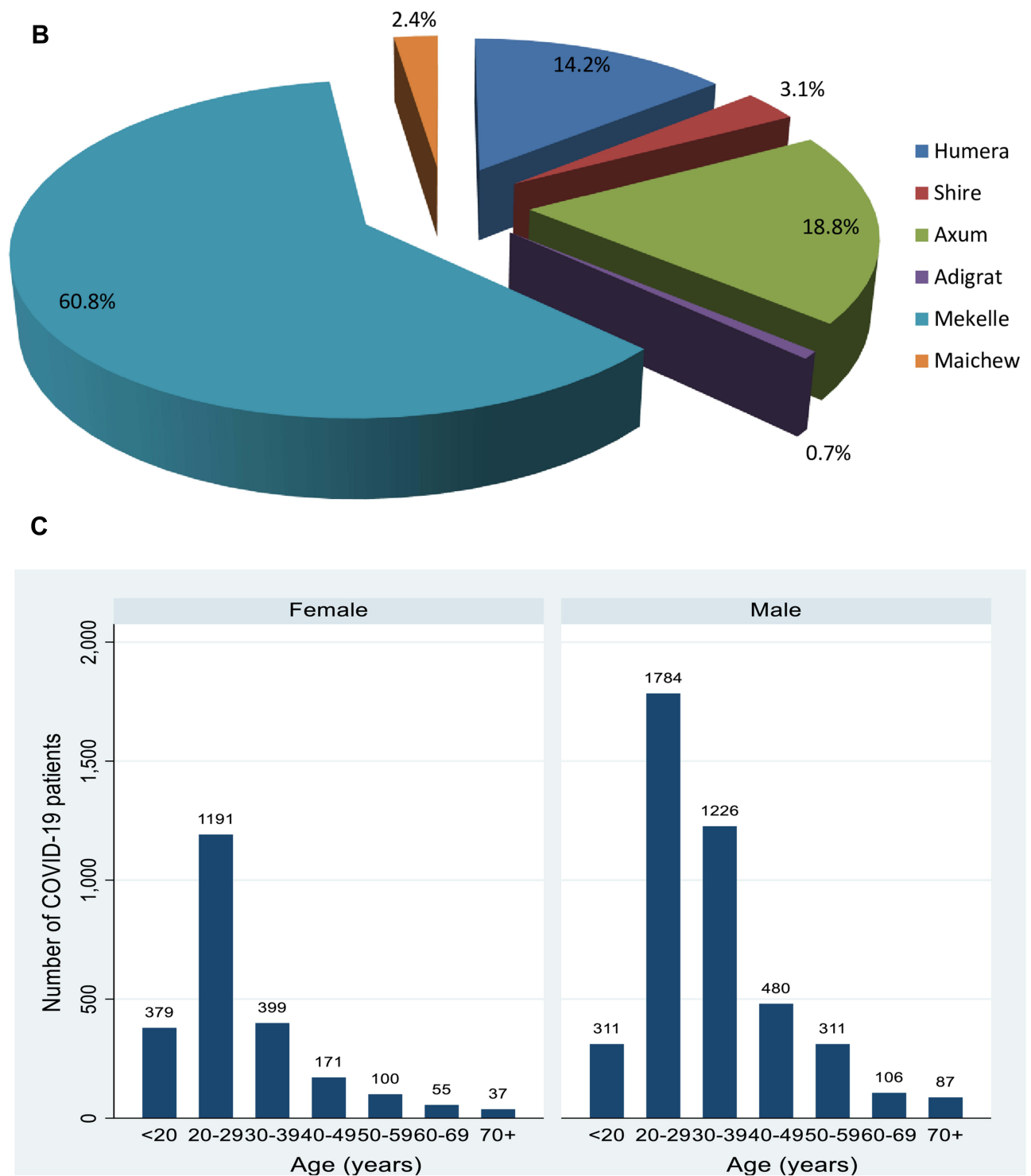


Figure 1 (A) Flowchart of the study design and participants. (B) Distribution of participants by centers. (C) Number of confirmed COVID-19 patients by age and sex.

implemented mass screening of all travelers who enter the region, individuals who had been in contact with confirmed cases of COVID-19 and individuals from high risk settings (health care workers, private business employees, long track drivers, merchants). Cases were confirmed by Polymerase Chain Reaction (PCR) in the treatment centers. Regardless of signs and/or symptom development, all individuals with laboratory confirmed SARS-CoV-2 infection were admitted to the isolation and treatment centers within 24 hours.

Study Participants and Period

The study participants were all laboratory-confirmed positive cases of SARS-CoV-2, who were admitted to the aforementioned isolation and treatment centers between May 7 and October 28, 2020.

Data Source and Sample

The data were collected using a standardized form from electronic medical records. The data set contains demographic characteristics, clinical information, and outcomes of the patients. All laboratory-confirmed COVID-19 patients who were admitted to the isolation and treatment centers between May 7 and October 28, 2020 were included in this study.

Inclusion and Exclusion Criteria

All COVID-19 patients who were admitted to the six isolation and treatments centers during the study period were included. Patient data with incomplete demographic and treatment outcome related electronic medical record information was excluded.

Operational Definitions

The COVID-19 cases were all individuals tested by PCR in the treatment centers and found to be infected with SARS-CoV-2. Symptomatic cases were defined as any SARS-CoV-2 positive individual with at least one sign or symptom for COVID-19, including but not limited to: cough, fever, headache, sore throat, pain, shortness of breath, diarrhea, and vomiting. Asymptomatic cases were any individual who tested positive for SARS-CoV-2 but did not have any of the symptoms. COVID-19 cases with comorbidity are those with at least one known preexisting chronic medical illness. Severity of COVID-19 was defined according to the diagnostic and treatment guidelines for SARS-CoV-2. Severe COVID-19 cases are with clinical signs of pneumonia (fever, cough, dyspnea, fast breathing) and have one of the following criteria: i) respiratory rate interval > 30 breaths/min; ii) SpO₂ (saturation of peripheral oxygen) <93% at rest; iii) severe respiratory distress, and iv) oxygenation index (artery partial pressure of oxygen/inspired oxygen fraction, PaO₂/FiO₂) <300 mmHg.

Statistical Data Analysis

The data were coded, cleaned, and checked for completeness. STATA version 16 software was used for data processing and statistical analyses. The continuous variables were summarized as mean and standard deviation (SD), while categorical variables were presented as frequencies (%). Chi-square test or Fisher's exact test was used to compare the epidemiological and clinical characteristics of COVID-19 patients as appropriate. A *p*-value of less than 0.05 was considered statistically significant.

Results

Socio-Demographic Characteristics

Our study population consisted of 6,637 confirmed COVID-19 cases that were reported from May 7, 2020 to October 28, 2020. In total, 5,593 were asymptomatic cases, of these 5,143 have recovered and discharged, while 450 were still in the isolation centers at the end of the study period. Of the symptomatic cases (1,044 (15.7%) of 6,637), 56 had died, 869 had recovered, and 119 were in the isolation and treatment centers at the end of the study period (Figure 1A). About 61% of the patients were isolated and treated in Mekelle center and 18.8% were in the Axum center (Figure 1B).

The mean age of the study participants was 31.3 years (SD=12.8). A total of 10.4% (95% CI=9.7–11.1%) of patients were younger than 20 years, 44.8% (95% CI=43.6–46.0%) were in the age range of 20–29 years, 24.5% (95% CI=23.5–25.5%) were between 30–39 years, 9.8% (95% CI=9.1–10.5%) were between 40–49 years, and 10.5% (95% CI=9.7–11.2%) were older than 49 years.

Among the symptomatic patients (1,044 of 6,637), 13.3% (95% CI=11.2–15.4%) were admitted to intensive care units due to the severity of their disease, of whom 70% (95% CI=67.2–72.8%) were male patients. Of the symptomatic patients, 6.1% (95% CI=4.6–7.5%) were non-survivors. The patients in the non-survivor group were much older than

those in the survivor group [mean=53.1 years (SD=22.8) versus mean=30.8 years (SD=12.2), p -value <0.001]. About 60% of the non-survivor patients were older than 49 years. Regarding the occupation of the patients, about 6% (391 of 6,637) were health care workers and 31.2% (122 of 391) of them declared having contact with COVID-19 patients. Age was significantly correlated with the severity of the disease and treatment outcome of COVID-19 patients. The majority of COVID-19 patients (64.9%; 95% CI=63.7–66.0%) were males. Similarly, 73.2% (41 of 56) of COVID-19 deaths were in males and 55.4% (31 of 56) were in the age group of ≥ 50 years (Table 1).

Of the male patients (4,305 (64.9%) of 6,637), a high proportion (41.4%) of confirmed COVID-19 infections were in the middle aged individuals (the age group of 20–39 years) and a lower proportion (2.0%) were in the older age groups (>69 years). From the female patients (2,332 (35.1%) of 6,637), 51.1% of COVID-19 infections were in the age group of 20–39 years and 1.6% were in the age group >69 years (Figure 1C).

Clinical Characteristics

Based on the patients' body temperature on admission, 89.3% of the patients had temperature <37.1°C, 8.4% had 37.1–38°C and 2.3% had >38°C. These values were different between severe and non-severe patients (p -values <0.001). Of the total 6,637 COVID-19 cases, 15.7% (95% CI=14.8–16.6%) were symptomatic. Among the hospitalized patients (1,044 of 6,637), the most common symptoms at the onset of the disease as reported by patients were cough in 74.1% and fever in 39.7% of the cases. This is followed by sore throat in 27.9%, body weakness in 24.9%, and shortness of breath in 23.4% of the cases. Headache was less common, only found in 17.2% of the patients.

Among the non-survivor patients (56 (6.1%) of 925), 78.6% had shortness of breath, 76.8% had cough, 51.8% had body weakness, 33.9% had pain, 28.6% had sore throat, 26.8% had fever, and 26.8% had headache. Of the symptomatic COVID-19 cases, 13.3% were severely ill and the mortality rate among the severe COVID-19 was 40.3% (95% CI=32.1–48.4%).

From the total study participants, the sources of infection for about 50% of the COVID-19 patients were community infections, while 34.2% of the patients were imported. Among the COVID-19 patients in the study, 33.4% of the patients had a travel history.

Table 1 Socio-Demographic Characteristics of Confirmed COVID-19 Patients of Tigray, Northern Ethiopia, 2020

Variables	Total (%)	Symptomatic (n=1,044)					
		Severity Status (n=1,044)			Outcome (n=925)		
		Non-severe (%)	Severe (%)	p-value	Recovered (%)	Dead (%)	p-value
Age (years)				<0.001			<0.001
<20	690 (10.40)	66 (85.71)	11 (14.29)		65 (92.86)	5 (7.14)	
20–29	2,975 (44.82)	344 (89.12)	42 (10.88)		343 (97.44)	9 (2.56)	
30–39	1,626 (24.50)	216 (90.00)	24 (10.00)		211 (98.60)	3 (1.40)	
40–49	651 (9.81)	108 (88.52)	14 (11.48)		104 (92.86)	8 (7.14)	
50–59	411 (6.19)	88 (88.00)	12 (12.00)		76 (95.00)	4 (5.00)	
60–69	160 (2.41)	41 (77.36)	12 (22.64)		38 (82.61)	8 (17.39)	
70+	124 (1.87)	42 (63.64)	24 (36.36)		32 (62.75)	19 (37.25)	
Gender				0.054			0.594
Female	2,332 (35.14)	281 (89.78)	32 (10.22)		262 (94.58)	15 (5.42)	
Male	4,305 (64.86)	624 (85.36)	107 (14.64)		607 (93.67)	41 (6.33)	
Nationality				0.667*			0.121
Ethiopian	6,579 (99.13)	895 (86.72)	137 (13.74)		859 (94.09)	54 (5.91)	
Foreign	58 (0.87)	10 (83.33)	2 (16.67)		10 (83.33)	2 (16.67)	
Occupation				0.016			0.081
Health care workers	391 (5.89)	99 (94.29)	6 (5.71)		95 (97.94)	2 (2.06)	
Non-health workers	6,240 (94.11)	806 (85.84)	133 (14.16)		774 (93.48)	54 (6.52)	
Total, n (row %)	6,637 (100.00)	905 (86.69)	139 (13.31)		869 (93.95)	56 (6.05)	

Note: *Fisher exact p-value.

With regard to the outcome between groups, the proportion of severely ill in the non-survivor group was significantly higher than in the survivor group (p -value <0.001). Two hundred and eighty-two (4.25%) of the patients had one or more coexisting medical conditions; the most frequent comorbidity being cardiovascular diseases accounting for 30.1%. This is followed by diabetes mellitus and respiratory diseases, 23.8% and 19.9%, respectively. The comorbidity rate in the non-survivor group was higher than that of the survivor group (44.6% versus 10.5%, p -value <0.001), and it was also higher in the severely ill group than the non-severe group (28.8% versus 10.4%, p -value <0.001). A large proportion of cardiovascular diseases, diabetes mellitus, respiratory diseases, renal diseases, and traumatic injury were observed in the non-survivor group and non-severe group (Table 2).

Among the patients with comorbidities, 43% were in the age group ≥ 50 years, 22% were in the age group 30–39 years, 21% were in the age group 20–29 years, 14% were in the age group 40–49 years, and 5% were in the age group

Table 2 Clinical Characteristics of 6,637 Confirmed COVID-19 Patients of Tigray, Northern Ethiopia, 2020

Variables	Total (%)	Symptomatic (n=1,044)					
		Severity Status, (n=1,044)			Outcome (n=925)		
		Non-severe (%)	Severe (%)	p-value	Recovered (%)	Dead (%)	P-value
Temperature**				0.001			0.071
<37.1	3,514 (89.26)	243 (77.88)	67 (21.61)		287 (91.99)	25 (8.01)	
37.1–38	331 (8.41)	291 (88.99)	36 (11.01)		270 (96.43)	10 (3.57)	
>38	92 (2.34)	79 (85.87)	13 (14.13)		85 (94.44)	5 (5.56)	
Comorbidity				<0.001			<0.001
Yes	282 (4.25)	96 (70.59)	40 (29.41)		93 (78.81)	25 (21.19)	
No	6,355 (95.75)	812 (89.43)	96 (10.57)		776 (96.16)	31 (3.83)	
Comorbidity type (n=282)							
Cardiovascular disease ^{&}	85 (30.14)	32 (61.54)	20 (38.46)	<0.001	35 (71.43)	14 (28.57)	<0.001
Diabetes mellitus	67 (23.76)	32 (80.00)	8 (20.00)	0.182	25 (83.33)	5 (16.67)	0.013
HIV	18 (6.38)	3 (50.00)	3 (50.00)	0.008*	6 (100.00)	0 (0.00)	1.000*
Pregnancy	21 (7.45)	2 (100.00)	0 (0.00)	1.000*	2 (100.00)	0 (0.00)	1.000*
Renal disease	7 (2.48)	4 (66.67)	2 (33.33)	0.148*	4 (80.00)	1 (20.00)	0.269*
Respiratory disease	56 (19.86)	13 (65.00)	7 (35.00)	0.003	16 (80.00)	4 (20.00)	0.008
Traumatic injury	5 (1.77)	0 (0.00)	4 (100.00)	<0.001*	2 (50.00)	2 (50.00)	0.020*
Other comorbidities***	37 (13.12)	10 (58.825)	7 (41.18)	0.003	11 (73.33)	4 (26.67)	0.010*
Travel History				<0.001			0.114
Yes	2,215 (33.40)	76 (73.08)	28 (26.92)		83 (86.40)	9 (5.60)	
No	4,422 (66.60)	832 (88.51)	108 (11.49.0)		782 (94.36)	47 (5.64)	
Source of Infection				0.006			0.120
Community	3,288 (49.54)	644 (88.58)	83 (11.42)		591 (93.36)	42 (6.64)	
Contact	1,079 (16.26)	177 (86.34)	28 (13.66)		188 (96.91)	6 (3.09)	
Imported	2,270 (34.20)	87 (77.68)	25 (22.32)		90 (91.84)	8 (8.16)	
Symptoms (n=1,044)							
Fever	414 (39.66)	366 (88.41)	48 (11.59)	0.265	349 (95.88)	15 (4.12)	0.047
Cough	774 (74.14)	674 (87.08)	100 (12.92)	0.862	641 (93.71)	43 (6.29)	0.617
Shortness of breath	244 (23.37)	148 (60.66)	96 (39.34)	<0.001	168 (79.25)	44 (20.75)	<0.001
Sore throat	291 (27.87)	252 (86.60)	39 (13.40)	0.823	243 (93.82)	16 (6.18)	0.922
Headache	179 (17.15)	143 (79.89)	36 (20.11)	0.002	161 (91.48)	15 (8.52)	0.127
Body weakness	260 (24.90)	204 (78.46)	56 (21.54)	<0.001	217 (88.210)	29 (11.79)	<0.001
Pain	211 (20.25)	165 (78.20)	46 (21.80)	0.001	191 (90.95)	19 (9.05)	0.040
Other symptoms****	21 (2.01)	17 (80.95)	4 (19.05)	0.435	20 (95.24)	1 (4.76)	1.000*
Total, n (row %)	6,637 (100.00)	905 (86.69)	139 (13.31)		869 (93.95)	56 (6.05)	

Notes: *Fisher exact p-value; **40% missing values existed in this variable. [&]Cardiovascular disease included hypertension and heart failure. ***Other comorbidities: gastritis, malignancy, allergic, psychotic disorder, rabies, arthritis, epilepsy, neurological. ****Other symptoms: vomiting, diarrhea, loss of appetite, loss of smell, loss of taste, myalgia, abdominal cramping, chills.

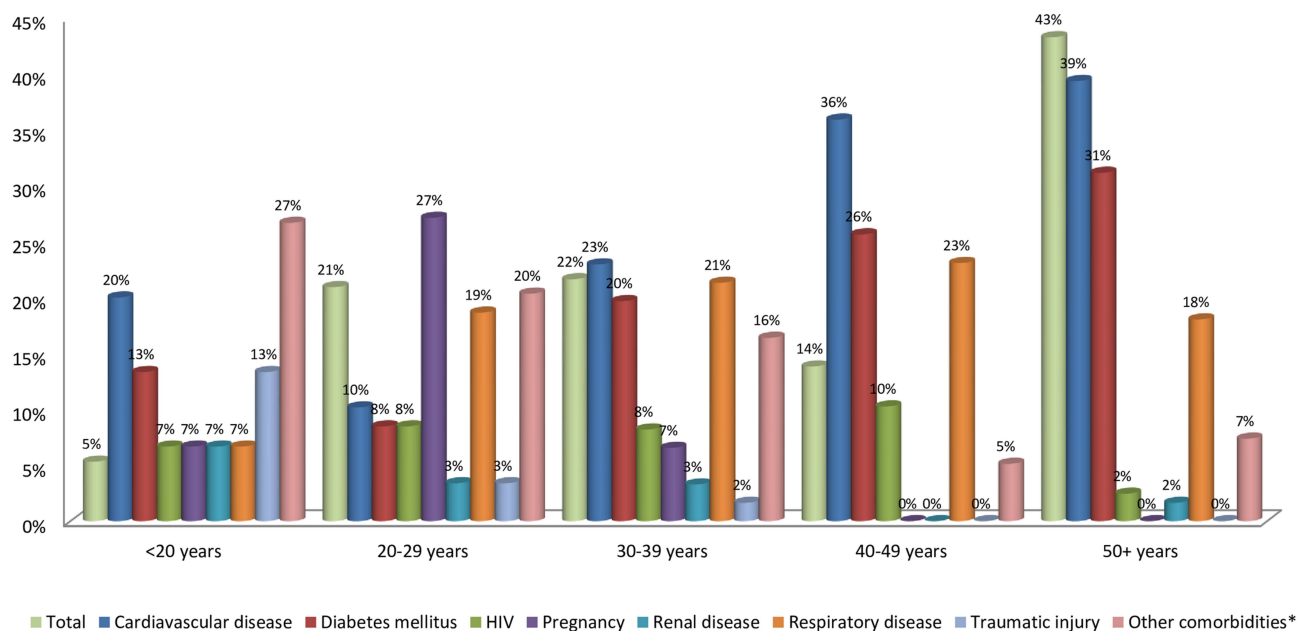


Figure 2 Comorbidities among confirmed COVID-19 cases by age. *Other comorbidities: gastritis, malignancy, allergic, psychotic disorder, rabies, arthritis, epilepsy, neurological.

<20 years. Of the patients with COVID-19, older age groups tended to have a higher proportion of cardiovascular, diabetes, and respiratory disease than younger age groups (Figure 2).

Discussion

A total of 6,637 patients were admitted to the six COVID-19 isolation and treatment centers in Tigray region (Mekelle, Maichew, Axum, Adigrat, Shire, and Humera) during the study period. The mean age of patients was 31 years old (SD=12.8). Of the total, 44.8% were in the age range of 20–29 years and 34.3% were between 30–39 years.

The result showed that COVID-19 infects men more than women, with a male-to-female ratio of 1.85:1. These findings are consistent with the findings of the previous studies.^{24–33} The reason for the higher proportion of infections among males than females could be due to the variation in hormone concentrations of males and females which contributes to differences in immune system packages and disease susceptibility patterns. Moreover, biological sex affects the immune response to foreign bodies, resulting in sex differences in responses to infections. In this regard, studies have confirmed that males are at higher risk of diseases caused by deleterious X-linked alleles.²⁵ Based on previous studies, evidence suggests that men tended to develop more serious COVID-19 cases and high mortality than women,^{24,27} which is also in line with our finding.

Of the total study participants, 5,593 (84.3%) were asymptomatic COVID-19 cases and 15.7% were symptomatic cases. Asymptomatic patients presented a hidden infection source for silent infection spread among their family, colleagues, and the community. With regards to the source of infection, earlier WHO reports³⁴ suggested health care professionals are being infected both in the workplace (contact) and in the community, most often through infected family members. In this study, about 6% (391 of 6,637) were health care professionals with confirmed COVID-19. Of these, 57.3% (224 of 391) health care professionals got infected from the community and 31.2% (122 of 391) declared having contact with a COVID-19 patient.

Of the symptomatic patients, 11.4% were on treatment, 83.2% were discharged, and 5.4% died. Of the hospitalized patients, 13.3% were admitted to intensive care units due to the severity of their disease and 86.7% had a non-severe disease, which is consistent with previous studies conducted in south Iran and Wuhan, China.^{35,36} This could be due to the higher proportion of younger COVID-19 patients.

In this study, the observed overall case fatality rate among hospitalized COVID-19 patients was 6.1%, which was similar to what has been reported in China.^{29,37–39} However, it was significantly lower than those reported from the studies conducted in France and New York City.^{32,40} The overall case fatality rate of COVID-19 was 21.1% and 20.0%, respectively, in these studies. The older age of patients in those studies (median ages: 72 and 63 years, respectively) could have led to severe disease that explains the higher mortality rates.

The mortality rate increased to 40.3% among patients with severe illness. This was lower than studies conducted in France.³² The discrepancy can be due to the younger age of patients in our study that may have led to lower comorbidities and a lower mortality rate. Moreover, it could be the experience in treating COVID-19 cases and level of awareness in the later period of this pandemic. Taking the patients' age into consideration, of the non-survival patients, 55.4% of the patients were older than 49 years and with frequent comorbidities. This finding was consistent with most previous research studies.^{20,27,28,32,38,39,41–43} In this study, cardiovascular diseases and diabetes mellitus were the most common comorbidities, which are aligned with the data that has been previously reported.^{1,27,29,32,33,39,44–46} The comorbidity rate in the non-survivor group was higher than in the survivor group (44.6% versus 10.5%, p -value <0.001), and also higher in the severe group than non-severe (28.8% versus 10.4%, p -value <0.001). Older age groups tended to have a higher proportion of cardiovascular disease, diabetes mellitus, and respiratory disease than younger age groups. Moreover, our study showed that the most frequently reported signs and symptoms on admission were cough, fever, sore throat, body weakness, shortness of breath, and pain. This was also consistent with most previous studies.^{20,28,47,48}

Limitation

Finding the whole array of each COVID-19 patient information from the electronic medical record was a challenge as some of the records were incomplete. Hence this could limit the findings of this study.

Conclusion

The proportion of symptomatic patients was low, at only 15.7%. The observed overall case fatality rate among hospitalized COVID-19 patients was 6.1%. Non-survivors were older and had underlying comorbidities. The findings of this study can help in designing appropriate management strategies for COVID-19 patients, such as relying on mass screening, as the majority of COVID-19 cases are asymptomatic, giving due emphasis to COVID-19 patients who are old and have comorbidities such as cardiovascular diseases and diabetes mellitus would be worthy to fight the pandemic.

Abbreviations

COVID-19, Coronavirus 2019; SD, standard deviation; CI, confidence interval; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2; THB, Tigray Health Bureau.

Data Sharing Statement

The dataset that are generated and analyzed for this study can be obtained from the corresponding author upon request.

Ethics

The ethics committee of the College of Health Sciences of Mekelle University approved the study with the ethical clearance registration number of IBR1826/2021. The study was conducted in accordance with the Declaration of Helsinki. The Tigray Health Bureau waived the requirement informed consent before the study started due to the urgent need to collect epidemiological and clinical data. All information collected from patient cards was kept strictly confidential as there were no personal identifiers used and neither the raw data nor the extracted data were passed to a third person.

Disclosure

The authors declare that they have no competing interests.

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