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ARTICLE

Incidence and predictors of diabetes mellitus among severe COVID-19 patients in western Ethiopia: a retrospective cohort study

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Background: Evidence reported a high occurrence of diabetes mellitus (DM) during the time of COVID-19. This study aimed to assess the incidence of DM and its predictors among severe COVID-19 patients admitted to the treatment centre of Wollega University Referral Hospital (WURH), western Ethiopia.
Methods: A facility-based retrospective cohort study was conducted among severe COVID-19 patients diagnosed using the rRT-PCR from September 30, 2020, to June 10, 2021. EpiData version 3.2 was used for data entry, and STATA version 14 for analysis. A Cox proportional hazard regression analysis was used to determine factors associated with DM. A multivariable Cox regression model with 95% CI and adjusted hazard ratio (AHR) was used to identify a significant predictor of the incidence of DM at p-value < 0.05.
Results: A total of 304 patient cards with complete data were included in the final analysis. The mean age of the participants was 43.3 (SD ± 16.9) years. Of the total 304 patients admitted with severe COVID-19, 14.5% were newly diagnosed with DM with an overall incidence rate of 13.7 per 1 000 person days' observation (PDO). The median time to occurrence of DM was 11 days (95% CI 7, 13) days. Age > 41 years (AHR = 2.54, 95% CI 1.15, 5.57), living in urban (AHR = 2.49, 95% CI 1.12, 5.52) and loss of appetite (AHR = 2.24, 95% CI 1.16, 4.34) increased the hazard of DM incidence, while presenting to the health facility after two days of clinical manifestation (AHR = 0.49, 95% CI 0.23, 0.96) decreased the risk of developing DM.
Conclusions: The incidence rate of DM among patients admitted with severe COVID-19 in the study area was found to be 13.7 per 1 000 person days' observation. Higher age, urban residence, early presentation to a health facility and loss of appetite were independent predictors of DM incidence. Therefore, we recommend early detection of DM and frequent monitoring of blood glucose for patients diagnosed with COVID-19.

Keywords: COVID-19, diabetes mellitus, Ethiopia, incidence, predictors

Introduction

According to a World Health Organization (WHO) report of July 1, 2021, COVID-19 has infected more than 182,319,261 people, of whom more than 3.9 million people have died.[1] The rates of infection and death from COVID-19 vary significantly between developed and low-income countries. The United States of America (USA) is the region where the highest death rate due to COVID-19 was observed, followed by India and Mexico.[2]

Since its epidemic eruption, the infectivity and fatality rate has been increasing rapidly, particularly in people living with chronic diseases such as hypertension, diabetes mellitus (DM), kidney diseases and other non-communicable diseases.[3,4] The research findings indicated that the severity of COVID-19 disease in terms of its virulence and mortality is devastating in people living with DM.[4–12] Currently, the world including developing countries is suffering from non-communicable chronic diseases that contribute to 71% of total deaths globally, to which DM contributes the highest number.[13]

During this period, COVID-19 has emerged and is a double burden to patients living with chronic diseases such as DM.[14] This new problem is superimposed on the previous problem of chronic diseases and further aggravates mortality and morbidity from chronic diseases.[15] The severity and mortality of COVID-19 is very much higher in diabetic patients than in patients without this non-communicable chronic disease.[16]

According to different evidence, high diabetes incidence has been diagnosed among patients infected with COVID-19. The coexistence of DM with COVID-19 is the major contributing factor for the increased severity and mortality from COVID-19.[9,10] Starting from the first report of the COVID-19 pandemic, a high number of patients with COVID-19 have been newly diagnosed with DM.[17] A global systematic review and meta-analysis research showed that the incidence of DM among patients infected with COVID-19 ranged from 7% to 17%.[10] The coexistence of these diseases is significantly associated with the socioeconomic status of the population. It is known that the treatment outcomes of DM in developing countries are poor due to low self-care practices. COVID-19 also has a significant effect among the population who are of low socioeconomic status. As the number of people infected with COVID-19 increases, people living with chronic diseases such as DM are at higher risk of severe disease, which might increase the rate of admission to the intensive care unit.[18] The pandemic brought a double burden to people with chronic disease and the number of COVID-19 cases has risen unacceptably among DM patients.[19]

A study conducted in China showed that the pooled incidence of DM among patients admitted with COVID-19 was 10%.[20]

Other research findings showed that DM is a risk factor for bad outcomes of coronavirus infection[4,21] due to the body having an impaired immune system.[22] The damage of pancreatic islet cells, and release of glucocorticoids and catecholamines by inflammation from coronavirus is related to the incidence of DM among patients with COVID-19.[23]

Even though the pathophysiology is not well studied, the coronavirus also disturbs management of the glucose level and causes inflammatory-based insulin resistance.[21] In addition, several factors have been reported as contributing to the incidence of DM among patients infected with COVID-19. Being male, in an older age group, hospitalised cases, obesity, hypoventilation and acute respiratory distress were the main contributing factors for the occurrence of DM among patients infected with COVID-19.[24]

There is no evidence on the incidence of DM among patients admitted with COVID-19 in Ethiopia. Therefore, this study aimed to assess the incidence of DM and its predictors among severe COVID-19 patients admitted to Wollega University referral hospital treatment centre, western Ethiopia.

Material and methods

Study area and period

This study was conducted in Wollega University Referral Hospital (WURH), Oromia regional state, western Ethiopia. WURH is in Nekemte town, which is 330 km from Addis Ababa, the capital of Ethiopia. It was the first COVID-19 treatment centre established in western Ethiopia. The treatment centre offers both diagnostic and treatment services. The study period was from September 30, 2020, to June 10, 2021, and the data was retrieved from medical record cards from June 10 to 25, 2021.

Study design, population and eligibility criteria

A retrospective cohort study was employed. All patients admitted to WURH treatment centre with severe COVID-19 were both source population and study population and had medical cards available from September 30, 2020 to June 10, 2021.

All available medical record cards of COVID-19 related admissions from September 30, 2020 to June 10, 2021 were included in the study. Medical record cards with incomplete information and patients with prior exposure to corticosteroids were excluded from the study. Furthermore, those patients who had previouslybeen diagnosed with DM before their presentation to the treatment centre were excluded from the analysis.

Sample size and sampling techniques

There were 417 admissions to the WURH COVID treatment centre from September 30, 2020, to June 10, 2021. Of these, 304 medical record cards with complete information were included in the study.

Variables and outcome measurements

The survival time was estimated in days, and was calculated from the point when the patient was diagnosed positive for COVID-19 by using an rRT-PCR test to the patient developing the outcome (event/censored). The outcome variable of this study was the incidence of diabetes mellitus, taken as an event of the study. Patients were diagnosed with DM when two fasting blood sugar measurements were ≥ 126 mg/dl ($\geq$ 7.0 mmol/l) after the patient was admitted with severe COVID-19.[25] Those patients who did not develop DM while on treatment (recovery, refused treatment/on treatment when the study was completed, and death) were censored.

The predictor variables considered for this study were sociodemographic factors such as age, residence and sex. Clinically related variables such as fever on admission, headache on admission, loss of appetite, sore throat, cough on admission, fatigue, status of the patient on admission, organ failure, oxygen supplementation activity, duration of clinical manifestation on admission, comorbidity on admission and type of comorbidity were also considered. Types of medication prescribed by the physician and laboratory-related variables such as oxygen saturation, chest X-ray, RBS, complete blood count, haemoglobin, and GeneXpert were also included. Oxygen saturation was categorised as normal oxygen levels in a pulse oximeter, i.e. ranging from 94% to 100%; blood oxygen levels below 94% are considered low (hypoxemia).[26]

Severity of the disease was categorised as asymptomatic for individuals with no symptoms consistent with COVID-19. Mild illness was the existence of any of the various signs and symptoms of COVID-19 (e.g. fever, cough, sore throat, malaise, headache, muscle pain, nausea, vomiting, diarrhoea, loss of taste and smell) but no shortness of breath, dyspnoea or abnormal chest imaging. Moderate illness was defined as evidence of lower respiratory disease during clinical assessment or imaging and oxygen saturation (SpO_2) $\geq$ 94% on room air at sea level. Severe illness was when an individual manifested oxygen saturation (SpO_2) < 94% on room air at sea level, a respiratory rate >30 breaths/minute or lung infiltrates > 50%. Critical illness was reported when an individual showed evidence of respiratory failure, septic shock and/or multiple organ dysfunction.[18]

Data collection tools and techniques

The checklist was developed in the English language. The data collectors collected information by reviewing all medical record cards of COVID patients admitted to WURH. The checklist was developed by reviewing medical cards and similar literature. Data were collected by two nurses working in the treatment centre. When the event or diabetes mellitus occurred, the date of diagnosis and important information was recorded on the checklist. The principal investigator monitored the progress of data collection every day. During data collection, the questionnaires were checked for completeness and consistency by the principal investigator every day.

Data management and analysis

EpiData version 3.2 (https://www.epidata.dk/) was used for data entry, and the data were then exported to STATA version 14 (StataCorp, College Station, TX, USA) for further analysis. Data were cleaned and edited by simple frequency and cross-tabulation before analysis. Descriptive survival analysis such as Kaplan–Meier survival function estimation was used for the estimation of the distribution of survival time. The Kaplan–Meier survival curve together with a log-rank test was fitted to test for the presence of difference in the occurrence of DM among categorical variables.

The overall survival function and separate estimates for the stratum of covariates were considered as statistically significant at a *p*-value of 0.05 in the log-rank test. A Cox proportional hazards regression model was used to determine the predictors of DM by controlling for confounding. Factors

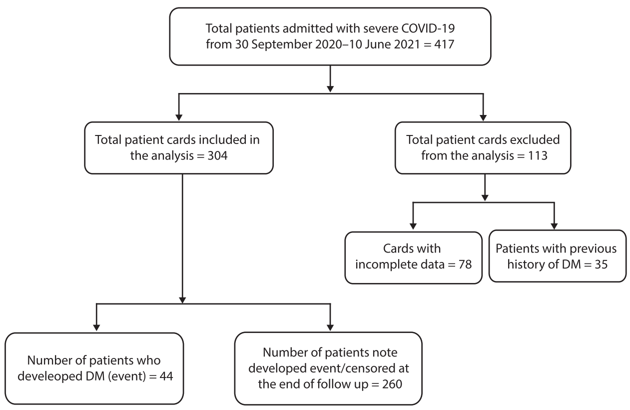

Figure 1: Schematic presentation of patients included in the analysis.

that were associated with outcome variables at 25% ($p < 0.25$) significance level in the bivariable test were included in the final multivariable analysis. The hazard ratio (HR) with 95% confidence intervals was computed and statistical significance was declared when it was significant at the 5% level ($p < 0.05$). For categorical covariates, the proportionality hazard assumption was tested graphically (log–log plot) and the global goodness of fit test or Schoenfeld residuals were used to test the proportionality hazard assumption for both continuous and categorical covariates. A Cox–Snell residual plot was used to assess the overall goodness of fit of the proportional hazard model.

Results

From September 30, 2020, to June 10, 2021, a total of 417 patients with severe COVID-19 were admitted to the WURH treatment centre. Of these, 304 patient cards with complete data were included in the final analysis (Figure 1).

Sociodemographic characteristics

The mean age of the participants was 43.3 (SD ± 16.9) years. One-third of the participants were in the age group 26–40 years. More than three-quarters (68.1%) of the cohort were male, and the majority (60.5%) of the participants resided in urban areas (Table 1).

Clinical manifestation and types of medication

Among the total participants, nearly three-quarters of patients (73.7%) had fever on admission. More than two-thirds (66.5%) had headache and more than half (52.2%) had pain. Some 80.0% had reported shortness of breath on arrival at the treatment centre (Table 2).

As regards medications, 83.9%, 65.5% and 57.2% of the patients were prescribed anti-pain/analgesics, azithromycin and dexamethasone, respectively (Figure 2).

Baseline medical, clinical and laboratory characteristics

More than half (41.8%) of the patients had a history of one or more comorbidities on admission. Hypertension (50.4%), heart disease (16.5%), asthma (11.9%), kidney disease (3.2%) and stroke (0.8%) were the major comorbidities reported on admission. Some 54% of the patients were at the subcritical status on admission, while 27% were critical. Almost all (93.1%) the patients were assisted by oxygen supplementation, among whom 73.1% were supplemented with intranasal oxygen (Table 3).

Types of complications

In terms of complications, around 24%, 3.9% and 3% developed respiratory distress, deep vein thrombosis and acute kidney failure, respectively (Table 4).

Treatment outcome and incidence of DM

Patients admitted with severe COVID-19 were followed for a total of 3 208 case days. Of the total 304 patients admitted with severe COVID-19, 44 (14.5%) developed DM during the follow-up period, while 260 were censored (218 recovered, 34 died, 1 refused treatment and 7 remained on treatment when the study was completed). The mean follow-up time was 26.5 (95% CI 24.9, 28.8) days. The patients had been followed up for a minimum and maximum of 1 and 34 days, respectively.

At the end of follow-up, the overall incidence rate of DM was 13.7/1 000 person days' observation (PDO) (95% CI 10.2, 18.4). The median occurrence of DM was 11 days (95%:CI: 7, 13) days. The overall Kaplan–Meier survival estimates showed that, over time, the risk of developing DM increased for the first 20 days, and was constant after 20 days of follow-up (Figure 3).

To examine for a significant difference in survival probability, a log-rank test was performed. According to the log-rank test, there was a significance difference in survival function for categorical variables such as residence (p-value = 0.0043), age of participants (p-value = 0.0060), duration of clinical manifestation on arrival (p-value = 0.0143) and oxygen saturation (p-value = 0.0003).

Predictors of DM incidence

Residence, age of the patient, loss of appetite, sex, duration of clinical manifestation on arrival at the hospital, status of patient on admission and level of oxygen saturation were found to be candidates for the multivariable Cox regression model. In multi-Cox regression analysis, age of the patient, residence, loss of appetite and duration of clinical manifestation on arrival were significant predictors of DM among patients with severe COVID-19. For patients who were above the age of 41 years, the risk of DM by 2.54 increased compared with patients aged under 25 years (AHR = 2.54, 95% CI 1.15, 5.57). The risk of DM among patients who resided in urban settings was 2.49 times higher than patients residing in rural settings (AHR = 2.49, 95% CI 1.12, 5.52). Patients who presented to a health facility within two days of clinical manifestation had a 51% higher risk of DM when compared with patients who presented to health facilities after 48 hours from clinical manifestation of

Table 1: Sociodemographic characteristics of severe COVID-19 cases admitted to Wollega University Referral Hospital, western Ethiopia

Variables	Category	Outcome		Total, *n* (%)
		Event, *n* (%)	Censored, *n* (%)	
Age	≤ 25 years	10	76	86 (28.3)
	26–40 years	11	95	106 (34.9)
	≥ 41 years	23	89	112 (36.8)
Sex	Male	32	175	207 (68.1)
	Female	12	85	97 (31.9)
Residence	Urban	36	148	184 (60.5)
	Rural	8	112	120 (39.5)

Table 2: Baseline clinical manifestation of severe COVID-19 cases admitted to Wollega University Referral Hospital treatment centre, western Ethiopia

Clinical manifestations	Category	Outcome		Total, *n* (%)
		Event, *n* (%)	Censored, *n* (%)	
Fever on admission	No	12	68	80 (26.3)
	Yes	32	192	224 (73.7)
Headache on admission	No	13	189	102 (33.5)
	Yes	31	171	202 (66.5)
Pain on admission	No	18	125	143 (47.8)
	Yes	26	135	161 (52.2)
Loss of appetite on admission	No	22	163	185 (60.9)
	Yes	22	197	119 (39.1)
Sore throat	No	42	237	279 (91.8)
	Yes	2	23	25 (8.2)
Cough on admission	No	0	20	20 (6.6)
	Yes	44	244	284 (93.4)
Shortness of breath	No	6	55	61 (20.1)
	Yes	38	205	243 (80.0)
Fatigue on admission	No	13	111	124 (40.8)
	Yes	31	149	180 (59.2)

the disease (AHR = 0.49, 95% CI 0.23, 0.96). Patients who reported loss of appetite on admission had an increased rate of DM of 2.24 compared with patients who had a good appetite on admission (AHR = 2.24, 95% CI 1.16, 4.34) (Table 5).

Discussion

Despite much effort having been undertaken to combat and tackle the spread of COVID-19, the COVID-19 pandemic continues to be a global and regional public health challenge. Evidence indicates that there is a bidirectional relationship between COVID-19 and DM. This is taken to mean that DM exacerbates the severity of COVID-19, whereas COVID-19 also causes new onset of DM.[27–29]

The findings from this study indicated that, of the total 304 patients admitted with severe COVID-19, 14.5% were newly diagnosed with DM with an overall incidence rate of 13.7 per 1 000 PDO. This is in line with a number of primary studies done in different countries such as the USA (20.82%),[30] India (20.6%)[31] and China (19.5%).[32] The occurrence of DM among COVID-19 patients could be due to the binding of COVID-19 to ACE2 on the host cells as a receptor. ACE2 is abundantly found in lung, kidney, liver and pancreas cells. As the number of ACE2 increases in the host cells, most viruses attach to ACE2 as a receptor, which causes damage to lung, liver, kidney and pancreas cells. Finally, it causes disturbance of the blood glucose level, and DM may arise.[33,34] Our findings also depicted that the status of COVID-19 patients on admission ranged from stable (18.18%) to subcritical (54.54%) and critical

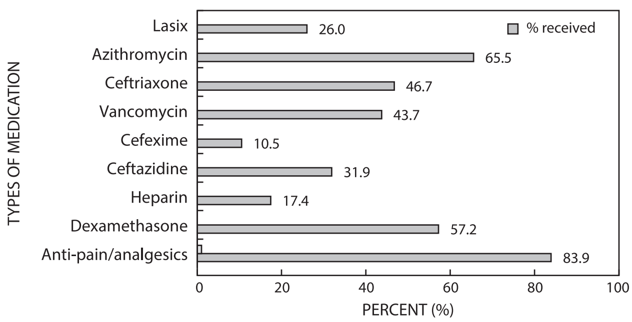

Figure 2: Types of medication prescribed for patients admitted with severe COVID-19 in WURH, western Ethiopia.

(27.27%). Thus, in the era of pandemics such as COVID-19, early screening and frequent monitoring of blood sugar should be emphasised, and physician–patient communication should receive due attention.[35]

Our study also showed that nearly a quarter of patients with newly diagnosed diabetes had respiratory distress. This result was in line with findings from China[36] in which newly diagnosed patients had more cough and dyspnoea. More importantly, there is increasing evidence from animal research which reveals that angiotensin-converting enzyme 2 (ACE2) is involved in regulation of the blood glucose level, but its mechanism is yet to be confirmed. Hence, this might lead to respiratory distress/failure due to ACE2 being believed to be an entry point for the coronavirus. Hence, COVID-19 infection lessens the angiotensin-converting enzyme 2 (ACE2) countenance, which undoubtedly leads to induced cellular damage, hyperinflammation and respiratory failure.[37] Furthermore, the majority (84.09%) of COVID-19 patients who were newly diagnosed with DM had a low neutrophil level of less than 1.5 neutrophils/mcl. This is perhaps an indication of a suppressed immune system, which might be attributed to the new onset of DM accompanied by COVID-19.

In our study, the place of residence was independently associated with new DM among COVID-19 patients. The time to developing DM was significantly faster among urban patients compared with rural patients with COVID-19. This was supported by pre-existing evidence regarding the disparities of the epidemiology of cardiovascular disease (CVD), in which the majority of CVD, including diabetes mellitus, is pro-urban.[38]

In this study, the risk of developing DM is 2.5-fold higher among COVID-19 patients who are aged above 41 than among their counterparts. This was in line with previous case reports on newly diagnosed diabetes among COVID-19 patients in which 2 out of 3 were aged above 40.[39] Furthermore, this finding was supported by a study conducted in India in which the mean age of about 20% of COVID-19 patients who were newly diagnosed with DM were above 50 years of age.[31]

Both age and residence are associated with the incidence of DM due to the presence of the lockdown principle during the early pandemic phases. Most patients, particularly the older age

Table 3: Baseline medical, clinical and laboratory results of severe COVID-19 cases admitted to Wollega University Referral Hospital treatment centre, western Ethiopia

Variables	Category	Outcomes		Total, *n* (%)
		Event, *n* (%)	Censored, *n* (%)	
Comorbidity on admission	No Yes	26 18	151 109	177 (58.2) 127 (41.8)
Status of patient on admission	Stable Subcritical Critical	8 24 12	49 141 70	57 (18.7) 165 (54.3) 82 (27.0)
Organ failure	No Yes	44 0	247 13	291 (95.7) 13 (4.3)
Duration of clinical manifestations on arrival	48 hours > 48 hours	11 33	30 230	41 (13.5) 263 (86.5)
Intranasal oxygen	No Yes	5 39	16 244	21 (6.9) 283 (93.1)
Types of intranasal oxygen	Facemask oxygen Intranasal oxygen	4 35	72 172	76 (26.9) 207 (73.1)
Oxygen saturation	≥ 94% < 94%	24 20	201 59	225 (74.0) 79 (26.0)
RBS level	≤ 200 mg/dl > 200 mg/dl	34 10	212 48	246 (80.9) 58 (19.1)
Haemoglobin level	≥ 12.1 gm/dl < 12.0 gm/dl	42 2	220 40	262 (86.2) 42 (13.8)
Neutrophil level	1.5–8 neu/µl < 1.5 neu/µl	7 37	27 233	34 (11.2) 277 (88.8)
WBC count	≥ 4000/µl < 4000/µl	3 41	9 251	12 (4.0) 292 (96.0)

Table 4: Types of complications that developed in patients admitted with severe COVID-19 cases to WURH treatment centre, western Ethiopia

Variables	Category	Outcomes		Total, *n* (%)
		Event, *n* (%)	Censored, *n* (%)	
Respiratory distress	No Yes	34 10	197 63	231 (76.0) 73 (24.0)
Deep vein thrombosis	No Yes	39 5	253 7	292 (96.1) 12 (3.9)
Acute kidney failure	No Yes	42 2	253 7	295 (97.0) 9 (3.0)
Bedsores	No Yes	43 1	255 5	298 (98.0) 6 (2.0)
Electrolyte imbalance	No Yes	41 3	245 15	286 (94.0) 18 (6.0)
Loss of consciousness	No Yes	35 9	232 28	267 (87.8) 37 (12.2)

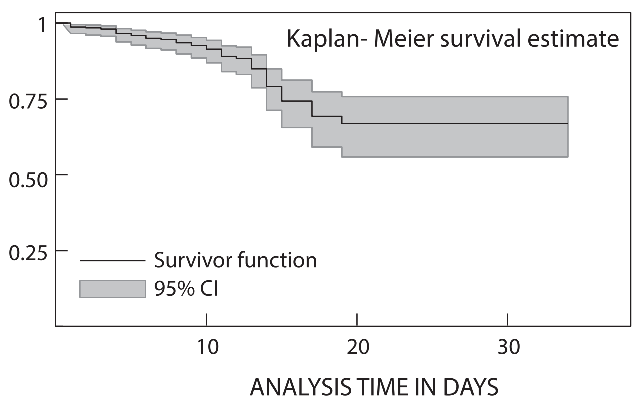

Figure 3: Overall Kaplan–Meier survival curve of patients admitted with severe COVID-19, western Ethiopia.

population and urban residents, implemented the lockdown guidelines. In line with the lockdown principle, routine daily activities were reduced, physical activity was minimised and there was no mobility from place to place. In addition, there was stress due to the disease and to staying at home. This led to a lack of options for the selection and consumption of vegetables and fruits, such that most people consumed only processed food. This all increases the chance of manifesting the clinical symptoms of DM, particularly undiagnosed DM.[22]

This study has also identified that the time from the onset of clinical manifestation of COVID-19 until a facility visit is also a predictor for the onset of new DM among COVID-19 patients. That is, those who presented to the health facilities within two days of clinical manifestation had 51% higher risk of DM when compared with patients who presented to health facilities after 48 hours from clinical manifestation of the disease (AHR =

Table 5: Multivariable Cox regression analysis of predictors of DM among patients admitted with severe COVID-19 to WURH treatment centre, western Ethiopia

Variables	Category	Outcomes: Event (DM), *n*	Outcomes: Censored (without DM), *n*	CHR	AHR	*p*-value
Residence	Rural	8	112	Ref	Ref	
	Urban	36	148	2.87 (1.33, 6.18)	2.49 (1.12, 5.52)	0.024*
Age	≤ 25 years	10	76	Ref	Ref	
	26–40 years	11	95	1.12 (0.47, 2.65)	1.20 (0.49, 2.91)	0.685
	≥ 41 years	23	89	2.69 (1.27, 5.69)	2.54 (1.15, 5.57)	0.020*
Sex	Female	32	175	Ref	Ref	
	Male	12	85	1.25 (0.61, 2.33)	1.21 (0.62, 2.38)	0.565
Loss of appetite on admission	No	22	163	Ref	Ref	
	Yes	22	97	1.56 (0.86, 2.83)	2.24 (1.16, 4.34)	0.016*
Oxygen saturation on admission	≥ 94%	37	233	Ref	Ref	
	< 94%	7	27	4.52 (0.97, 9.75)	4.27 (0.94, 10.20)	0.076
Duration of clinical manifestation	≤ 48 hours	11	30	Ref	Ref	
	> 48 hours	33	230	0.43 (0.22, 0.87)	0.47 (0.23, 0.96)	0.040*
Status of patients on admission	Stable	8	49	Ref	Ref	
	Subcritical	24	141	0.48 (0.55, 3.37)	0.74 (0.31, 1.74)	0.499
	Critical	12	70	1.23 (0.61, 2.48)	0.69 (0.27, 1.78)	0.454

*Significance level at *p*-value of 0.05. AHR = adjusted hazard ratio, CHR = crude hazard ratio.

0.49, 95% CI 0.23, 0.96). The effect of delay in seeking care for COVID-19 is observed in severe consequences such as myocardial infarction,[40] which is a signal of late presentation of COVID-19 patients and is a risk factor for a higher rate of complications.

Loss of appetite was one of the factors significantly increasing the risk of developing DM among patients diagnosed with severe COVID-19. This might be due to the fact that severe COVID-19 illness can trigger severe diabetic ketoacidosis, a diabetic-related complication that occurs when high levels of ketones build up in the blood and urine in individuals with new-onset diabetes. Loss of appetite may thus be related to the presence of diabetic keto-acidosis.[41]

This study has its limitations. First, because data was retrieved by reviewing patient medical cards, due to incomplete and undocumented cards this study may have missed essential variables that could influence the occurrence of DM. Another limitation of this study was it did not clearly identify stress hyperglycaemia from DM due to the nature of the study design and use of secondary data, which was limited by data incompleteness. Furthermore, it is obvious that the manifestation of DM is gradual and might be undiagnosed for a longer period. Therefore, it is uncertain whether DM or COVID-19 proceeds during the admission period without knowing the level of A1C. Since A1C is not routinely performed in our setting, we cannot ascertain whether or not the occurrence of DM was definitely due to COVID-19.

Conclusion

The incidence rate of DM among patients admitted with severe COVID-19 in the study area was found to be 13.7 per 1 000 person days' observation. The study also identified age greater than 41 years, living in an urban area, early presentation to a health facility and loss of appetite as independent predictors of DM incidence among patients admitted with severe COVID-19. Therefore, we will recommend early detection of DM and frequent monitoring of blood glucose for patients diagnosed with COVID-19. In addition, the elderly and patients who present with clinical manifestations must receive prompt attention. Finally, we recommend that scholars undertake further prospective and randomised trial studies to achieve plausible evidence for the unclear and unidentified phenomena of an association between DM and COVID-19.

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Ethical approval – Ethical clearance was obtained from the Review Ethics Committee of Wollega University, Institute of Health Sciences (Ref. no: REC524/2020). Since the data were extracted from patient medical cards, informed consent was not applicable for this study. Neither the case records nor the data extracted were used for any other purpose.

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