Journal of Ideas in Health

e ISSN: 2645-9248 Journal homepage: www.jidhealth.com Open Access

Original Article

Effect of risk factors on the outcomes of COVID-19-infected intensive care patients: a single-center retrospective study

Aditya Sapra[1], Jagadeeswaran VU[2], Shyamal Jha[2], HN Madhusudana[1]*, Mohammad Muzammil[1], Meghna Majumdar[1], Jeet Singh Arya[1], Aarti Sheoran[1]

Abstract

Background: To date, little attention has been paid to the impact of risk factors on the outcome of patients with coronavirus disease 2019 (COVID-19) hospitalized in the intensive care unit (ICU). This study was performed to examine the effects of risk factors on death among COVID-19 patients hospitalized in the ICU.

Methods: From April 2020 to November 2020, data on 141 COVID-19-infected intensive care patients at 7 Air Force Hospital, Kanpur, were retrospectively retrieved. All analyses were performed using SPSS statistical software (SPSS Inc., Chicago, IL, USA, 15.0). Bivariate and multivariate logistic regression analysis was done to identify independent risk factors. A p-value <0.05 was considered statistically significant.

Results: Most of study population were males (69.5%) with mean age of 59.8 ± 17.5 years. Out of 141 patients, 60 (42.6%) patients had comorbidities and 81 (57.4%) patients had no comorbidities. ICU death rates were 46.1%. Bivariate logistic regression analysis revealed that male sex (OR:0.45;95%CI:0.21-0.94), diabetes mellitus (OR:2.96; 95%CI:1.16-7.54), coronary artery disease (OR:2.48;95%CI:0.83-7.37), chronic kidney disease (OR:0.13,95% CI:0.02-1.12), patients with one (OR:1.25,95%CI:0.54-2.86) or more than two comorbidities (OR:1.95,95%CI:0.81-4.70), and who required high flow oxygen therapy (OR:13.30,95%CI:5.81-30.43), non-invasive (OR: 0.10,95% CI:0.02-0.45) and invasive ventilators (OR:0.04,95%CI:0.02-0.09) all were associated with higher ICU death rates. Multivariable logistic regression found following independent risk factors for death: patients with one comorbidity (OR:0.10;95%CI:0.02-0.66), non-invasive ventilator (OR:0.005;95%CI:0.000-0.091), and invasive ventilator (OR:0.003;95%CI:0.000-0.032).

Conclusion: Identification of risk factors is of utmost importance to reduce death in COVID-19 infected intensive care patients.

Keywords: Comorbidities, COVID-19, Mortality Rate, Morbidity Rate, Intensive Care Unit, Risk Factors, India

Background

Globally, coronavirus disease 2019 (COVID-19) has posed unparallel complications for patients hospitalized in intensive care units (ICU) [1, 2]. The prevalence of ICU hospitalization among confirmed COVID-19 patients varies from 3.0% to 100% based on the country's progress in healthcare infrastructures, equipment, and adequately trained healthcare workers. In addition, COVID-19-infected intensive care patients had substantial death rates ranging between 6% and 86% [3-8]. Many predisposing risk factors such as hypertension, diabetes mellitus, obesity, cardiovascular disorders, chronic obstructive pulmonary disease, male sex, and old age have higher death rates in COVID-19 patients [9-12]. Moreover, COVID-19 can cause acute respiratory distress syndrome (40% to 96%), which usually entails oxygen therapy and long-term mechanical ventilation, with higher death rates from 16% to 97% in these patients [8, 11, 13-15].

Despite the rapid transmission of COVID-19 and the swiftly growing number of patients afflicted with COVID-19, there is a dearth of literature addressing the risk factors for the progression of COVID-19 in the Indian population. Therefore, the present study examined the impact of risk factors on the death of COVID-19 patients hospitalized in the ICU.

*Correspondence: bullamadhu@gmail.com
[1]Department of Anaesthesia, 7 Air Force Hospital, Kanpur, Uttar Pradesh-208004, India.
Full list of author information is available at the end of the article

Methods

Study Design and Sample

This was a single-center, retrospective study of 141 confirmed COVID-19 patients hospitalized in the ICU in 140 bedded multispecialty hospital at 7 Air Force Hospital, Kanpur, from April 2020 to November 2020.

Inclusion and exclusion criteria

We included laboratory-confirmed all-comer COVID-19 patients with the help of chest computed tomography or real-time reverse transcription-polymerase chain reaction (RRT-PCR), including both nasopharyngeal and throat swab samples. All the diagnosis of COVID-19 was made per World Health Organization (WHO)'s interim guidance. Exclusion criteria were suspected COVID-19 patients without laboratory confirmation.

Data collection and sampling method

Medical records of demographics, comorbidities, and laboratory tests at the initial presentation were collected as per predefined proforma. The following variables were recorded: age, sex, comorbidities, the requirement of oxygen through high flow oxygen therapy, and a non-invasive or invasive ventilator. All patients received medical management as per WHO guidelines.

Definition of variables

Hypertension was defined as systolic blood pressure values ≥ 130 mm Hg and/or diastolic blood pressure ≥ 80 mm Hg. Diabetes mellitus was defined as fasting blood glucose level >126 gm/dl, or a clinical diagnosis of diabetes with dietary, oral, or insulin treatment. Coronary artery disease was defined as atherosclerotic plaque buildup in the vessel lumen. Cerebrovascular accident was defined as clinical syndrome manifested by the sudden onset (minutes to hours) of neurologic symptoms like hemiparesis and aphasia. Hypothyroidism was defined as the inability of the thyroid gland to produce enough thyroid hormone to fulfill the metabolic requirements of the body. Chronic kidney disease was defined as kidney damage characterized by abnormal albumin excretion or impaired kidney function enumerated as a measure of glomerular filtration rate that lasts for >3 months. Asthma was defined as a chronic respiratory disorder marked by inflammation and narrowing of the airway passages. Chronic obstructive pulmonary disease was defined as a chronic respiratory disorder indicated by airflow narrowing and persistent respiratory traits like dyspnea and cough.

Outcomes

The study outcomes were ICU death due to risk factors. Patients who had a negative result in RT-PCR finding of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2 RNA) were safely discharged.

Statistical analysis

Data are summarized using descriptive statistics. Categorical variables are presented as frequency and percentage, while continuous variables are expressed as mean ± S.D. A Chi-square test was used to compare categorical variables as appropriate. Bivariate logistic regression analysis was done to identify multivariable logistic regression analysis candidates. All explanatory variables with a value of <0.2 in the bivariate logistic regression analysis were included in the initial logistic model of multivariable logistic regression analysis to identify independent predictors. Crude and adjusted odds ratio (OR) and corresponding 95% confidence intervals (CI) were computed. All data were analyzed with the SPSS statistical software, version 15.0 (Statistical Package for the Social Sciences, Inc., Chicago, Illinois, USA). Differences were considered statistically significant at a p-value < 0.05 for all tests.

Results

Social and demographic characteristics

The average age of the study population was 59.8 ± 17.5 years, with male preponderance (69.5%). Patients were categorized into two groups based on the presence of comorbidities: a) patients with comorbidities (n=60) and b) patients with no comorbidities (n=81). Thirty-one patients (51.7%) had one comorbidity, and 29 patients (48.3%) had two comorbidities and above. The mean duration of ventilator support was 3.7 ± 3.7 days. As demonstrated in Table 1, all mentioned demographic parameters were similar among the two groups (P=0.001). Patients aged 12-45 years (OR: 0.05; 95% CI:0.00-0.87) and patients who required invasive (OR: 0.33; 95% CI:0.63-1.77) and non-invasive ventilator (OR: 063; 95% CI:0.31-1.27) were found as significant predictors in patients with comorbidities. However, multivariate analysis between these two groups revealed no significant predictors. Diabetes mellitus (19.1%) and coronary artery disease (12.8%) were the most common comorbidities in our study population, followed by hypertension (12.1%), chronic obstructive pulmonary disease (9.9%), chronic kidney disease (5.0%), cerebrovascular accident (5.0%), asthma (1.4%), and hypothyroidism (0.7%). The majority of the patients with one comorbidity or more than two comorbidities were males aged >45 years (Figure 1).

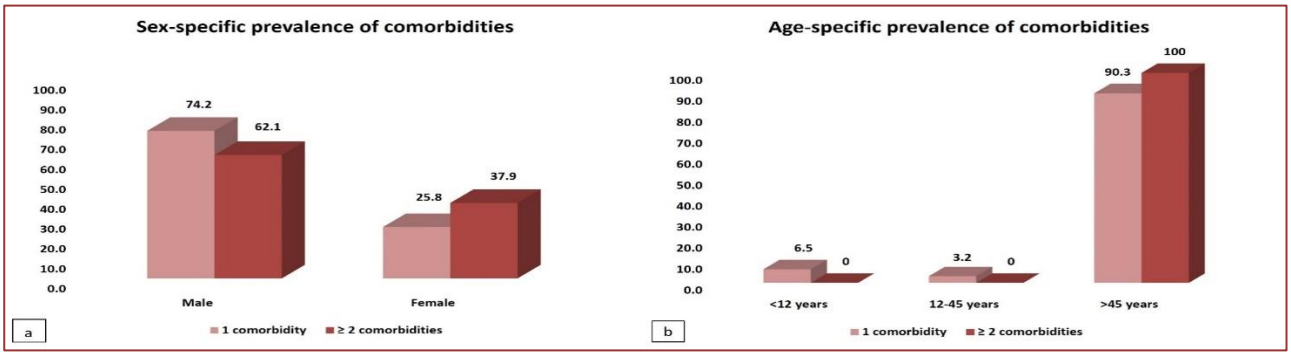

Figure 1: Sex and age-specific prevalence of comorbidities among 141 COVID-19-infected intensive care patients

Table 1: Profile of 141 confirmed COVID-19 patients with or with no comorbidities(N=141)

Characteristics	Category	Total N(%)	Patients with comorbidities N (%)	Patients with no comorbidities N (%)	P-value
Observations		141(100)	60(42.6)	81(57.4)	
Age group (years)	<12	4 (2.8)	2 (3.3)	2 (2.5)	0.001
	12-45	20 (14.2)	1 (1.7)	19 (23.5)	
	>45	117 (83.0)	57 (95.0)	60 (74.1)	
Gender	Male	98 (69.5)	41 (68.3)	57 (70.4)	0.795
	Female	43 (30.5)	19 (31.7)	24 (29.6)	
Requirement of oxygen supplementation	High flow oxygen therapy	68 (48.2)	34 (56.7)	34 (42.0)	0.183
	Oxygen supplement not required	3 (2.1)	0 (0.0)	3 (3.7)	
	Non-invasive ventilator	8 (5.7)	2 (3.3)	6 (7.4)	
	Invasive ventilator	62 (44.0)	24 (40.0)	38 (46.9)	
Outcomes	Death	65 (46.1)	24 (40.0)	41 (50.6)	0.211
	Discharged	76 (53.9)	36 (60.0)	40 (49.4)	

Out of 141 COVID-19 patients, 65 (46.1%) patients died, and 76 (53.9%) patients were discharged. There was a significant difference found between both the groups concerning sex (p=0.033), diabetes mellitus (p=0.019), chronic kidney disease (p=0.048), and patients requiring oxygen supplementation (p<0.001). The remaining outcomes among these two groups were delineated in Table 2. Based on bivariate logistic regression analysis, comorbidities that were found as risk factors responsible for death were diabetes mellitus (OR: 2.96; 95% CI:1.16-7.54), coronary artery disease (OR: 2.48; 95% CI:0.83-7.37), and chronic kidney disease (OR:0.13, 95% CI: 0.02-1.12). COVID-19 patients with more than two comorbidities were associated with a 2-fold increased risk of death compared to those with one comorbidity. Male sex (OR: 0.45; 95% CI: 0.21-0.94), non-invasive (OR: 0.03; 95% CI: 0.01-0.20) and invasive ventilators (OR: 0.02; 95% CI: 0.01-0.06) were found as other significant identified risk factors (Table 3). During the multivariate logistic regression analysis, patients with one comorbidity (OR: 0.10; 95% CI: 0.02-0.66), non-invasive ventilator (OR: 0.001; 95% CI: 0.00-0.03), and invasive ventilator (OR: 0.001; 95% CI:0.00-0.11) were found as significant risk factors responsible for death (Table 4).

Table 2: Outcomes of 141 confirmed COVID-19 patients admitted to the intensive care unit (N=141)

Characteristics	**Categories**	**Total (N)%**	**Death (N)%**	**Discharged (N)%**	**p-value**
	Observations	**141(100)**	**65(%)**	**73(%)**	
Age group, years	<12	4 (2.8)	02 (3.1)	02 (2.7)	0.269
	12-45	20 (14.2)	06 (9.2)	13 (17.3)	
	> 45	117 (83.0)	57 (87.7)	58 (79.5)	
Sex	Male	98 (69.5)	51 (78.5)	46 (63.0)	**0.033***
	Female	43 (30.5)	14 (21.5)	27 (37.0)	
Comorbidities	Hypertension	17 (12.1)	06 (9.2)	11 (15.1)	0.341
	Diabetes mellitus	27 (19.1)	07 (10.8)	19 (26.0)	**0.019***
	Coronary artery disease	18 (12.8)	05 (7.7)	12 (16.4)	0.095
	Cerebrovascular accident	7 (5.0)	03 (4.6)	04 (5.5)	>0.999
	Hypothyroidism	1 (0.7)	00 (0)	01 (1.4)	>0.999
	Chronic kidney disease	7 (5.0)	06 (9.2)	01 (1.4)	**0.048***
	Asthma	2 (1.4)	01 (1.5)	01 (1.4)	>0.999
	Chronic obstructive pulmonary disease	14 (9.9)	8 (12.3)	6 (8.2)	0.382
Number of comorbidities(n=60)	1	31 (22.0)	14 (21.5)	17 (23.3)	0.324
	≥ 2	29 (20.6)	10 (15.4)	18 (24.7)	
Requirement of oxygen supplementation	High flow oxygen therapy	68 (48.2)	6 (9.2)	62 (81.6)	**<0.001***
	Oxygen supplement not required	3 (2.1)	1 (1.5)	2 (2.6)	
	Non-invasive ventilator	8 (5.7)	6 (9.2)	2 (2.6)	
	Invasive ventilator	62 (44.0)	52 (80.0)	10 (13.2)	

Table 3: Bivariate logistic regression analysis of COVID-19 comorbidities as risk factors for death (n=141)

Characteristics	Categories	Bivariate OR*, 95% CI	p value
Age group, years	<12	Ref	
	12-45	2.33 (0.26-20.66)	0.446
	> 45	1.05 (0.14-7.73)	0.960
Sex	Female	Ref	
	Male	0.45 (0.21-0.94) *	**0.035**
Comorbidities (ref "No")	Hypertension	1.66 (0.58-4.78)	0.344
	Diabetes mellitus	2.96 (1.16-7.54) *	**0.023**
	Coronary artery disease	2.48 (0.83-7.37) *	**0.103**
	Cerebrovascular accident	1.15 (0.25-5.33)	0.860
	Hypothyroidism	0 (0)	>0.999
	Chronic kidney disease	0.13 (0.02-1.12) *	**0.063**
	Asthma	0.85 (0.05-13.92)	0.911
	Chronic obstructive pulmonary disease	0.61 (0.20-1.86)	0.386
Number of comorbidities (ref "No")	1	1.25 (0.54-2.86)	0.606
	≥ 2	1.95 (0.81-4.70) *	**0.138**
Requirement of oxygen supplementation	High flow oxygen therapy	Ref	
	Oxygen supplement not required	0.19 (0.015-2.46)	0.206
	Non-invasive ventilator	0.03 (0.01-0.20) *	**<0.001**
	Invasive ventilator	0.02 (0.01-0.06) *	**<0.001**

* Covariates found to be significant at α < 0.2 were selected for multivariate analysis. The coefficients are given with 95% confidence intervals. CI = confidence interval; OR = odds ratio

Table 4: Multivariate logistic regression analysis of COVID-19 comorbidities as risk factors for death (n=141

Characteristics	Categories	Multivariate OR, 95% CI	p-value
Sex	Female	Ref	
	Male	0.37 (0.10-1.39)	0.141
Comorbidities (ref "No")	Diabetes mellitus	5.02 (0.55-45.67)	0.152
	Coronary artery disease	3.77 (0.54-26.61)	0.183
	Chronic kidney disease	0.04 (0.00-4.63)	0.186
Number of comorbidities (ref "No")	1	0.10 (0.02-0.66)*	**0.017**
	≥ 2	2.40 (0.23-24.98)	0.464
Oxygen supplementation required	High flow oxygen therapy	Ref	
	Oxygen supplement not required	0.09 (0.01-1.57)	0.098
	Non-invasive ventilator	0.01 (0.00-0.03)*	**<0.001**
	Invasive ventilator	0.01 (0.00-0.11)*	**<0.001**

CI = confidence interval; OR = odds ratio

Discussion

The present study is among the few studies in India to determine the impact of comorbidities on death among COVID-19-infected intensive care patients. The main findings were as follows: a) mortality rates were higher in COVID-19-infected intensive care patients and b) male sex, diabetes mellitus, coronary artery disease, chronic kidney disease, patients with one or more than two comorbidities, and necessity of non-invasive and invasive ventilators all were independent risk factors associated with higher ICU death rates. However, we have found only the following three independent risk factors for death in multivariate analysis: a) patients with one comorbidity, b) the necessity of non-invasive ventilators, and c) invasive ventilators. The retrospective study reported 46.1% death rates in India's overall study patient population, which is concordant with the findings of Grasselli et al.[11], who had found a death rate of 48.8% in COVID-19 patients hospitalized in the ICU in Italy? However, in contrast to the present study's findings, earlier investigations by Budhiraja et al.[16]and Guan et al.[17] revealed low mortality rates of 32.2% in India and25.6% in China, respectively. Similarly, in a meta-analysis, Abate et al.[18] found a low ICU death rate of 39% in ICU admitted patients with COVID-19. The high frequency of death rate in ICU in the present study may be attributable to a substantial need for high oxygen flow therapy, a constrained number of mechanical ventilators, and a high incidence of comorbidities.

Risk factors for higher ICU death rates

Gender

Numerous risk factors such as hypertension, diabetes mellitus, obesity, cardiovascular disorders, chronic obstructive pulmonary disease, male sex, and old age, present in COVID-19 patients impose a significant burden to patients' life, emphasizing the importance of assessing the effect of risk factors on death in COVID-19 patients [9-12]. In the present study, the most common risk factor for death in COVID-19-

infected intensive care patients was male sex. This death rate in male COVID-19 patients hospitalized in the ICU was almost double that of the female COVID-19 patients, which is concordant with the previous studies [11, 12, 19]. In addition to comorbidity, a few studies have discovered the following rationale for higher death rates in males than females: higher risk behaviors such as smoking and alcohol use, occupational exposure, social difference, and biological difference. However, we have found no significant evidence of a higher prevalence of comorbidities in male patients.

Comorbidities

Patients with different comorbidities have been presented to have a poor prognosis even without COVID-19 because of late presentation coupled with lack of medical professionals, diagnostic and therapeutic equipment, and exorbitant treatment costs [20-23]. Regarding comorbidities that anticipated death in COVID-19-infected intensive care patients, our study confirms the prior finding of Grasselli et al. [11] and Osibogun et al. [12] who had found that diabetes mellitus exacerbated COVID-19 progression, and patients with diabetes mellitus have succumbed to COVID-19. The Global Burden of Disease collaboration has found that chronic kidney disease is the most common risk factor for death in COVID-19 patients [24], which is in line with the present study's finding. Furthermore, coronary artery disease was an independent risk factor for increased mortality in these patients [25, 26]. Likewise, in a prior study in China [27] and Southwest Nigeria [12], our data elicits that the presence of multiple comorbidities raises the chance of death in these patients. Therefore, patients with various comorbidities must require extra vigilance.

Non-invasive and invasive ventilators

The present study found a higher death rate in critically ill COVID-19-infected intensive care patients who required invasive or non-invasive ventilators in high dependency units. Similarly, Ferreira et al. [28] also found higher death rates in patients who required mechanical ventilation. Based on the present study's findings, we can speculate that this data can aid the clinicians in identifying the patients at a higher risk of serious infections and fatality and monitoring and reporting them appropriately. The present study has a few limitations. To begin with, this was a single-center retrospective study with small sample size; thus, the data is not representative of the general population. Furthermore, because only hospitalized patients were included, statistics on morbidity from COVID-19-infected intensive care patients may be understated. Hence, future studies with a large sample size are warranted.

Conclusion

Male gender, diabetes mellitus, coronary artery disease, chronic kidney disease, patients with one or more than two comorbidities, and the necessity of non-invasive and invasive ventilators all were linked to death in patients with COVID-19-infected intensive patients. Most crucially, as the COVID-19 pandemic expands, proper management of patients based on risk factors, adequate well-trained personnel, and mechanical ventilation all can facilitate clinicians to reduce the disease's death.

Abbreviation

CKD: Chronic Kidney Disease; COPD: Chronic Pulmonary Obstructive Disease; COVID-19: Coronavirus Disease 2019; ICU: Intensive Care Unit; WHO: World Health Organization.

Declaration

Acknowledgment

The authors would like to give special thanks to all patients who agreed to participate in this study.

Funding

The authors received no financial support for their research, authorship, and/or publication of this article.

Availability of data and materials

Data will be available by emailing bullamadhu@gmail.com

Authors' contributions

All authors equally contributed to the concept, design, scientific literature search, data collection, data analysis, manuscript writing, editing, and reviewing. All authors substantially contributed to the study and approved its submission.

Ethics approval and consent to participate

We conducted the research following the Declaration of Helsinki, and the protocol was approved by the Institutional Ethics Committee of 7 Air Force Hospital (Reg No.15965/58th/9/2020) on 08th January 2021. All patients provided a written informed consent form to use anonymized clinical data.

Consent for publication

Not applicable

Competing interest

The authors declare that they have no competing interests.

Author details

[1]Department of anesthesia, 7 Air Force Hospital, Kanpur, Uttar Pradesh-208004, India.

[2]Department of ENT, 7 Air Force Hospital, Kanpur, Uttar Pradesh-208004, India.

Article Info

Received: 03 November 2021
Accepted: 01 February 2022
Published: 13 March 2022

References

1. Elhadi M, Msherghi A, Alkeelani M, Zorgani A, Zaid A, Alsuyihili A, et al. Assessment of healthcare workers' levels of preparedness and awareness regarding COVID-19 infection in low-resource settings. Am J Trop Med Hyg. 2020;103(2):828-33.https://doi.org/10.4269/ajtmh.20-0330
2. Tabah A, Ramanan M, Laupland KB, Buetti N, Cortegiani A, Mellinghoff J, et al. Personal protective equipment and intensive care unit healthcare worker safety in the COVID-19 era (PPE-SAFE): an international survey. J Crit Care. 2020;59:70-75.https://doi.org/10.1016/j.jcrc.2020.06.005
3. Chen C-Y, Lee C-H, Liu C-Y, Wang J-H, Wang L-M, Perng R-P. Clinical features and outcomes of severe acute respiratory syndrome and predictive factors for acute respiratory distress syndrome. J Chin Med Assoc. 2005;68(1):4-10.https://doi.org/10.1016/s1726-4901(09)70124-8
4. Al-Dorzi HM, Aldawood AS, Khan R, Baharoon S, Alchin JD, Matroud AA, et al. The critical care response to a hospital outbreak of Middle East respiratory syndrome coronavirus (MERS-CoV) infection: an observational study. Ann Intensive Care. 2016;6(1):1-11. https://doi.org/10.1186/s13613-016-0203-z
5. Arabi YM, Arifi AA, Balkhy HH, Najm H, Aldawood AS, Ghabashi A, et al. Clinical course and outcomes of critically ill patients with Middle East respiratory syndrome coronavirus infection. Ann Intern Med. 2014;160(6):389-97.https://doi.org/10.7326/M13-2486
6. Halim AA, Alsayed B, Embarak S, Yaseen T, Dabbous S. Clinical characteristics and outcome of ICU admitted MERS corona virus infected patients. Egypt J Chest Dis Tuberc. 2016;65(1):81-87.https://doi.org/10.1016/j.ejcdt.2015.11.011
7. Rodriguez-Morales AJ, Cardona-Ospina JA, Gutiérrez-Ocampo E, Villamizar-Peña R, Holguin-Rivera Y, Escalera-Antezana JP, et al. Clinical, laboratory and imaging features of COVID-19: A systematic review and meta-analysis. Travel Med Infect Dis. 2020;34:101623.https://doi.org/10.1016/j.tmaid.2020.101623
8. Arentz M, Yim E, Klaff L, Lokhandwala S, Riedo FX, Chong M, et al. Characteristics and outcomes of 21 critically ill patients with COVID-19 in Washington State. JAMA. 2020;323(16):1612-14.https://doi.org/10.1001/jama.2020.4326
9. 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(20):2052-59.https://doi.org/10.1001/jama.2020.6775
10. Myers LC, Parodi SM, Escobar GJ, Liu VX. Characteristics of hospitalized adults with COVID-19 in an integrated health care system in California. JAMA. 2020;323(21):2195-98.https://doi.org/10.1001/jama.2020.7202
11. Grasselli G, Greco M, Zanella A, Albano G, Antonelli M, Bellani G, et al. Risk factors associated with mortality among patients with COVID-19 in intensive care units in Lombardy, Italy. JAMA Intern Med. 2020;180(10):1345-55.https://doi.org/10.1001/jamainternmed.2020.3539
12. Osibogun A, Balogun M, Abayomi A, Idris J, Kuyinu Y, Odukoya O, et al. Outcomes of COVID-19 patients with comorbidities in southwest Nigeria. PloS One. 2021;16(3):e0248281.https://doi.org/10.1371/journal.pone.0248281
13. Bhatraju PK, Ghassemieh BJ, Nichols M, Kim R, Jerome KR, Nalla AK, et al. Covid-19 in critically ill patients in the Seattle region—case series. N Engl J Med. 2020;382(21):2012-22.https://doi.org/10.1056/NEJMoa2004500
14. Yang X, Yu Y, Xu J, Shu H, Liu H, Wu Y, et al. Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: a single-centered, retrospective, observational study. Lancet Respir Med. 2020;8(5):475-81.https://doi.org/10.1016/S2213-2600(20)30079-5
15. Zhou F, Yu T, Du R, Fan G, Liu Y, Liu Z, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. Lancet. 2020;395(10229):1054-62.https://doi.org/10.1016/S0140-6736(20)30566-3
16. Budhiraja S, Soni A, Jha V, Indrayan A, Dewan A, Singh O, et al. Clinical Profile of First 1000 COVID-19 cases admitted at tertiary care hospitals and the correlates of their mortality: an Indian experience. medRxiv. 2020:1-19.https://doi.org/10.1101/2020.11.16.20232223
17. Guan W-j, Ni Z-y, Hu Y, Liang W-h, Ou C-q, He J-x, et al. Clinical characteristics of coronavirus disease 2019 in China. N Engl J Med. 2020;382(18):1708-20.https://doi.org/10.1056/NEJMoa2002032
18. Abate SM, Ahmed Ali S, Mantfardo B, Basu B. Rate of Intensive Care Unit admission and outcomes among patients with coronavirus: A systematic review and Meta-analysis. PloS one. 2020;15(7):e0235653.https://doi.org/10.1371/journal.pone.0235653
19. Sharma G, Volgman AS, Michos ED. Sex differences in mortality from COVID-19 pandemic: are men vulnerable and women protected? Case Reports. 2020;2(9):1407-10.https://dx.doi.org/10.1016%2Fj.jaccas.2020.04.027
20. Ayoade B, Salami B, Agboola A, Tade A, Adekoya A, Olatunji A, et al. Beliefs and practices associated with late presentation in patients with breast cancer; an observational study of patient presenting in a tertiary care facility in Southwest Nigeria. J Afr Cance. 2015;7(4):178-85.https://doi.org/10.1007/s12558-015-0404-7
21. Ulasi II, Ijoma CK. The enormity of chronic kidney disease in Nigeria: the situation in a teaching hospital in South-East Nigeria. J Trop Med. 2010:1-6.https://doi.org/10.1155/2010/501957
22. Adejumo OA, Akinbodewa AA, Ogunleye A, Enikuomehin AC, Lawal OM. Cost implication of inpatient care of chronic kidney disease patients in a tertiary hospital in Southwest Nigeria. Saudi J Kidney Dis Transpl. 2020;31(1):209-14.https://doi.org/10.4103/1319-2442.279942
23. Anudeep A, Somu C, Kumar J. Clinical profile and outcomes of critically ill covid-19 patients admitted in a

tertiary care hospital. Ann Trop Med Public Health. 2020;23(19):232-141.https://doi.org/10.36295/ASRO.2020.232141

24. Bikbov B, Purcell CA, Levey AS, Smith M, Abdoli A, Abebe M, et al. Global, regional, and national burden of chronic kidney disease, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. The Lancet. 2020;395(10225):709-33.https://doi.org/10.1016/S0140-6736(20)30045-3
25. Loffi M, Piccolo R, Regazzoni V, Di Tano G, Moschini L, Robba D, et al. Coronary artery disease in patients hospitalized with Coronavirus disease 2019 (COVID-19) infection. Open heart. 2020;7(2):e001428.https://doi.org/10.1136/openhrt-2020-001428
26. Liang C, Zhang W, Li S, Qin G. Coronary heart disease and COVID-19: A meta-analysis. Medicina Clínica (English Edition). 2021;156(11):547-54.https://doi.org/10.1016/j.medcle.2020.12.021
27. Guan W-j, Liang W-h, Zhao Y, Liang H-r, Chen Z-s, Li Y-m, et al. Comorbidity and its impact on 1590 patients with COVID-19 in China: a nationwide analysis. European Respiratory Journal. 2020;55(5).https://dx.doi.org/10.1183%2F13993003.00547-2020
28. Ferreira JC, Ho Y-L, Besen BAMP, Malbouisson LMS, Taniguchi LU, Mendes PV, et al. Protective ventilation and outcomes of critically ill patients with COVID-19: a cohort study. Annals of intensive care. 2021;11(1):1-11. https://doi.org/10.1186/s13613-021-00882-w