Original Article

Morbidity and mortality pattern of COVID-19 patients and its associated risk factors: A cross-sectional study

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Abstract

Background: Early identification of patients with poor prognosis may facilitate the provision of proper supportive treatment in advance and reduce mortality due to Coronavirus Disease 2019 (COVID-19). The present study estimates the recovery and mortality rates among in-house COVID-19 patients admitted to a tertiary care center and also determines any association between mortality and variables of interest. **Methods and Material:** This cross-sectional study was conducted in June to December 2021 among the COVID-19 patients admitted to the hospital based on their case sheets. A sample size of 1500 was calculated which was obtained by simple random sampling. Descriptive statistics were generated. Association between mortality and other variables was tested by using bivariate logistic regression and multiple logistic regression analysis. **Results:** The overall recovery rate was 80.1%. Vaccination status was significantly associated with mortality, with the AOR (95% CI) of getting both vaccine doses and a single dose being 0.18 (0.05-0.70) and 0.28 (0.15-0.55), respectively, when compared to the unvaccinated group. Also, patients who sought admission on their own were found to be having more chances of recovery compared to those who were referred from other health facilities. The risk of dying was found to be increased nearly 5-fold among those who used Non-Rebreathing machines. The use of Non-Invasive ventilation and Bain Circuit was significantly associated with a bad prognosis. None on the mechanical ventilation survived. **Conclusions:** The mortality rate of COVID-19 patients admitted to the tertiary care hospital was found to be one-fifth and the ICU-specific mortality rate was 83.6% while other factors like age and gender were not found to be associated with mortality. Among comorbidities, only liver diseases were found to be a significant determinant of mortality. Finally, patients who needed more flow rate of oxygen had a significant association with mortality.

Keywords: COVID-19, morbidity, mortality, tertiary care institute

Introduction

In December 2019, Wuhan City the capital of Hubei province of China became the center of an outbreak of pneumonia designated as Coronavirus disease 2019 (COVID-19). World Health Organization (WHO) declared it as a global pandemic on 11 March 2020.[1] Since then, there have been 214,468,60 confirmed cases worldwide and giving a total 4,470,969 deaths globally. In India, out of the total 32,603,788 confirmed affected

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individuals, 436,861 died.[2] In Manipur, out of total 112,941 affected cases, 1775 died due to COVID-19.[3]

Mild acute respiratory infection symptoms, such as fever, dry cough, and fatigue are common in the early stage of the disease but some patients rapidly develop acute respiratory distress syndrome, acute respiratory failure, multiple organ failure, and other complications.[4,5] Early identification of patients with poor prognosis may facilitate the provision of proper supportive treatment in advance and reduce mortality due to COVID-19.[6]

Asghar MS *et al.*[7] have established a link between COVID-19 disease severity and mortality along with laboratory investigations in their study. Cao J *et al.*[8] revealed in their study that there were no differences in mortality among those who did or did not receive antimicrobial or glucocorticoid drug treatments. Aloisio *et al.*[9] also established higher odds of death and intensive care in their study and several publications which address the clinical characteristics of hospitalized COVID-19 and determined the various risk factors for the disease.[9,10] However, the differences in the Chinese, US, and European populations could have an impact on the generalizability and translatability of our Indian patients. Moreover, there is a dearth of such studies in the North-eastern part of India to explore the factors associated with COVID-19.

Primary care physicians are the first point of contact for the general population and for providing a continuum of care. Timely recognition of morbid conditions and prompt referral are necessary to improve quality of life and care and also for preventing any untoward incident. The study will help to provide deeper insights into the associated factors of COVID-19 morbidity and mortality.

Thus, the present study was done to estimate the recovery and mortality rates among in-house COVID-19 patients admitted to the JN Institute of Medical Sciences Hospital which is a tertiary care center. The study further aimed to determine any association between mortality and important variables like patients' background characteristics, comorbidities present, and method of oxygen administration.

Methods

Study design and population

The cross-sectional study was conducted at the JN Institute of Medical Sciences, Imphal, during the period of June to December 2021 among the COVID-19 patients admitted to the hospital based on their case sheets.

Sample size calculation and sampling technique

A total of 4513 patients were admitted to the same hospital from the onset of the second wave of the COVID-19 pandemic till the ebbing of the same in the state of Manipur (April-Nov 2021).[11] A sample size of 1500 was calculated considering the mortality rate from a study by Rosenthal N *et al.*,[12] a significance level of 95% and an absolute precision of 2. This sample was obtained by simple random sampling through computer-generated random numbers from the in-patient registration numbers maintained in the Medical Record Department of the hospital.

Variables, tool, technique, and data collection

A data abstraction pro forma was used to collect information. It had sections on socio-demography, referral status, time period between testing positive and seeking admission, main symptoms before admission and their duration, referral status, vitals at admission, comorbidities, vaccination status, interventions given after admission, and outcome of the hospitalization.

Statistical analysis

Data collected were entered and analyzed by using SPSS version 22 (IBM Company, Chicago, Illinois, United States). Proportions, means, median, standard deviation, and inter-quartile range were used for descriptive analysis of the predictor variables, morbidity, and mortality. Association between the predictor variables and dependent variables was tested by using bivariate logistic regression. Further, to rule out the confounding effect, multiple logistic regression analysis was done using the independent variables which had a statistically significant association with the dependent variable. A P value of <0.05 was considered as statistically significant.

Ethical considerations

To access the patient case sheets, permission was obtained from the Medical Superintendent of the JNIMS Hospital. Ethical approval of the present study was obtained from the Institutional Ethics Committee of JNIMS, Imphal vide No. Ac/03/IEC/JNIMS/2018 dt. the 25 September 2021. All the data were kept confidential and no identifiers were used.

Results

Socio-demographic and patients' characteristics

Data were abstracted from 1500 case records. Males outnumbered the females (801:699). The median age (IQR) was found to be 55 (40-65.75) years. Roughly, one-third of them belonged to the age groups of 15 to 45 years, 45 to 60 years, and >60 years each while under-5 years constituted only 2%.

Of them, 322 (21.5%) were cases referred from COVID Care centers, Community Home Isolation Centres, or other Public or Private Health facilities, the remaining 1178 (78.5%) cases being directly coming from home. Comorbidities were found in 639 (42.6%) cases, the commoner ones being hypertension, Type 2 diabetes mellitus, CVA/its sequelae, chronic kidney disease, chronic obstructive pulmonary disease/bronchial asthma, and chronic liver disease. They occurred either singly or in combinations. Hypertension in combination with diabetes mellitus was found most often.

A total of 638 were discharged after recovery, thus making an overall recovery rate of 80.1%, while 298 died giving an overall case fatality rate of 19.9%. A few of them (20; 1.3%) needed further admission in non-COVID wards for further management after getting tested as negative.

Out of all the patients admitted, 128 (8.5%) were direct admissions to ICU ward as they had severe COVID-19, among which 107 died giving an ICU-specific mortality rate of 83.6%, while among 35 patients who during the course of treatment in the general ward got worsened and needed ICU treatment and thereby shifted to ICU ward later, 33 died giving a mortality rate of 91.4%.

Descriptive statistics

The mean number of days (SD) patients stayed in the hospital before being discharged after recovery was 7.62 (8.2) and the median days (IQR) before death occurred was 6 (2-11) with a wide range of 1 to 61 days. The maximum proportion of deaths happened after 5 days of admission (138; 46%), whereas more than a quarter of deaths (27%) happened on the same day of admission [Figure 1].

Logistic regression analysis

On bivariate analysis, the age of the patient had a seemingly statistically significant association with mortality, with older persons aged >60 years having a COR (95% CI) of 5.95 (1.40-25.26). But on multiple logistic regression, it was not found to be statistically significant. Likewise, none of the other socio-demographic variables like gender and referral status showed any significant association with mortality. However, vaccination status was significantly associated with mortality, with the AOR (95% CI) of getting both vaccine doses and a single dose being 0.18 (0.05-0.70) and 0.28 (0.15-0.55), respectively, when compared to the unvaccinated group. Also, patients who sought admission on their own were found to be having more chances of recovery compared to those who were referred from other health facilities [Table 1].

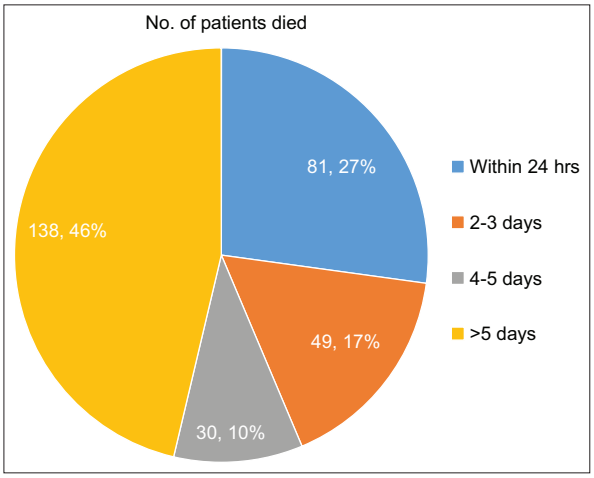

Figure 1: Distribution of deaths by hospital stay

None of the comorbidities except chronic liver disease (AOR; 96% CI = 7.87; 3.10-20.0) had any statistically significant association with mortality [Table 2].

Those who were managed with O_2 concentrators did not show any significant association with death. The risk of dying was found to be increased nearly 5-fold among those who used Non-Rebreathing Machine (NRBM) (AOR; 95% CI = 4.84; 3.34-7.01). The use of Non-Invasive ventilation (NIV) and Bain Circuit (BC) was significantly associated with a bad prognosis, the AORs (95% CI) being 36.17 (30.56-63.66) and 15.22 (4.61-57.03), respectively. And none of the patients who were put into mechanical ventilation survived [Table 3].

Discussion

The overall recovery rate and mortality rate, as found in the present study were 80.1% and 19.9%, respectively. The mortality rate was much higher among patients with severe COVID-19 who directly got admitted to the ICU ward. The current overall mortality rate is slightly lower than the finding made by the ISARIC4C study by WHO (26%) in acute care hospitals in England, Wales, and Scotland.[13] Probably, the ISARIAC4C study covered only severe cases, whereas the present study hospital is dealing with all types of cases. Studies by Gayam V *et al.* and Chilimuri S *et al.* in New York also gave higher mortality rates of 33.35% and 43%, respectively.[14,15] But, Rosenthal N *et al.*[12] from their study done among the US nationals found a mortality rate of 20.3%, while Khamis F *et al.*[16] from their study in Oman found an overall mortality rate of 26%. Their findings are comparable with the current study finding. Malhotra V *et al.*[17] from their study in Delhi found a much lesser mortality figure of 13.72%. It may be because the tertiary care center where their study took place admitted all forms of COVID-19 patients, thereby diluting the mortality rate. Inter-regional variations cannot be ruled out.

The ICU-specific mortality rate of 83.6% as found in the present study was much higher than the ICU mortality rate of 42% found by Khamis F *et al.* in their study in Oman and 49% by Olivas Martnez A *et al.*[16,18] Severity of the patient's condition on admission and promptness in seeking health care may be important factors making the difference.

Comorbidities, mainly hypertension and type 2 diabetes mellitus, were found in 42.6% of the patients in the current study. This is comparable with the findings made by Chilimuri S *et al.*[15] from their study in New York and Osbogun A *et al.*[19] from their study in Nigeria. On the contrary, Mohan A *et al.*,[20] in their study done in north India, found a much lower rate of comorbidities: 15.9% for hypertension and 11.1% for diabetes mellitus. This may reflect the difference in the prevalence of hypertension and diabetes mellitus in the general population before the COVID-19 era. This can be ascertained from the fact sheet of the latest NFHS Report which shows an increasing trend in the prevalence of hypertension and diabetes in the state of Manipur.[21]

Table 1: Association between mortality and patients' background characteristics

Independent variable	Recovered (%)	Died (%)	COR (95% CI)	AOR (95% CI)
Age				
<15	28 (93.3)	02 (6.7)	1	1
15-45	437 (91.4)	41 (8.6)	1.31 (0.30-5.71)	0.56 (0.12-2.71)
45-60	358 (79.2)	94 (20.8)	3.68 (0.86-15.71)	1.76 (0.38-8.29)
>60	379 (70.2)	161 (29.8)	5.95 (1.40-25.26)	2.70 (0.58-12.82)
Gender				
Male	623 (77.8)	178 (22.2)	1	1
Female	579 (82.8)	120 (17.2)	0.72 (0.56-0.93)	0.85 (0.59-1.21)
Referral status				
From other health facilities	206 (64.0)	116 (36.0)	1	1
From home by self	996 (84.6)	182 (15.4)	0.32 (0.24-0.42)	0.50 (0.34-0.73)
Comorbidity				
No	728 (82.0)	133 (18.0)	1	1
Yes	474 (74.1)	165 (26.9)	1.91 (1.47-2.46)	1.08 (0.66-1.76)
Vaccination status				
Unvaccinated	940 (77.0)	281 (23.3)	1	1
First dose only	180 (92.8)	14 (7.2)	0.26 (0.14-0.45)	0.28 (0.15-0.55)
Both doses	82 (96.5)	3 (3.5)	0.12 (0.03-0.39)	0.18 (0.05-0.70)

Table 2: Association between mortality and comorbidities

Comorbidities	Recovered (%)	Died (%)	COR (95% CI)	AOR (95% CI)
Hypertension				
No	927 (81.6)	209 (18.4)	1	1
Yes	275 (75.5)	89 (24.5)	1.43 (1.08-1.90)	1.08 (0.66-1.76)
Type 2 Diabetes mellitus				
No	936 (81.5)	213 (18.5)	1	1
Yes	266 (75.8)	85 (24.2)	1.41 (1.10-1.87)	0.95 (0.58-1.57)
CVA/CVA sequelae				
No	1178 (80.5)	285 (19.5)	1	1
Yes	24 (64.9)	13 (35.1)	1.01 (0.74-1.62)	2.30 (0.93-5.70)
Chronic kidney disease				
No	1162 (80.5)	282 (19.5)	1	1
Yes	40 (71.4)	16 (28.6)	1.64 (0.91-2.98)	0.82 (0.33-2.01)
COPD/Br asthma				
No	1171 (80.6)	282 (19.4)	1	1
Yes	31 (66.0)	16 (34.0)	2.14 (1.15-3.97)	1.09 (0.43-2.75)
Chronic liver disease				
No	1186	281	1	1
Yes	16	17	4.48 (2.23-8.98)	7.87 (3.10-20.0)
Malignancy				
No	1199 (80.1)	297 (19.9)	1	1
Yes	3 (75.0)	1 (25.0)	1.34 (0.13-12.9)	3.03 (0.20-45.56)

None of the socio-demographic and background characteristics like age, gender, and presence of comorbidities except for vaccination status and referral status were found to be significantly associated with mortality. This is in contrast to previous study findings made by earlier scholars from different parts of the world.[12,15,17,18,22-25] This may be due to the difference in the population characteristics or in treatment such as time of initiation, and so on. The lesser chance of mortality among those who sought hospital admission of their own may be that, they belonged to the less severe type of the disease while health facilities referred only when the condition starts deteriorating.

The presence of liver disease was found to be associated with increased mortality in our study. This finding supports the Khami F *et al.*[16] study findings.

As anticipated, not very serious patients who needed a low flow rate of oxygen via O_2 concentrators did not show any significant association with mortality. But those who needed higher flow and needed NRBM, BC, or NIV for Oxygen administration showed a 5-fold, 16-fold, and 36-fold chance of dying, respectively. Those patients who had acute respiratory distress syndrome and needed mechanical ventilation for the same purpose did not survive.

Finally, a study done by Grattagliano I *et al.*[26] highlighted the critical role of the family doctor or primary care in easing the burden of the acute-care system by facilitating the early identification of cases and by helping to amplify the key messages to people.

Table 3: Association between mortality and means of O_2 administration

Means of O_2 administration	Recovered (%)	Died (%)	COR (95% CI)	AOR (95% CI)
O_2 Concentrators				
No	1165 (80.1)	290 (19.9)	1	1
Yes	37 (82.2)	8 (17.8)	0.86 (0.40-1.9)	-
NRBM				
No	1043 (87.1)	155 (12.3)	1	1
Yes	159 (52.6)	143 (47.4)	6.01 (4.56-8.02)	4.84 (3.34-7.01)
Bain Circuit				
No	1197 (82.7)	251 (17.3)	1	1
Yes	5 (9.6)	47 (90.4)	44.82 (17.7-113.8)	16.22 (4.61-57.03)
Non-invasive ventilation				
No	1182 (87.8)	164 (12.2)	1	1
Yes	20 (13.0)	134 (87.0)	48.3 (29.4-79.4)	36.17 (20.56-63.66)
Intubation				
No	1202 (82.0)	264 (18.0)	1	1
Yes	-	34 (100)	-	-

Limitations and strength

Our study setting being at a tertiary care center might have overestimated the symptoms and complications pertaining to certain study variables. The treatment outcome might be affected by the level of health care provided and hence limiting the generalizability to a lower setting. However, our study is one of the maiden studies in the state regarding the COVID-19-related problems and it will provide evidence for future studies.

Conclusion

The recovery and mortality rates of the COVID-19 patients admitted in the tertiary care hospital were found to be 80.1% and 19.9%, respectively, and the ICU-specific mortality rate was found to be 83.6% while other factors like age and gender were not found to be associated with mortality. Getting one dose or full doses of vaccine significantly reduced the chance of succumbing to death. The majority of the patients were found to be unvaccinated. Comorbidities mainly hypertension and type 2 diabetes mellitus were found in 42.6% of patients. Liver diseases were found to be a significant determinant of mortality while other forms of comorbidity did not show any significant association with mortality. Finally, serious patients who needed more flow rate of oxygen had a significant association with mortality. Mechanical ventilation might have the least to do in reducing the mortality rate among COVID-19 patients.

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Conflicts of interest

There are no conflicts of interest.

References

1. World Health Organization. Coronavirus disease (COVID-19) Weekly Epidemiological Update and Weekly Operational Update. Available from: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports. [Last accessed on 2021 Mar].
2. World Health Organization. Coronavirus (COVID-19) Dashboard. Available from: https://covid19.who.int/. [Last accessed on 2021 Aug].
3. Government of Manipur. Directorate of Health Services. COVID-19 Update. Available from: https://nrhmmanipur.org/?p=6751. [Last accessed on 2021 Aug].
4. Chen N, Zhou M, Dong X. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: A descriptive study. Lancet 2020;395:50-13.
5. Huang C, Wang Y, Li X. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet 2020;395:497-506.
6. Wang K, Zuo P, Liu Y, Zhang M, Zhao X, Xie S, *et al.* Clinical and laboratory predictors of In-hospital mortality in patients with coronavirus disease-2019: A Cohort study in Wuhan, China. Clin Infect Dis 2020;71:2079-88.
7. Asghar MS, Haider Kazmi SJ, Ahmed Khan N, Akram M, Ahmed Khan S, Rasheed U, *et al.* Clinical profiles, characteristics, and outcomes of the first 100 admitted COVID-19 patients in Pakistan: A single-center retrospective study in a tertiary care hospital of Karachi. Cureus 2020;12:8712. doi: 10.7759/cureus. 8712.
8. Cao J, Tu WJ, Cheng W, Yu L, Liu YK, Hu X, *et al.* Clinical features and short-term outcomes of 102 patients with corona virus disease 2019 in Wuhan, China. Clin Infect Dis 2020;71:748-55.
9. Aloisio E, Chibireva M, Serafini L, Pasqualetti S, Falvella FS, Dolci A, *et al.* A comprehensive appraisal of laboratory biochemistry tests as major predictors of COVID-19 severity. Arch Pathol Lab Med 2020;144:1457-64.
10. Gavin W, Campbell E, Zaidi A, Gavin N, Dbeibo L, Beeler C, *et al.* Clinical characteristics, outcomes and prognosticators

in adult patients hospitalized with COVID-19. Am J Infect Control 2020 2021;49:158-65.

11. JNIMS COVID-19 Weekly updates. Porompat, Imphal, Manipur. JNIMS. Report number:20,2021.
12. Rosenthal L, Cao Z, Gundrum J, Siane J, Safo S. Risk factors associated with In-hospital mortality in a US National Sample of patients with COVID-19. JAMA Open Access 2020;3:e2029058. doi: 10.1001/jamanetworkopen. 2020.29058.
13. Docherty AB, Harrison EM, Green CA, Hardwick HE, Pius R, Norman L, *et al*. Features of 20,133 UK patients in hospitals with COVID-19 using ISARIC WHO clinical characterization protocol: Prospective observation cohort study. BMJ 2020;369:m1985. doi: 10.1136/bmj.m1985.
14. Gayam V, Chobulo MP, Merghani MA, Lamichhane S, Garlapati PS, Adler MK. Clinical characteristics and predictors of mortality in African-Americans with COVID-19 from an inner city community teaching hospital in New York. J Med Virol 2020;93:812-19.
15. Chilimuri S, Sun H, Aleman A, Mantri N, Shehi E, Tejada J, *et al*. Predictors of mortality in adults admitted with COVID-19: Retrospective cohort study from New York city. West J Emerg Med 2020;21:779-84.
16. Khamis F, Memiz Z, Baharani MA, Dowaiki SA, Pandak N, Bolushi ZA, *et al*. Prevalence and predictors of in-hospital mortality of patients hospitalized with COVID-19 infection. J Inf Pub Health 2021;14:759-65.
17. Malhotra V, Basu S, Sharma N, Kumar S, Garg S, Dushyant K, *et al*. Outcomes among 10,314 hospitalized COVID-19 patients at a teriary government hospital in Delhi, India. J Med Virol 2021;93:4553-58.
18. Olivas-Martinez A, Cardenas-Fragoso JL, Jimenez JV, Lozano-Cruz OA, Ortiz-Brizuela E, Tovar-Méndez VH, *et al*. In-house mortality froms severe COVID-19 in a tertiary care center in Mexoico city; causesof death, risk factors and the impact of hospital saturation. PLoS One 2021;16:e0245772.
19. Osbogun A, Balogun M, Abayoni A, Idris J, Kuyinu Y, Odukoya O, *et al*. Outcomes of COVID-19 patients with comorbidities in Southwest Nigeria. PloS One. 2021;16(3):e248261.
20. Mohan A, Tiwari P, Bhatnagar S, Patel A, Maura A, dar L, *et al*. Clinico-demographic profile and hospital outcomes of COVID-19 patients admitted at a teriary care center in north India. Indian J Med Res 2020;152:61-9.
21. Ministry of Health & Family Welfare, Govt. of India. National Family Health Survey Report. Mumbai. International Institute of Population Sciences. Report number:5,2021.
22. Andrade JA, Muzykovsky K, Truong J. Risk factors for mortality in COVID-19 patients in a community teaching hospital. J Med Virol 2021;93:3184-93.
23. Zhou S, Mi S, Luo S, Wang Y, Ren B, Cai L, *et al*. Risk factors of mortality in 220 patients with COVID-19 in Wuhan, China: A single-center retrospective study. Ear Nose Throat J 2021;100 (2 suppl):140S-47S.
24. Albitar O, Ballouze R, Ooi JP, Seikh Ghadazi SM. Risk factors for mortality among COVID-19 patients. Diabetes Res Clin Pract 2020;166:108293.
25. Suleyman G, Fadel RA, Malette KM, Hammod C, Abdulla H, Entz A, *et al*. Clinical characyeristics and morbidity associated with coronavirus disease 2019 in a series of patients in Metropolitan Detroit. JAMA Netw Open 2020;3:e2012270.
26. Grattagliano I, Rossi A, Cricelli I, Cricelli C. The changing face of family medicine in the COVID and post-COVID era. Eur J Clin Invest 2020;50:e13303.