International Journal of Community Medicine and Public Health
Tomar K et al. Int J Community Med Public Health. 2026 Jul;13(7):3689-3695
https://www.ijcmph.com
pISSN 2394-6032 | eISSN 2394-6040

DOI: https://dx.doi.org/10.18203/2394-6040.ijcmph20262270

Original Research Article

Study of the association between co-morbidities with COVID-19 and resulting morbidity and mortality: a hospital-based study in Uttar Pradesh, India

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Received: 15 April 2026
Accepted: 16 June 2026

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ABSTRACT

Background: The pandemicity caused by SARS-CoV-2 virus led to increased number of morbidity and mortality worldwide. The clinical conditions, and the population infected were varied. For a new disease like this, it is very important to collectively measure all the co-morbidities being faced by the patients so that clinical case in future can be improved. The objective of this present study was to conduct a retrospective analysis of the patients infected with COVID-19 and study their clinical conditions and consequences.
Methods: The retrospective analysis of clinical conditions, comorbidities, complications etc. of COVID-19 infected patients (survived and not survived) was studied for the period 2020-2021.
Results: Varied type of infections were observed, such as anaemia, systemic sepsis, lower respiratory tract infections (LRTI), hypertension (HTN), type 2 diabetes mellitus (T2DM), and type 1 respiratory failure (T1RF). Some of these comorbidities were interconnected and can be considered to be the cause of poor prognostic results and fast clinical deterioration. Cardiopulmonary arrest, cardiorespiratory failure, acute respiratory distress syndrome (ARDS), pneumonia and complications due to COVID-19 were the main reasons of death found in the cohort studied.
Conclusions: The results highlight the significance of proactive management techniques for early identification of high-risk individuals, and integrated, multidisciplinary care approaches for patients with multiple morbidities.

Keywords: COVID-19, Co-morbidities, Mortality, Recovery

INTRODUCTION

COVID-19 caused by SARS-CoV-2 (Severe Acute Respiratory Syndrome-Coronavirus-2) emerged as one of the alarming public health as well as a clinical challenge, that the world has ever faced. As of June 12, 2025, the World Health Organization reported approximately 777 million confirmed COVID-19 cases and over 7 million deaths worldwide.[1] In India, there have been around 45 million confirmed cases and 533,600 deaths till date.[2] Currently the disease is in circulation at a very low rate. During the time of high pandemicity i.e. between 2020-2022, there were many co-morbidities observed, some were being associated with short term morbidity, some with severity and others with mortality.[3,4] The SARS-CoV-2 enters human cells by using the angiotensin converting enzyme2 (ACE2) receptor present in the intranasal and oral pathways. It is also known to affect the olfactory sensory neurons present in that particular area. In the due course of time, it infects the central nervous

system, causing loss of all sensory functions like smell, taste and others.[5-7] The evidence of this could be seen in some studies, where they have reported the long-term impact of COVID-19 and people who were infected are still facing some or other clinical issues.[8,9] The virus infects people of all ages and genders; but majority of research shows that individuals with comorbidities are more susceptible and even the male patients who are older in age age with or without comorbidities shows a substantial risk of death.[10-12] Based on clinical findings of COVID-19, comorbidities like cardiovascular disease (CVD) including hypertension and diabetes have been the most prevalent.[13,14] The presence of comorbidities can worsen the situation by weakening the immune system and reducing the virus clearance from the system. This will lead to inflammation such that there was an overall impact on other organs as well viz heart, kidneys etc. The effects like cardiomyopathy and myocarditis were quite obvious.[15] Few researchers have also provided hypothesis on the severity of the disease while some researchers have seen complications similar to that, that occurred during MERS.[16,17] Overviewing the possible role of health research in facing current challenge of COVID-19, the transmission chain of disease and to support severe clinical cases to reduce resultant mortalities, the present study was conducted.

The aim of this study was to observe the retrospective data for analysis of COVID-19 patients having various comorbidities and infected with SARS-CoV-2. The hospital collected data of COVID-19 morbidity and mortality were observed and tabulated. We also studied their clinical conditions and consequences in terms of clinical outcomes of various parameters.

METHODS

Study design

The retrospective data of the patients infected with COVID-19 and who were diagnosed in Sharda Hospital, India during the year 2020-2021 were selected for the present study.

Inclusion criteria

The patients who were tested positive for qRT-PCR assay were only considered for this study.

The data was segregated into two categories; recovered (Morbidity cases) and non-recovered (Mortality cases). The gender, age wise data, associated comorbidities during the infection, cause of death, vitals measured etc were recorded.

Statistical analysis

The statistical analysis for the recovered and non-survived patients and graphical representation was done using IBM SPSS version 23 and MS office 2016 software. The study has been approved by the Institutional Ethical Committee, Sharda University, India.

RESULTS

A total of 936 cases were found positive during the year 2020. The cases wherein appropriate data was not available, were excluded from the study. Of these, a total of 880 cases were those that were infected and then recovered (94%) while the rest 56 were infected but did not survive (6%).

The gender ratio found was 531 males (60.3%) and 349 females (39.7%) under recovered category. Most of the cases were from U.P. i.e. 821 (93.3%), few cases were also from Delhi, 23 (2.6%), Haryana 12, Maharashtra 5, Madhya Pradesh 4, Jharkhand 3, Uttarakhand 3 and Bihar 2 cases. Amongst those who did not survive, 39 were males (69.6%) and 17 females (30.35%).

The age wise split suggested that highest infectivity and recovery was seen was in those among the 31-40 age group, followed by 21-30 age group in both male and female category (Figure 1, 2).

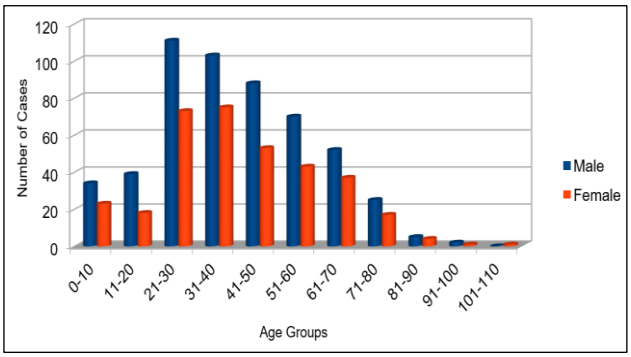

Figure 1: Graphical representation of the number of cases (male and female) infected with SARS-CoV-2 and later got recovered (year 2020).

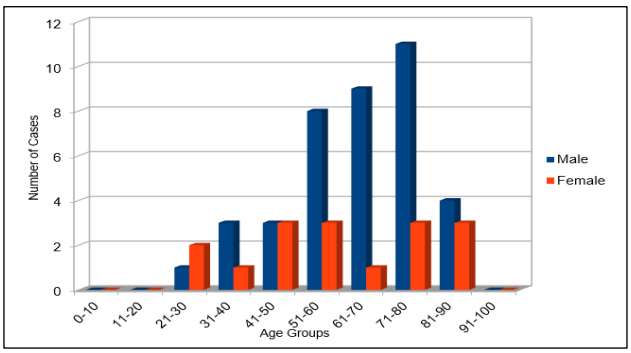

Figure 2: Graphical representation of the number of cases (male and female) infected with SARS-CoV-2 and did not survive (year 2020).

When the patients who did not survive were observed for the duration and time of infection, it was observed that

maximum cases of death occurred in the month of November 17 (30.3%) followed by June 9 (16.1%), September 8 (14.3%) and so on. The time duration of mortality from the day of admission was found to be minimum of two days 9 cases (16.1%) to a maximum of 17th day 1 (1.8%). Of the 56 reported cases, it was seen that 22 (66.1%) had cardiopulmonary arrest, followed by type 1 respiratory failure 11 (33%), acute respiratory distress syndrome (ARDS), Lower Respiratory Tract Illness (LRTI), Acute Kidney Injury (AKI) 1 (0.9%). In some patients, multiple co-morbidities existed while in some, single comorbidity existed. It was observed that patients who did not survive within day 1-2 were mostly having T1RF followed by Cardiopulmonary arrest, LRTI and viral pneumonia.

The details of the pre-existing comorbidities were also recorded. It was observed that hypertension 23 (47.9%), LRTI 19 (39.5%), T2DM 17 (35.4%), hypothyroidism 4 (8.3%), CKD 4 (8.3%), COPD 2 (4.2%) were recorded. Few patients reported for some complaints e.g. shortness of breath, fever, and cough.

The details of the comorbidities in patients who were hospitalized and recovered were also seen. It was observed that T2DM 45 (17.3%), LRTI 35 (13.5%), URTI 25 (9.6%), hypertension 24 (9.2%), CAD 20 (7.7%), hypothyroidism 12 (4.6%), CKD 12 (4.6%), COPD 9 (3.5%), pneumonia 5 (2%), asthma 1, HIV 1 and HCV 1 comorbidities were reported. The data of only 260 patients were available in the records. Few patients reported for some complaints e.g. shortness of breath, fever, and cough. The record showed that most of the cases were recorded in the month of August 387 (44%) followed by September 266 (30.2%), and July 95 (10.8%). The time of hospitalization from the day of admission was found to be minimum of 1 day, five cases (1.2%) to approximately 28 days (one case).

The overall hospitalization time was compared in both the recovered and not-recovered/not-surviving cases (Table 1).

It was observed that maximum patients recovered within 10 days of hospitalization and were discharged. Whereas a hospitalization of 6 days and less were recorded for patients who could not survive/recover amidst the treatment provided (Figure 3).

During the year 2021, a total of 697 cases were obtained from the Hospital database. The cases with incomplete parameters and incomplete observations were excluded from the study. Of these, a total of 446 cases were those who were infected and then recovered (63.98%) while 251 were those who were SARS-CoV-2 infected but could not survive (36.01%).

In the recovered category, a total of 256 were male (36.72%) and 190 were females (27.25%). Most of the cases were from Uttar Pradesh. i.e., 368 (82.5%), 54 (12.1%) cases were from Delhi, 12 (2.69%) from Haryana, 3 (0.67%) from Bihar, 2 (0.44%) from Jharkhand, 2 (0.44%) from Madhya Pradesh, 2 (0.44%) from Uttarakhand, 1 (0.22%) from Karnataka, 1 (0.22%) from Maharashtra and 1 (0.22%) from Rajasthan.

In the not-recovered category, a total of 182 were males (72.5%) and 69 were females (27.49%). Most of the cases were from Uttar Pradesh. i.e., 182 (72.5%), a few cases were also from Delhi, 58 (23.1%), Haryana, 6 (2.39%), Rajasthan, 2 (0.79%) Jharkhand, 2 (0.79%), Nagaland, 1 (0.39%) and Punjab, 1 (0.39%).

Table 1: Statistical analysis of hospitalization days of individuals infected with COVID-19 during the year 2020.

	Number of patients recovered	Number of patients who did not survive
Total patients	429	54
Percentage (%)	88.81	11.18
≤5 days hospital stay (χ^2 contribution)	5.62	44.61
6-10 days hospital stay (χ^2 contribution)	0.69	5.53
11-15 days hospital stay (χ^2 Contribution)	0.18	1.42
>15 days hospital stay (χ^2 contribution)	0.11	0.87
Mean hospital stay (days)	9.53	6.02
Median hospital stay (days)	10	5
Recovery:Death Ratio	7.94:1	NA
Test	**Value**	
Chi-square (χ^2)	59.03	
Degrees of freedom	3	
P value	<0.0001	
Significance	Highly significant	

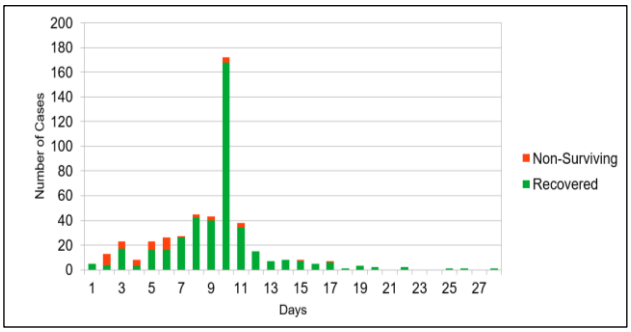

Figure 3: Graphical representation of hospitalization days of individuals infected with COVID-19 in the year 2020 (comparative viz survived and not survived).

The age wise data indicated that highest infectivity and recovery was seen in the 30-40 group in case of males

and in the 20-30 years group in case of female, followed by 40-50 group in male and 30-40 and 60-70 group in female category (Figure 4).

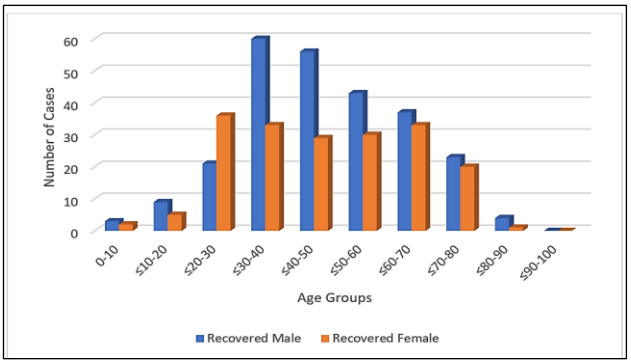

Figure 4: Graphical representation of number of cases (male and female) infected with COVID-19 and later recovered (year 2021).

The age group range of highest infectivity and non-surviving was seen in the age group of 60-70 years in both male and female categories followed by 40-50 years in both male and female category (Figure 5).

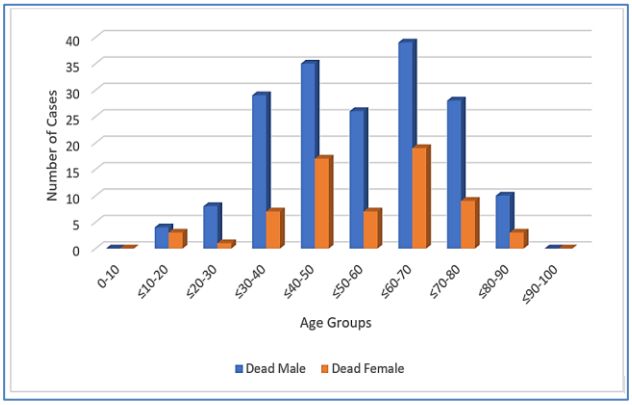

Figure 5: Graphical representation of number of cases (male and female) infected with COVID-19 and did not survive (year 2021).

The cases that did not survived were also looked into for their causation of death and the complaints indicated as well as any type of comorbidities existing.

It was observed that maximum cases of death were in the month of April 119 (47.4%) followed by May 118 (47%), June 8 (3.18%), August 4 (1.59%) and January 1 (0.39%). The time duration of mortality from the day of admission was found to be minimum of one day in 18 cases (7.1%) and maximum of twenty-nine days in one of the patient (0.39%) (Table 2). Of the 91 reported major causes of death, it was seen that Type 1 Respiratory Failure (T1RF) was there in 55 cases (60.4%) followed by 41 cases (45%) with Acute Respiratory Distress Syndrome (ARDS), 32 cases (35.16%) with lower respiratory tract infection and 9 cases (9.8%) with cardiopulmonary arrest.

In some patient's multiple comorbidities existed while in some, only single comorbidity existed. Out of 152 patients reported with comorbidities, the major observed comorbidities were hypertension in 38 cases (25%), T2DM in 31 cases (20.3%), CAD in 8 cases (5.26%), hypothyroidism in 6 cases (3.94%), CKD in 5 cases (3.28%) and HCV in 1 case (0.6%). Almost all the patients had the complaint of shortness of breath, fever and cough at the time of admission.

Table 2: Statistical analysis of hospitalization days of individuals infected with COVID-19 during the year 2021.

	Number of patients recovered	Number of patients who did not survive
Total patients	239	263
Percentage (%)	47.61	52.39
≤5 days hospital stay (χ^2 contribution)	2.31	2.10
6-10 days hospital stay (χ^2 contribution)	0.001	0.001
11-15 days hospital stay (χ^2 contribution)	0.07	0.06
>15 days hospital stay (χ^2 contribution)	9.72	8.84
Mean hospital stay (days)	6.08	8.21
Median hospital stay (days)	5	6
Test	**Value**	
Chi-square (χ^2)	23.10	
Degrees of freedom	3	
P value	<0.001	
Significance	Significant	

The maximum cases of recovered patients were in the month of April 252 (56.5%) followed by May 168 (37.6%), July 11 (2.46%), June 5 (1.12%) and September 1 (0.02%). The time duration of hospitalization from the day of admission was found to be minimum of one day in 2% of the cases (9 in no.) and maximum of twenty-four days in one patient (0.2%) (Table 2). The details of the comorbidities in the patients who were hospitalized and recovered were also recorded. It was observed that out of the 111 reported cases, 54 cases (48.6%) had type 2 Diabetes mellitus (T2DM) followed by hypertension in 44 cases (39.6%), lower respiratory tract infection in 21 cases (18.9%), hypothyroidism in 13 cases (11.7%), asthma in 5 cases (4.5%), CAD in 2 cases (1.8%), CKD in 1 case (0.9%), COPD in 1 case (0.9%) and urinary tract infection in 1 case (0.9%). In some patient's multiple comorbidities existed while in some only single comorbidity existed. Most of the patients had the complaint of shortness of breath, fever and cough at the time of admission.

It was seen that maximum patients recovered within 3 days of hospitalization and were discharged. Whereas in case of non-surviving patients, a hospitalization of 5 days was recorded after the treatment provided (Figure 6).

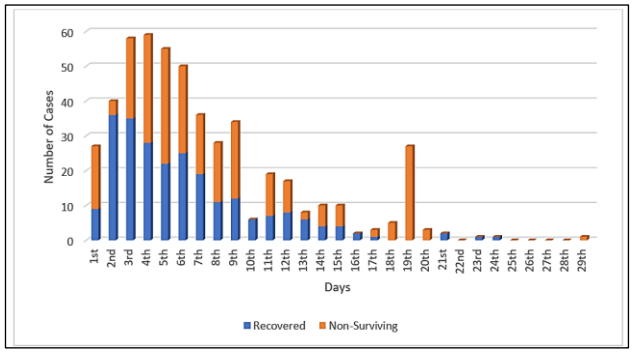

Figure 6: Graphical representation of hospitalization of patients infected with COVID-19 during the Year 2021.

The comorbidities which were present in patients who could not survive was also seen. It was estimated that most patients had dual infection and some had triple infection prior to getting infected by COVID-19. Individual co-morbidity was observed in 49 male and 26 female patients. Of these, 29 males and 11 female patients were hypertensive cases, 23 males and 18 females were T2D cases, 6 males were hypothyroidism case, 3 males and 3 females of anemia case, 2 males with asthma, 2 males with hepatic encephalopathy, 1 male with HCV and HBV each and 1 female of tuberculosis (past) and 1 female of hernia case.

Dual co-morbidities counted in males was observed in 14. Out of these 9 suffered from HTN and T2DM while others had different comorbidity condition (two with T2DM and hypothyroidism, one with T2DM and Asthma, one with HTN and asthma and one with T2DM and HBV) while one patient (male of 66 years) was suffering from HTN, T2DM and hyperthyroidism prior COVID-19 infection. In case of females, there were 6 cases of dual infections, of which 5 suffered from HTN and T2DM and one from T2DM and hernia. One female patient, 18 years of age with triple coinfection HTN, T2DM and tuberculosis was also found.

Statistical analysis

The statistical analysis was done using IBM SPSS VERSION 23 and MS office. The descriptive analysis of patient's data (Table 1) reported in 2020 was done. A total of 429 patients (88.8%) were recovered while 54 (11.2%) did not survived. The hospital stay of recovered cases was of longer duration (Table 1) compared to patients who did not survive. The median stay was 10 days for recovered patients and 5 for deceased cases. The Chi-square test was done to analyse the association between hospital duration along with outcome and compared it with p-value to compare whether the association is statistically significant or not. We firstly grouped data in meaningful intervals from date available in Table 1, because many of hospital day categories contain very small frequencies to perform test (Table 1).

The Chi-square test was found to have high significant association between duration of hospitalization and clinical outcome ($\chi^2 \approx 59.03$, df ≈ 3, $p<0.0001$). Percentage -wise, it was observed that mortality rate varied substantially according to the duration of hospitalization. The highest mortality was observed among patients for ≤5 days (i.e. 37.5%). Whereas mortality declined markedly among patients with longer hospital stays reaching to 4.55% in those hospitalized for more than 15 days.

Similarly, the statistical analysis was done for the patients infected during the year 2021 (Table 2). 239 (47.61%) of the 502 hospitalised patients made a full recovery, whereas 263 (52.39%) did not. Patients who recovered spent an average of 6.08 days in the hospital, whereas those who did not survive spent an average of 8.21 days. Patients who did not survive typically had more prolonged hospital stays than those who recovered, as seen by the median hospital stays of 5 and 6 days, respectively.

A chi-square test of independence demonstrated a significant association between hospitalization duration and clinical outcome ($\chi^2=23.10$, df=3, $p<0.001$). Non-survivors exhibited disproportionately longer hospital stays, particularly beyond 15 days, whereas recovered patients were concentrated in the shorter hospitalization categories. Percentage-wise, it was seen that hospitalization duration showed a progressive increase in mortality with longer hospital stay. Patients hospitalized for ≤5 days exhibited a mortality rate of 45.61%, which increased to 52.60% among those hospitalized for 6-10 days and 54.69% among those hospitalized for 11-15 days. The highest mortality rate was observed among patients hospitalized for >15 days (84.44%), where only 7 of 45 patients survived. These findings indicate that prolonged hospitalization was strongly associated with adverse clinical outcomes and may reflect increased disease severity and complications during the course of illness.

DISCUSSION

This study is a hospital-based survey taken during the year 2020 and 2021 of patients who were either deceased or recovered after COVID-19 infection, with particular attention to comorbidities, age groups, causes of death, and causes of admission. Girardin and co-workers reported that pulmonary diseases and Diabetes mellitus were closely associated with the mortality in the United States of America.[3] However, they had not studied the parallel control population which showed that patients without these co-morbidities have recovered. Thakur and group have reported that in different ethnic groups of

America, cardiovascular, cerebrovascular and chronic kidney diseases were associated with the mortality.[4] Cho and colleagues have reported that in Korea co-morbidities such as hypertension, diabetes mellitus, congestive heart failure, dementia, chronic pulmonary diseases, renal diseases and cancer etc. were associated with mortality due to COVID-19.[5] Richardson and group in 2021 have reported Diabetes mellitus, hypertension and obesity associated with mortality among patients of New York city, USA.[13] Kabarriti and group have compared the mortality between non-Hispanic black and non-Hispanic white of USA, and have reported that non-Hispanic black showed more mortality than white population.[14] In another study, cardiovascular and cancer associated with mortality.[18] A study from China reported that patients with any co-morbidity showed poor clinical outcome.[19]

In India, number of studies have been made on above correlation. One study have reported that Diabetes mellitus as the major co-morbidity associated with mortality of COVID-19 patients.[20] Joshi et al reported that in Maharashtra, India, age of patients above 55 years, hypertension, diabetes, chronic heart diseases, lung diseases and renal diseases were associated with the mortality.[21] Laxminarayan and coworkers have reported that in Madurai, South India, cancer, diabetes, endocrine disorders, hypertension and kidney diseases were associated with mortality.[22] While another study mentioned prediction of mortality by age.[23]

The present study highlights how COVID-19 infection, when combined with multiple comorbidities, significantly impacted patient outcomes, often resulting into severe complications or mortality due to multiple organ failure. The major co-morbidities identified were type 2 diabetes mellitus, lower respiratory tract infections, acute respiratory distress syndrome, hypertension, pneumonia, anaemia, and type 1 respiratory failure, all of which were associated with increased severity and poor outcomes. Our analysis revealed that in 2020, a higher proportion of female patients did not recover compared to males. Among these female patients, comorbidities such as T2DM, ARDS, T1RF, anaemia, LRTI were more relevant. Conversely, male patients exhibited higher incidences of HTN, T2DM, pneumonia and bilateral pneumonia. These findings align with the existing literature indicating gender-based differences in COVID-19 outcomes and comorbidity profiles. Given these findings, it is essential for healthcare systems to develop and implement targeted management programmes focused on controlling and mitigating the impact of such comorbid conditions in COVID-19 patients. Proactive monitoring and management of comorbidities and vital parameters during treatment can significantly improve recovery rates and reduce mortality.

A limitation of this study is that it was conducted in a hospital-based setting in Uttar Pradesh, India. To better understand the etiology of a pandemic disease such as COVID-19, it is necessary to collect large-scale data and develop a comprehensive database using AI-based tools.

CONCLUSION

To summarize, the study highlights the need of regulating the homeostatic parameters during the high-risk respiratory illness i.e. COVID-19. This study demonstrates how important co-morbidities were in influencing COVID-19 outcomes. Future pandemics can be lessened with targeted programs to manage co-morbid illnesses and give priority to at-risk populations for preventive actions.

Funding: The study has been funded by Indian Council of Medical Research (Grant Number 2021-6369)
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee, Sharda University, India (SU/SMS&R/76-A/2021/112)

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Cite this article as: Tomar K, Angel A, Joshi V, Angel B, Chitransh A, Jethani J, et al. Study of the association between co-morbidities with COVID-19 and resulting morbidity and mortality: a hospital-based study in Uttar Pradesh, India. Int J Community Med Public Health 2026;13:3689-95.