



## Cardiovascular Comorbidity and its Impact on Patients with COVID-19 in a Tertiary Care Hospital, Bangladesh

Mohammad Shakhawat Hossain<sup>1\*</sup>, Muhammad Abdus Salam<sup>2</sup>

<sup>1</sup>Assistant Professor, Department of Cardiology, BIHS General Hospital, Dhaka, Bangladesh.

Email: drshbb810@gmail.com

Orcid ID: 0000-0003-4532-0692,

<sup>2</sup>Professor, Department of Cardiology, BIHS General Hospital, Dhaka, Bangladesh.

Email: masalamcard@gmail.com

Orcid ID: 0000-0002-4404-5126,

\*Corresponding author

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### Abstract

**Background:** People with cardiovascular issues have been shown to be at an elevated risk of acquiring the 2019 new corona virus infection, according to studies (COVID-19). This study's objective was to determine if cardiovascular disease has any effect on the severity of COVID-19. **Material & Methods:** Between January 2020 and December 2020, 210 comorbid patients aged over 40 years old diagnosed with COVID-19 admitted in BIRDEM hospital in Bangladesh were recruited purposively for a cross sectional study as per inclusion criteria. A baseline study was created for each patient based on their medical history, physical examination, biochemical tests, and the amount of care they needed (intensive care vs. ward-based care). SPSS 26 was used to analyze the data. **Results:** Among the 210 comorbid individuals, 74 had cardiovascular comorbidities and the remaining 136 had other comorbidities. Among the respondents, 48% were serious cases and required ICU support within 30 days. Cases with up to 2 comorbidities did not require ICU support. The severity of COVID-19 was predicted by factors such as age above 80 years (OR 35.5, 95 percent CIs 18.7,98.5), male gender (OR 3.14, CI 1.16, 3.50), and a high troponin level in the patient's blood (OR 1.34, CI 0.84,3.54). It was shown that cardiovascular comorbidities (CI=1.8,3.0) were 2.9 times more likely to be linked to severity. The risk factors also included a history of diabetes, hypertension, and chronic obstructive pulmonary disease. **Conclusions:** Cardiovascular patients, who were previously grouped together as high risk due to the nature of their ailment, need more tailored counseling and treatment from public health authorities and clinicians.

**Keywords:-** Cardiovascular patients, who were previously grouped together as high risk due to the nature of their ailment, need more tailored counseling and treatment from public health authorities and clinicians.

### INTRODUCTION

Coronavirus disease (also known as COVID-19) is a newly identified viral disease that is brought on by severe acute respiratory syndrome brought on by SARS-CoV-2, which was only discovered very recently.<sup>[1,2]</sup> Recent studies have shown that those over the age of 65 and those with chronic health disorders

such as heart disease (CVD) are now at a greater risk than the general population for illness and death due to COVID-19.<sup>[2]</sup> This is because COVID-19 tends to affect people who already have compromised immune systems. Even in those who do not have any prior heart issues, the results of a recently conducted study suggest that COVID-19 may cause harm



to the heart even in healthy persons.<sup>[2]</sup> However, despite the fact that respiratory symptoms overwhelmingly dominant among the clinical symptoms of COVID-19, cardiovascular involvement may take place as a result of a number of distinct mechanisms.<sup>[3]</sup> This is despite the fact that respiratory symptoms account for the majority of COVID-19's clinical manifestations. The cardiovascular aberration that has been recorded the most often in COVID-19 is known as acute cardiac injury, and it has been seen in anywhere from 8 percent to 12 percent of all cases.<sup>[4]</sup> A study that was somewhat similar to this one and analyzed the characteristics of 187 COVID-19 participants identified the factors that were found to be connected with the outcomes of the study. They observed that 35% of the patients had an underlying cardiovascular ailment such as coronary heart disease, hypertension or cardiomyopathy, and that 28% of the patients exhibited symptoms of acute myocardial injury. These findings were based on the fact that the patients were examined (defined as high troponin T). In addition, the death rate was much greater among people who had elevated troponin T levels compared to those whose level of troponin T were normal. This was a significant difference between the two groups. This was the case notwithstanding the existence of other considerations. Patients who were aged and had comorbidities, such as hypertension, coronary heart disease, cardiomyopathy, and chronic renal disease were shown to have elevated levels of troponin T. Injury to the heart muscle has been linked to the enzymes creatine kinase (CK) and lactate dehydrogenase (LDH), as well as their respective isoenzymes, as well as the protein

troponin I (TnI), which exhibited higher cardiac selectivity than the other two enzymes. According to the data that Chen et al. came up with, out of the 99 confirmed instances of COVID-19, 13 of the patients had an increased level of CK, and 75 of the patients had an increased level of LDH.<sup>[5]</sup> COVID-19 is primarily an illness that affects the respiratory system; however, a sizeable percentage of people who have COVID-19 either already have an underlying cardiovascular disease (CVD) or develop new-onset heart malfunction as the disease progresses. This is because COVID-19 can cause inflammation of the heart muscle.<sup>[6]</sup> The coronavirus has been shown to cause epidemics in the past, such as the severe acute respiratory syndrome (SARS-CoV) and the Middle East respiratory syndrome (MERS-CoV). It is important to highlight that COVID-19 has a reduced death rate compared to the last epidemic of SARS. On the other hand, it has a more amazing potential to spread swiftly, which makes it an effective virus resulting in a pandemic.<sup>[7]</sup> In light of this, several health experts have advocated for greater social distance and/or isolation for cardiovascular disease patients in comparison to the population that served as the baseline. Although taking these precautions might lower the likelihood of contracting COVID-19, there is a good chance that they have unintended negative effects. For instance, they might make it more difficult to maintain good mental and physical health during isolation,<sup>[8]</sup> and/or they might make it less likely that patients will seek treatment for conditions unrelated to COVID-19.<sup>[9,10]</sup> However, it is yet unknown how the COVID-19 prognosis varies amongst the various kinds of cardiovascular diseases. One research using a New York cohort

demonstrates that heart failure, but not coronary artery disease, is related with greater risk.<sup>[11]</sup> On the other hand, a study with a Chinese cohort shows that people with CHD were less likely to get better from their condition.<sup>[12]</sup> In addition, the results of a more limited case-series study demonstrate that individuals with underlying cardiovascular disease who do not acquire myocardial damage during hospitalization do not have an elevated risk of mortality.<sup>[13]</sup> In addition, there is no evidence of an independent link between cardiovascular diseases and COVID 19 mortality in one cohort analysis.<sup>[14]</sup> It is essential for the healthcare system to determine which populations are most likely to suffer serious consequences as a result of COVID-19. This will enable the system to prioritize the provision of preventative and treatment resources to areas in which they are required the most.<sup>[15,16]</sup> In the past, it was discovered that the coronavirus was the root cause of epidemics such as the severe acute respiratory syndrome (SARS-CoV) and the Middle East respiratory syndrome (MERS) (MERS-CoV).<sup>[17]</sup> It is essential to bring attention to the fact that the fatality rate associated with COVID-19 is reduced compared to that of the most recent SARS pandemic.<sup>[18]</sup> On the other side, it has a more remarkable capacity to spread quickly, which makes it a great virus to result in a pandemic. This makes it an outstanding candidate for causing a pandemic.<sup>[19,20]</sup> By attaching to ACE2 with its spike glycoprotein, SARS-CoV-2 is able to obtain entry into the host cell, which subsequently allows it to potentially trigger ARDS and respiratory failure.<sup>[21]</sup> In addition, it was found that hypertension is a significant risk variable for mortality. It had a hazard ratio

(HR) of 3.05 for in-hospital mortality in 191 COVID-19 patients and a hazard ratio of 1.70–1.82 for death and acute respiratory distress syndrome (ARDS) in 201 COVID-19 patients.<sup>[22]</sup> These numbers indicate that hypertension is a significant risk factor for mortality. These numbers were derived from an investigation that was carried out in the United States. Having cardiovascular comorbidities has also been connected to a greater mortality rate,<sup>[23]</sup> which is comparable to what we just discussed. The COVID-19 infection first presents itself as a respiratory ailment in its early stages. On the other hand, there is an accumulation of data to suggest that COVID-19 is in fact a systemic illness that may result in the malfunctioning or failing of numerous organs. This lends credence to the notion that COVID-19 is connected to unfavorable outcomes.<sup>[24]</sup> Up to twenty percent of COVID-19 patients admitted to a hospital present with a severe condition and need treatment in an intensive care unit. The overall case-fatality rate in all patients ranges from one percent to four percent, and the rate fluctuates from one percent to four percent.<sup>[25]</sup> It is possible that the mortality rate of COVID-19 patients who are receiving treatment in the Intensive Care Unit might reach as high as fifty percent in this group of patients.<sup>[26]</sup> This high mortality rate is not simply attributable to the presence of pulmonary symptoms; rather, it may be the consequence of involvement in other organs, such as the kidneys and the heart.<sup>[27]</sup> It is noteworthy to note that early on in the evolution of the sickness, the levels of cardiac enzymes are within the normal range. On the other hand, readings of troponin and other myocardial damage markers could grow at later stages of the condition.<sup>[28,29]</sup>



## OBJECTIVES

### General objective

to investigate the impact of cardiovascular disease (CVD) comorbidities on disease prognosis among patients with COVID-19.

### Specific objectives

- To evaluate the impact of comorbidities on severity of COVID-19.
- To identify the association between risk factors and severity of COVID-19

## MATERIAL AND METHODS

This study was a cross-sectional, observational study contained both descriptive and analytical components. The study comprised 210 purposively selected comorbid patients over 40 years old diagnosed with COVID-19 between January 2020 to December 2020 in Bangladesh admitted in BIRDEM hospital, Dhaka. The inclusion criteria were both male and female patients aged over 40 years with a positive PCR test for Sars-CoV-2, and a period of 14 days between the onset of symptoms and hospital admission. Patients who were diagnosed with comorbidity after hospital admission, died or did not want to take part in the study were excluded. Using the patient's medical history, physical examination, biochemical testing, level of care required (intensive care vs ward based care) a baseline study was constructed for each patient. Patients were divided into two groups severe group which defined as diagnosis with severe acute respiratory syndrome, care in the ICU, use of respirator within 30 days of diagnosis and non severe group defined as people who had 30 days of follow-up with no requirement

of ICU support. After reviewing and rechecking the data, SPSS version 26 was used to do statistical analysis, including student's 't' test, chi-square test and logistic regression. The level for statistical significance was set at 0.05.

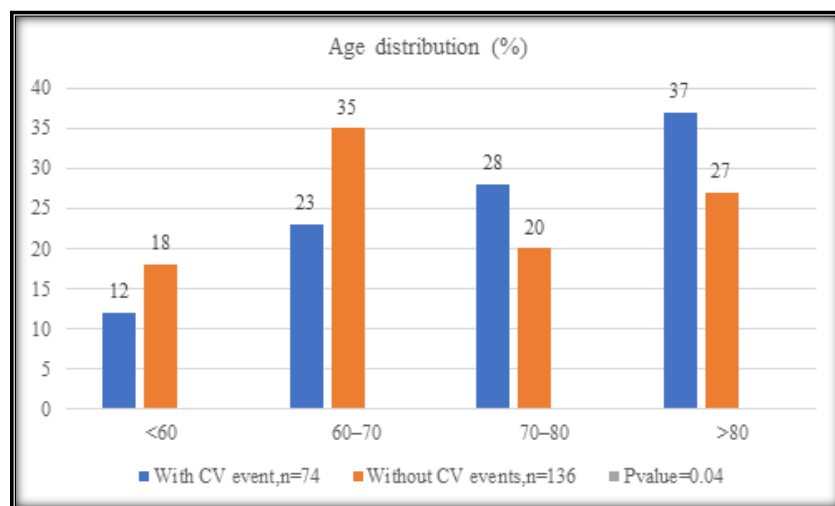
## RESULTS

About 210 adults who were eligible were asked to take part in the study. All of the people who took part were put into four age groups: <60, 60-70, 70-80, and >80. The average age of the respondents was 81.5±16.2 and 60.5±2.9 years respectively for the groups with and without cardiac events ( $p=0.04$ ) [Figure 1]. The results showed that in both groups, men were more affected than women (61.3 % vs. 38.7 %, and 66.5% vs 33.5% respectively) ( $p=0.008$ ) [Figure 2]. 52% cases belonged to non severe cases who did not need any ICU support and 48% cases were severe who needed ICU support and or mechanical ventilation [Figure 3]. Among the severe cases 28% had diabetes, 25% had HTN, 15% had IHD. Among the non severe cases 39% had HTN [Figure 4]. 27% and 25% cases had 1 and 2 comorbidities who did not need any ICU support where as 48% cases belonged to 3-7 comorbidities. The more comorbidities a patient had, the more severe their illness was. Those who had five or more comorbid conditions required the most intensive care unit (ICU) assistance (65.4%, 80%, and 72.7%, respectively) ( $p= 0.001$ ) as well as intubation or mechanical ventilation (61.6%, 63.5%, and 80.1%) ( $P = 0.003$ ) [Table 1]. Cases with CV events had higher level of creatinine and CRP than cases without CV events, mean±SD of creatinine 2.1±1.8 vs 1.2±2.1 ( $p=0.007$ ), CRP 50.98±70.05 vs 45.3±98.01 ( $p=0.021$ ) respectively [Table 2]. The logistic regression showed that people who were older (>80

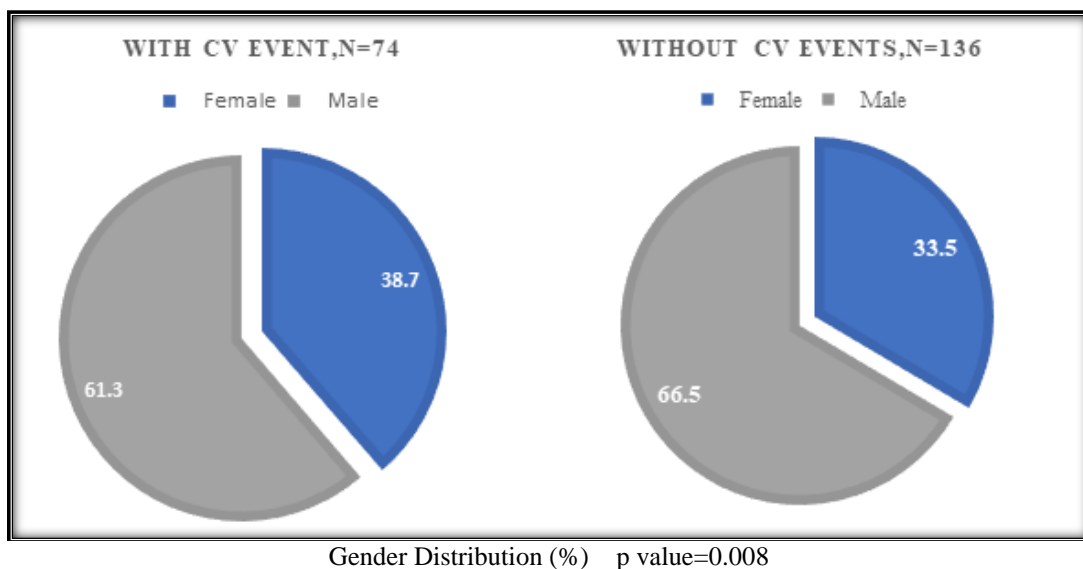
years) had more chances of severity (OR 35.5, 95 percent CIs 18.7,98.5). Male had 3.14 times more probability of severity with a CI of 1.16, 3.50,  $p=0.009$ . Cardiovascular comorbidities were 2.9 times associated with severity (CI=1.8,3.0). Presence of diabetes 1.5 (CI=0.8,2.9), HTN 1.5 (CI=0.8-1.3) and COPD 1.14 (CI=0.8-2.5) times

more chances of severity. Those who had elevated troponin level were 1.34 (CI=0.84-3.54) times more prone to severity [Table 3].

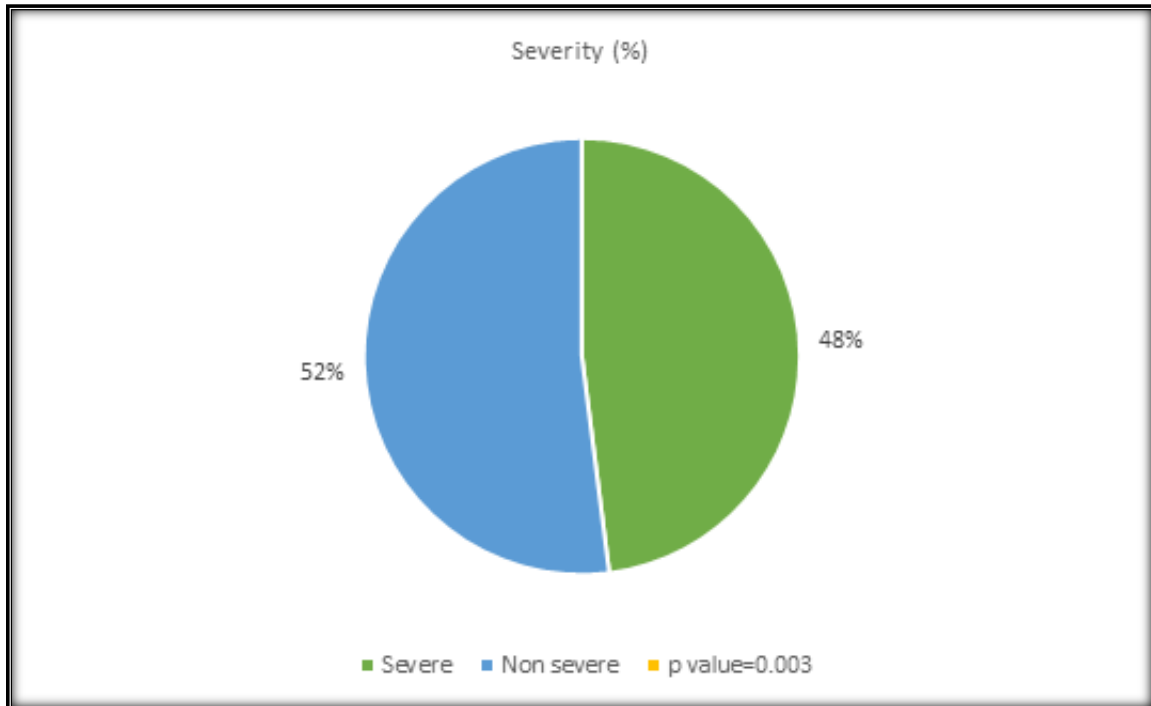
[Figure 1] shows the age distribution of the cases. The mean ages for with and without CV events cases were  $81.5 \pm 16.2$  and  $60.5 \pm 2.9$  years respectively.



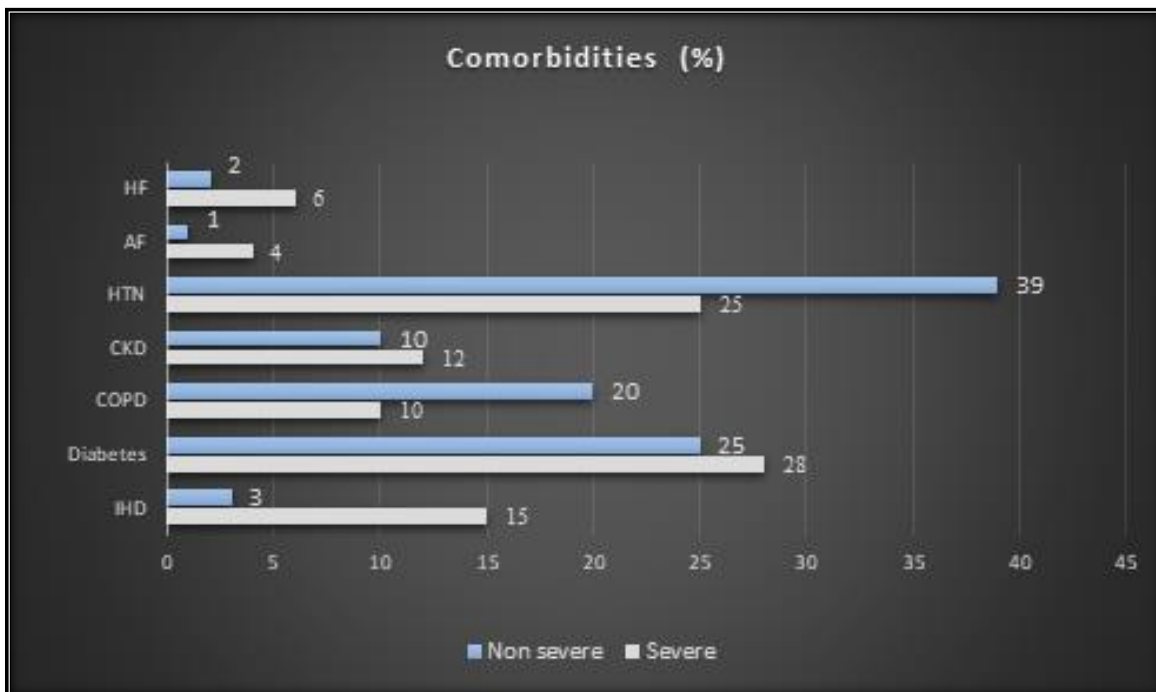
**Figure 1:** Age distribution between cases with CV events and without CV events (n=210)



**Figure 2:** Gender distribution between cases with and without CV events (n=210)



**Figure 3:** Case distribution according to severity (n=210)



**Figure 4:** Case distribution according to comorbidities (n=210)



**Table 1:** Clinical Outcomes of Patients with Predisposed Comorbidity and Severe COVID-19 Infection

Number of comorbidities	Patient (%)	Patients Received Support (%)	ICU	Patients Required Intubation on MV in ICU (%)
1	27			
2	25			
3	17	30.2		25.1
4	13	75.8		30.3
5	9	65.4		61.6
6	5.2	80		63.5
7	3.8	72.7		80.1
P value	0.0001	0.0035		0.0003

# Student's t-Test was employed to analyze the data and level of significance was 0.05.

**Table 2:** Laboratory findings of COVID-19 patients With and Without Cardiovascular Events (n=210)

Lab findings	Cases without CV events (Mean±SD)	Cases with CV events (Mean±SD)	P value
Creatinine mg/dL	1.2±2.1	2.1±1.8	0.007
CRP, mg/L	45.3±98.01	50.98±70.05	0.021
BNP, pg/mL	1123.6±8306.04	890.5±1173.37	0.698

**Table 3:** Univariable and multivariable logistic regression of severity of COVID-19 with comorbidities (n=210)

	Univariable analysis		Multivariable analysis	
	OR (95% CI)	P value	OR (95% CI)	P value
<b>Age</b>				
<60	Reference category			
60–70	3.7 (2.3, 10.6)	0.0236	3.2 (1.5,8.4)	0.0354
70–80	25.0 (10,60.2)	0.0012	23.2 (7.8,60.4)	0.0134
>80	45.5 (20,90.6)	0.0354	35.5 (18.7,98.5)	0.0274
<b>Gender</b>				
Female	Reference category			
Male	2.35 (1.55, 2.96)	0.036	3.14 (1.16, 3.50)	0.009
<b>Tobacco Use</b>				
Non smoker	Reference category			
Smoker	2.44 (2.01,2.98)	0.006	2.53 (1.95,2.79)	0.238
<b>Cardiovascular comorbidities</b>				
No	Reference category			
Yes	2.5 (1.5, 2.04)	0.025	2.9 (1.8, 3.0)	0.00978
<b>Diabetes</b>				
No	Reference category			



Yes	2.8 (1.3, 5.3)	0.00132	1.5 (0.8, 2.9)	0.00143
<b>Hypertension</b>				
No	Reference category			
Yes	2.5 (1.9, 3.5)	0.00012	1.5 (0.8, 1.3)	0.0004
<b>COPD</b>				
No	Reference category			
Yes	1.80 (1.35, 4.5)	0.042	1.14 (0.8, 2.5)	0.0016
<b>Chronic kidney disease</b>				
No	Reference category			
Yes	2.58 (2.01, 3.854)	0.009	1.29 (0.66, 2.01)	0.55
<b>CRP mg/L</b>				
+ 1 mg/dl	1.02 (1.01, 1.04)	0.00014	1.00 (0.57, 0.97)	0.00012
<b>Troponin ng/L</b>				
Elevated	3.92 (3.06, 4.98)	0.006	1.34 (0.84, 3.54)	0.076
<b>Creatinine mg/dL</b>				
+ 1 mg/dl	1.12 (1.05, 1.20)	0.00014	0.92 (0.63, 1.17)	0.00012

## DISCUSSION

Between January 2020 to December 2020 in Bangladesh, this cross-sectional study purposively included 210 patients who were COVID-19 positive and aged above 40 years. This study found that older age were more susceptible to severity. Patients with one or two comorbidities were more common than those with more than two comorbidities in this study (52% vs. 48%). Besides, there was a favorable correlation between the severity of COVID-19 and the number of previous comorbidities. Another research found that patients who had one or two comorbidities did not have any severe cases, but patients who had three or four comorbidities did have a greater incidence of severe symptoms (up to 30%).<sup>[30]</sup> In this study, the most frequent predisposing chronic illnesses in hospitalized patients with severe COVID-19 were diabetes (28 percent) and hypertension (25 percent), followed by coronary heart disease (IHD) (15 percent), and chronic kidney disease (CKD) (12

percent). First, Huang et al.<sup>[31]</sup> showed that 32 percent of patients had common comorbidities, such as high blood pressure, diabetes, heart illnesses, and chronic obstructive pulmonary disease (COPD). Previous research has shown that COVID-19 patients most often suffer from hypertension, coronary heart disease, and diabetes.<sup>[32,33,34]</sup> A study using a model of diabetes in mice demonstrated that the fundamental reasons for serious disease aggravation in MERS-CoV are excessive inflammation in the lungs, dysfunction of immune cells, and overexpression of the inflammatory mediators, all of which result in massive cytokine storm.<sup>[35]</sup> This study was conducted to determine the underlying cause of the problem. The severity of COVID-19 was shown to be progressively related with hypertension and diabetes, which are the two most frequent comorbidities in the hypertensive cohort, according to a recent research on the hypertensive cohort.<sup>[36]</sup> In this study, 30.2%, 75.8%, 65.4%, 80% and 72.7%





patients required ICU support with 3 to 7 comorbidities respectively and 25.1%, 30.3%, 61.6%, 80.1% and 63.5% required intubation or mechanical ventilation respectively. In a research, moderate-to-critical COVID-19 patients hospitalized with 4 to 7 underlying chronic illnesses had inferior clinical outcomes (i.e. greater need for ICU care) and mechanical ventilation support compared to patients with 3 comorbidities. HTN and DM are the two comorbidities that are most prevalent among Bangladeshi population.<sup>[37,38]</sup> Patients who had cardiovascular injuries had worse outcomes, including a higher incidence of ARDS, acute renal damage, anemia, and mortality. Mechanical ventilation was used more often in these patients.<sup>[39]</sup> One research on COVID-19 patients admitted to the ICU indicated that 49% patients had a cardiac injury at the beginning of their stay, and that 70% had cardiac damage during the first 14 days of their stay, with a median period of three days. An investigation on COVID-19-infected patients revealed this.<sup>[40]</sup> In this specific study, factors that predicted the severity of COVID-19 were advanced age (over 80 years), being male, having cardiovascular comorbidities, diabetes, hypertension, COPD, chronic renal disease, and elevated troponin level. Patients diagnosed with cardiac damage were shown to have a higher incidence of comorbidities such as hypertension, coronary disease, diabetes, heart failure, and cerebrovascular illness.<sup>[41]</sup> Using a multivariate logistic regression, the same authors indicated that older age, comorbidities (such as hypertension, coronary artery disease, CRF, and COPD), and elevated amounts of C-reactive protein were indicators of myocardial damage.<sup>[42]</sup> Pre-existing hypertension and a higher consecutive organ

dysfunction assessment score were discovered as risk factors for COVID-19 in acquiring cardiac damage via the use of a logistic regression model in a research study that included 113 participants.<sup>[43]</sup> Salvatici et al. observed that higher troponin levels were associated with enhanced mortality in patients with COVID-19. Additionally, they discovered that it was a helpful biomarker of disease progression and a poorer prognosis in patients with COVID-19.<sup>[44]</sup> It was observed that the prevalence of cardiac damage was 19 percent in all COVID-19 patients, 36 percent in severe COVID-19 patients, and 48 percent in patients who did not survive. In addition to this, it was shown that cardiac damage was connected to a substantial rise in the likelihood of unfavorable outcomes, severe illness, admission to the intensive care unit, and death.<sup>[45]</sup> Recent clinical investigations have demonstrated that a pre-existing condition of cardiovascular disease is connected with worse outcomes and an increased risk of mortality in patients who have COVID 19.<sup>[46,47,48,49]</sup> According to Guo et al., 27.8 percent of the patients, or 52 out of 187, showed elevated levels of troponin T (TnT). Those with abnormally elevated TnT levels had an in-hospital death rate of 59.6 percent (31 of 52), while those with normal levels had an 8.9 percent mortality rate (12 of 135).<sup>[49]</sup> Patients who have coronary artery disease and cardiovascular risk factors are at a higher risk of cardiac occurrences during acute infections and inflammations. This is because of an increase in myocardial demand, which can cause myocardial injury. Patients without CAD and cardiovascular risk factors are not at increased risk of cardiac occurrences.<sup>[50,51]</sup>

## Limitations

The findings' generalizability is a limitation. Different countries adopted different management and control tactics. This may affect CVD comorbidity severity. During the peak of the pandemic, individuals with pre-existing comorbidities may have received inadequate care in certain areas due to demand on healthcare systems and/or ICU capacity. Independent of any conceivable causal relationship between CVD comorbidities and COVID-19, those patients groups may have had worse outcomes. Patients with stable cardiovascular disease (CVD) may have been a reasonably well-treated group in this study. Long-term observational studies are necessary further and to examine the effectiveness in treating such patients.

## CONCLUSIONS

SARS-CoV-2 has infected a huge number of people throughout the world with underlying health issues are particularly vulnerable. In those with hypertension, diabetes and heart disease, life-threatening conditions might arise. In contrast to individuals without comorbidities, careful treatment of COVID-19 patients with comorbidities is encouraged to minimize the risk of death. During the pandemic, affected persons must take precautionary precautions to ensure their own safety. A person with a preexisting medical condition is more vulnerable to SARS-CoV-2 infection, and proper medical treatment is essential to their survival.

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