

Original Article

Short-term Clinical Outcomes of COVID-19 Patients Hospitalized with Chronic Obstructive Pulmonary Disease and Asthma in Three Tertiary Level Hospitals in Bangladesh

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Abstract

Background: Several comorbidities including chronic obstructive pulmonary disease (COPD) or bronchial asthma have been found associated with COVID-19 cases. But it remains unclear which of the comorbidities are associated with worse outcomes of the patients. **Objectives:** This study was carried out to determine the clinical outcomes of hospitalized COVID-19 patients with COPD or asthma. **Methodology:** This prospective study was carried out at Respiratory Medicine unit of Monno Medical College and Hospital, Manikganj, from April 2020 to December 2022. Admitted COVID-19 patients, suffering from COPD or bronchial asthma, were enrolled purposively upon fulfilling the inclusion and exclusion criteria. The patients were divided into two groups with associated comorbidities: Group A suffering from COPD and Group B suffering from Asthma. Data were collected from the patients on variables of interest using a semi-structured questionnaire. **Results:** Among the 144 enrolled patients, 96(66.67%) in group A were suffering from COPD and the other 48 (33.33%) in group B had bronchial asthma. In this study, 41(42.7%) patients in Group A exhibited >25% lung field involvement in the high-resolution computed tomography (CT) chest imaging, compared to only 10(20.8%) in COVID-19 patients in Group B, and this difference in distribution was statistically significant (p=0.026). The COVID-19 patients in Group A were more severe to critically ill (45, 46.9%), compared to patients in Group B (12, 25.0%) with a p value of 0.011. Group A study subjects required intensive care unit (ICU) admission (49, 51.0%) more than the group B participants (16, 33.3%), which was also found statistically significant (p<0.05). Nearly one-fifth (17, 17.7%) of the patients died among the Group A, compared to only 2(4.2%) mortality observed in Group B (p=0.024). The COVID-19 patients with COPD were found significantly associated with the risk of >25% lung field involvement, severe to critical illness, ICU admission, invasive mechanical ventilation, and death (all p values <0.05). **Conclusion:** The comorbidity of COPD was found to increase the risk of disease severity and adverse outcomes in COVID-19 patients significantly. It also heightened the risk of lung field involvement, exceeding 25% more severe disease and increased mortality rates compared to individuals with bronchial asthma.

Key Words: Intensive Care Unit, Chronic Obstructive Pulmonary Disease, COVID-19

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Introduction:

The corona virus disease 2019 (COVID-19) is a viral illness caused by the (Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) virus. It has been observed that the clinical outcomes of COVID-19 can vary widely depending on several factors, including age, underlying health conditions, and the severity of the infection. However, it is important to note that information and understanding of COVID-19 are continually evolving, and new research may provide updated insights into short-term clinical outcomes. The World Health Organization (WHO) refers to the SARS CoV-2 illness as COVID-19, or Coronavirus Disease. As of 18 December, 2022, over 649 million confirmed cases and over 6.6 million deaths have been reported globally.¹ Bangladesh reported 49,534 confirmed cases, of which 10,597 had recovered and 672 had passed away as on 23 November, 2020.²

Host demographic factors and preexisting health conditions are involved in determining the outcome of COVID-19.³ Changes in lung structure and muscle atrophy found in the elderly may contribute to physiological modifications such as reduced lung reserve, reduced airway clearance, and a weakened protective barrier.⁴ The sex is another risk factor as a higher prevalence has been seen in men than women.⁵ Clinical outcomes in individuals with COVID-19 have been shown to be more severe when concomitant illnesses such as diabetes mellitus, hypertension, endocrine disorders, and cardiovascular and pulmonary diseases are present.⁶

The most common clinical manifestations are severe acute respiratory illnesses with fever and respiratory symptoms including cough and shortness of breath. However, atypical symptoms, such as people with no respiratory symptoms or just very mild symptoms, are becoming more prevalent globally.⁷ COVID-19 affects the respiratory system, primarily the lungs, and individuals with pre-existing respiratory conditions such as chronic obstructive pulmonary disease (COPD) and asthma may be at higher risk of severe illness from the virus. Severe outcomes of COVID-19 including hospital admission for lung complications like acute respiratory distress syndrome or respiratory failure or death were found associated with older people with preexisting comorbidities.⁸

The SARS-CoV-2 and other respiratory viruses were found to more severely affect asthma patients and were associated with severe asthma outcomes like acute exacerbation.⁹ Although, asthma was not among the most

common clinical conditions in COVID-19 patients.¹⁰

The COPD was reported as the fourth leading cause of death affecting 16 million people in the United States. Although, the association of COPD with adverse outcomes in COVID-19 cases has been controversial, some of the studies with patients of COVID-19 reported COPD as a risk factor with increased hospitalization, intensive care unit (ICU) admission and death.^{4,11}

The association between COPD and adverse outcome from COVID-19 data on Bangladeshi context remains disputed. This study was undertaken to investigate the characteristics of COVID-19 patients with COPD and asthma to determining the health outcomes of COVID-19 hospitalized patients in Bangladesh.

Methodology

Study design

This prospective observational study was conducted on patients diagnosed with COVID-19 between April 2020, and December 2022, who were admitted in departments of Respiratory Medicine at Monno Medical College and Hospital, Manikganj. The enrolled patients were also included from Ibn Sina Medical College and Hospital, Dhaka and Bangladesh Specialized Hospital, Dhaka with history of chronic obstructive pulmonary diseases (COPD) or bronchial asthma. The COVID-19 was identified by a positive laboratory test for SARS-CoV-2. The purpose and procedure of the study were discussed with the patients, and informed written consent was taken from those who agreed to participate in the study. Information regarding demographics as well as clinical and medication history was collected from each of the patients. Inhaled corticosteroid use was defined as having at least 1 prescription in the 12 months preceding the COVID-19 diagnosis. The study protocol was approved by the Institutional Review Board of Monno Medical College. A total of 144 COVID-19 positive patients suffering from COPD or asthma were enrolled purposively upon fulfilling the inclusion and exclusion criteria. Patients suffering from COPD were allocated in group A, and the others with bronchial asthma were included in group B. History taking focused on the clinical presentation of patients upon admission, including information on comorbidities like duration and medications received for comorbidity management. Additionally, a detailed assessment of COVID-19 symptoms and physical examination findings were conducted. Laboratory analysis, including blood

samples, was performed based on the participant's treatment needs, and the cost of laboratory investigations was borne by the participants themselves. Outcome was observed for each of the patients within 30 days of hospital stay from admission. Whether patients with COPD or bronchial asthma required admission to the intensive care unit (ICU) during their hospitalization for COVID-19 was noted. Data on the requirement of High-Flow Nasal Oxygen (HFNO), Invasive Mechanical Ventilation (IMV), and duration of hospital stay were also collected as part of the study. Data were collected from hospital records review, or through face-to-face interview with the patients or their legal guardians. Related data were collected at 2 different time points related to the patients: at admission, and at discharge/death.

Data collection and Statistical analysis

Data entry involved the careful input of collected data into the latest version of Statistical Package for Social Science (SPSS) software, ensuring accuracy and proper coding of variables. Descriptive statistics, such as frequencies, means, and standard deviations, were calculated to summarize the characteristics of the study population. Inferential statistics, such as chi-square tests or t-tests, were used to assess relationships between variables and determine statistical significance. Odds ratio and binary logistic regression were used for examining the associations and predicting outcomes in this study. A 'p' value less than 0.05 was considered significant.

Results

Among the total of 144 COVID-19 patients enrolled, 96(66.67%) were suffering from chronic obstructive pulmonary disease (COPD) in group A and remaining 48(33.33%) had bronchial asthma in group B. Ages of the patients were between 18 to 70 years. Table I shows that there was statistically no significant differences between the Group A and Group B regarding their age, sex, level of education and monthly family income ($p > 0.05$). (Table I)

Table I: Distribution of the respondents according to socio-demographic characteristics by group (group A=96, group B=48)

Socio-demographic characteristics	Group A n (%)	Group B n (%)	Total n (%)	P-value
Age (years)				
≥ 50	44 (45.8)	17 (35.4)	61 (42.4)	0.233 ^a
< 50	52 (54.2)	31 (64.6)	83 (57.6)	
Mean ± SD	40.4 ± 14.25	38.3 ± 14.79		0.402 ^b
Sex				
Male	72 (75.0)	29 (60.4)	101 (70.1)	0.071 ^a
Female	24 (25.0)	19 (39.6)	43 (29.9)	
Educational qualifications				
Illiterate	24 (25.0)	11 (22.9)	35 (24.3)	0.837 ^a
Up to primary	31 (32.3)	18 (37.5)	49 (34.0)	
SSC/equivalent	22 (22.9)	12 (25.0)	34 (23.6)	
HSC and above	19 (19.8)	7 (14.6)	26 (18.1)	
Monthly household income				
≤10,000 Tk.	10 (10.4)	3 (6.3)	13 (9.0)	0.780 ^c
10,001 – 35,000 Tk.	68 (70.8)	35 (72.9)	103 (71.5)	
35,001 – 60,000 Tk.	13 (13.5)	6 (12.5)	19 (13.2)	
>60,000 Tk.	5 (5.2)	4 (8.3)	9 (6.3)	

^aChi-square test was done to measure the level of significance;

^bUnpaired T-test was done to measure the level of significance;

^cFisher's exact test was done to measure the level of significance; Group A- COVID-19 hospitalized patients with COPD; Group B- COVID-19 patients hospitalized with bronchial asthma

Table II demonstrates the differences in the distribution of findings of the respondents' baseline investigations at admission between the COPD and asthma patient groups and all of them were not significant statistically ($p > 0.05$).

Table III shows there was statistically no significant differences in between the Group A and Group B in respect to their oxygen saturation level ($p > 0.05$). Furthermore, 41(42.7%) COPD patients exhibited >25% lung field involvement in the high-resolution computed tomography chest imaging compared to only 10(20.8%) in COVID-19 patients with bronchial asthma, and this difference in distribution was statistically significant. (Table III)

Table II: Distribution of the respondents' baseline investigations findings at admission by group (Group A n=96, Group B n=48)

Baseline investigations	Mean + SD of the findings		P value
	Group A (n=96)	Group B (n=48)	
RBS (mmol/L)	7.5 ± 2.88	7.7 ± 3.06	0.683 ^b
ALT (IU/L)	38.6 ± 9.67	40.4 ± 9.67	0.318 ^b
S. Creatinine (mg/dL)	0.8 ± 0.27	0.8 ± 0.31	0.772 ^b
CBC			
Hb% (gm/dL)	11.3 ± 0.79	11.2 ± 0.77	0.694 ^b
ESR (mm in 1 st hr)	28.9 ± 4.92	29.8 ± 4.42	0.295 ^b
Haematocrit (l/l)	7.7 ± 1.19	7.9 ± 0.99	0.427 ^b
TC- WBC (/cmm ³)	9,856.4 ± 1928.19	9,843.9 ± 2211.53	0.972 ^b
Platelet count (/cmm ³)	296,828.9 ± 55754.1	312,526.9 ± 50460.51	0.103 ^b
TSH (mIU/L)	3.4 ± 0.76	3.6 ± 0.79	0.230 ^b
C-reactive protein (mg/L)	17.6 ± 4.83	18.2 ± 4.49	0.534 ^b
Serum ferritin (ng/mL)	1,193.2 ± 1099.14	1,137.5 ± 1120.0	0.920 ^b
Creatine kinase (units/L)	195.1 ± 75.03	191.4 ± 76.25	0.781 ^b
D-dimer (µmL)	1.9 ± 1.49	2.1 ± 1.59	0.681 ^b
LDH (U/L)	252.6 ± 64.83	245.8 ± 67.09	0.560 ^b

^bUnpaired T-test was done to measure the level of significance; Group A- COVID-19 affected hospitalized patients with COPD; Group B- COVID-19 affected hospitalized patients with bronchial asthma.

Table III: Distribution of the respondents' according to percent saturation of oxygen and lung field involvement by groups (Group A, n=96, Group B, n=48)

Parameters	No. (%) of enrolled patients			P value
	Group A	Group B	Total	
SpO₂ (%)				
93-100	49(51.0)	31(64.6)	80(55.6)	0.227 ^a
85-92	25 (26.0)	11 (22.9)	36 (25.0)	
<85	22 (22.9)	6 (12.5)	28 (19.4)	
Lung field involvement (in HR-CT chest)				
<10%	29 (30.2)	23 (47.9)	52 (36.1)	0.026 ^a
10-25%	26 (27.1)	15 (31.3)	41 (28.5)	
>25%	41 (42.7)	10 (20.8)	51 (35.4)	

^aChi-square test was done to measure the level of significance; Group A- COVID-19 hospitalized patients with COPD; Group B- COVID-19 hospitalized patients with bronchial asthma; Within parentheses are percents over column total

Table IV reveals that COVID-19 patients with COPD were more severe to critically ill, compared to patients with bronchial asthma (46.9% vs. 25.0%, respectively), which was statistically significant (p=0.011). Likewise, group A study subjects required ICU admission (51.0%) more than the group B participants (33.3%), which was also found statistically significant (p<0.05).

Table IV: Distribution of the respondents according to severity of disease and requirement of intensive care unit admission by groups (Group A, n=96, Group B, n=48)

Parameters	Group A n (%)	Group B n (%)	Total n (%)	P-value
Severity of COVID-19 disease				
Severe to critically ill	45 (46.9)	12 (25.0)	57 (39.6)	0.011 ^a
Mild to moderate	51 (53.1)	36 (75.0)	87 (60.4)	
ICU admission				
Required	49 (51.0)	16 (33.3)	65 (45.1)	0.044 ^a
Not required	47 (49.0)	32 (66.7)	79 (54.9)	

^aChi-square test was done to measure the level of significance; Group A- COVID-19 affected hospitalized patients with COPD; Group B - COVID-19 affected hospitalized patients with bronchial asthma. Within parenthesis are percentages over column total.

Table V shows, nearly one-fifths (17, 17.7%) of the patients died among the COVID-19 with COPD group compared to only 2(4.2%) mortality observed in patients with bronchial asthma. This difference in distribution was statistically significant (p=0.024). Moreover, there was statistically no significant differences between the Group A and Group B in respect to their duration of hospital stay (p > 0.05).

Table V: Distribution of the respondents according to outcomes by group (Group A with COPD, n=96, Group B with bronchial asthma, n=48)

Parameters	Group A n (%)	Group B n (%)	Total n (%)	P-value
Death	17 (17.7)	2 (4.2)	19 (13.2)	0.024 ^a
Recovered	79 (82.3)	46 (95.8)	125 (86.8)	
Duration of hospital stay (mean ± SD, days)	8.1±3.36	6.9 ± 3.84		0.064 ^b

^aChi-square test was done to measure the level of significance; ^bUnpaired t test was done to measure the level of significance; Group A- COVID-19 affected hospitalized patients with COPD; Group B- COVID-19 affected hospitalized patients with bronchial asthma.

The COVID-19 patients with COPD were found significantly associated with the risk of >25% lung field involvement, severe to critical illness, ICU admission, invasive mechanical ventilation, and death ($p < 0.05$). (Table VI)

Table VI: Clinical outcomes analysis for the presence of COPD among the hospitalized COVID-19 patients by Odd's ration (OR) and 95% confidence interval (CI) (n=144)

Clinical outcome parameters	Odds ratio (OR)	95% CI (upper-lower)	P value
Lung field involvement (>25%)	2.833	1.266-6.339	0.010*
Disease severity (severe to critical)	2.647	1.230-5.697	0.011*
ICU admission (required)	2.085	1.014-4.289	0.044*
Mechanical ventilation (required)	2.376	1.029-5.487	0.039*
Outcome (death)	4.949	1.094-22.395	0.024*

P-value was determined by the chi-square test, * = significant

Discussion

The baseline investigation findings between the hospitalized COVID-19 patients with COPD and asthma in the present study showed statistically no significant difference ($p > 0.05$). Majority of the patients (80, 55.6%) showed oxygen saturation levels within 93-100%. SpO₂ level <85% was observed in 22 (22.9%) COPD patients compared to 6(12.5%) respondents with asthma ($p=0.227$). Lower oxygen saturation levels are indicative of compromised respiratory function and may warrant close monitoring, timely interventions, and appropriate oxygen therapy to prevent further deterioration and improve patient outcomes. A study by Zhang et al conducted in a tertiary care hospital in China found that COVID-19 patients with COPD, had lower oxygen saturation levels compared to those with asthma.¹³ Similarly, a study by Gupta et al conducted in India reported that patients with COPD had significantly lower SpO₂ levels on admission compared to patients with asthma.¹⁴

In the present study, above two-fifths (41, 42.7%) of the patients had >25% lung field involvement in HR-CT chest findings among the COPD patients, while majority (23, 47.9%) of the COVID-19 patients with asthma revealed <10% lung field involvement. The immune response and inflammatory cascade triggered by COVID-19 can be heightened in patients with COPD leading to more pronounced lung inflammation and injury.

This inflammatory response can manifest as a range of radiological findings on HR-CT scans, including ground-glass opacities, consolidations, and interstitial abnormalities, which are often more severe in patients with COPD.¹⁵ More extensive and severe lung involvement observed on HR-CT scans may indicate a higher risk of disease progression, respiratory compromise, and poorer clinical outcomes. Mylona et al¹⁶ observed that 64.7% of the COVID-19 patients requiring ICU admission had the lung field score of 4 (extent of alveolar opacities >75%), compared to 29.9% patients who did not require intensive care unit (ICU) admission had the lung-field score of 0 (none) and 2 (extent of alveolar opacities 25-50%). In their study, COVID-19 patients had a statistically significant association between oxygen level and CT scan severity score (p -value = 0.001) and there was an inverse association between CT severity and oxygen saturation. Current study revealed that COVID-19 patients with COPD were more prone to severe to critical illness compared to patients with bronchial asthma (46.9% vs. 25.0%, respectively), which was statistically significant ($p=0.011$). In a systemic review and metaanalysis, Singh et al identified that COVID-19 patients with COPD had a greater risk of severe disease and death.¹⁷ The incidence of ICU admission was also found higher in patients with COPD compared with those with bronchial asthma (51.0% vs. 33.3%, respectively), with the P-value of 0.044. In a similar study by Sanyaolu et al found that older patients, especially those 65 years and above, who had comorbidities and were infected, had an increased admission rate into the ICU and mortality from the COVID-19 disease.¹⁸

But in regard to mortality rate, nearly one-fifths (17, 17.7%) of the patients died among the COVID-19 with COPD in group A, compared to only 2(4.2%) mortality observed in patients with asthma in group B. The distribution of outcome parameters differed significantly ($p=0.024$). The COVID-19 patients with COPD were found significantly associated with the risk of >25% lung field involvement, severe to critical illness, ICU admission, invasive mechanical ventilation, and death (all p values <0.05). In a retrospective cohort study from China by Zhou et al enumerated that hospitalized patients were predominantly men with a median age of 56 years; 26% required ICU care, and there was a 28% mortality rate.¹⁹ Therefore, the presence of COPD significantly increases the risk of extensive lung involvement, severe to critical illness, ICU admission, invasive mechanical ventilation,

and death. The findings underscore the importance of identifying and managing COPD in COVID-19 patients to mitigate the risk of complications and improve outcomes.

Conclusion

The COPD significantly increases the risk of disease severity and adverse outcomes in COVID-19 patients. Present study findings demonstrated that COVID-19 patients with COPD were significantly associated with a higher risk of invasive mechanical ventilation and death compared to patients with bronchial asthma. The presence of COPD also heightened the risk of lung field involvement exceeding 25%, more severe disease and increased mortality rates compared to individuals with bronchial asthma.

Conflict of interest: None declared.

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