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Chest Computed Tomography (CT) and Clinical Findings Among COVID-19 Patients of Tertiary Hospital in Bangladesh

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ABSTRACT

Bangladesh has experienced a sharp rise in cases during the third wave of the COVID-19 pandemic. This study investigates chest computed tomography (CT) and clinical findings of COVID-19 patients in Bangladesh. It is a single-centred cross-sectional study conducted at Chittagong Ma O Shishu Hospital. In total, 242 COVID-19 patients were recruited between June 2020 and July 2021 from a tertiary hospital in Chittagong, Bangladesh—most patients had a fever (90%) and cough (74.7%). Only a few patients had dyspnoea (13.3%), body aches (3.6%), sore throat (0.4%), fatigue (0.8%), diarrhoea (1.2%), headache (2%), and anosmia (2%). Most (91.3%) patients had abnormal CT image findings. Findings revealed that 89.6% had bilateral lung patchy opacities, 84.3% had ground glass opacities and crazy paving appearance, 29.3% had consolidation, and 16.9% had traction bronchiectasis. Clinical features, i.e., fever (93.7%) and cough (78.3%), were

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significantly more common (P<0.05) among those with positive radiological findings compared to those with negative radiological findings. However, this found that patients with negative radiological findings were more likely to have body aches (4.8%) than those with positive radiological findings (P=0.012**).** Most patients had lung involvement. There was no statistically significant difference in the demographic and patient comorbidities between these two radiological groups. A Chest CT scan was the best radiological option for detecting the progression of COVID-19 in high-risk and low-risk groups to initiate early clinical management and prevent complications during the pandemic.

Keywords: COVID-19, CT scan, lung, radiological findings

INTRODUCTION

The novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) epidemic emerged in December 2019 from Wuhan, Hubei and is responsible for the coronavirus disease (COVID-19) (Huang et al., 2020). The incubation period of COVID-19 varies from 2 to 14 days, with a median of 5–6 days. Its infectivity is higher than in previous epidemics from other viruses (Kolifarhood et al., 2020). In March 2020, the World Health Organization (WHO) officially acknowledged that the outbreak of COVID-19 was a global pandemic (WHO, 2021). The symptoms of patients with COVID-19 include fever, fatigue, dry cough, anorexia, myalgias, dyspnoea, sputum production, chills, lethargy, arthralgias, headache, nausea, vomiting, and diarrhoea (Valencia, 2020). However, the symptoms can vary drastically, as some could be asymptomatic, while others could have severe symptoms of acute respiratory distress syndrome or even death. The diagnosis of COVID-19 is confirmed by real-time reverse transcription polymerase chain reaction on respiratory or blood samples. At the same time, computed tomography (CT) findings such as bilateral ground-glass opacities and peripheral posterior distribution can be suggestive findings of COVID-19. Although many patients had no abnormal radiologic findings, a CT scan may show a paving pattern of multifocal consolidations as the disease progresses and is used in monitoring disease progression (Bernheim et al., 2020; Guan et al., 2020; Sun et al., 2020; Valencia, 2020). Moreover, clinical features and chest imaging can indicate higher levels of medical care (Cocconcelli et al., 2020), while risk factors such as age, smoking and hypertension may increase the severity of COVID-19 (Ieong et al., 2020).

COVID-19 is highly infectious and can become fatal acute respiratory distress syndrome (ARDS). Its early detection is an important factor in controlling its spread. Proper monitoring and management can drastically reduce mortality and morbidity rates. The most reliable screening method for COVID-19 is reverse-transcription polymerase chain reaction (RT-PCR) testing. However, it is a laborious and time-consuming method, and some studies reported its low sensitivity during the early stages (Mamun et al., 2021). Even though the

diagnosis of being COVID-19 positive or negative is primarily based on RT-PCR, a chest scan, such as a chest X-ray (CXR) and CT, are routine diagnostic approaches to detect abnormal lung changes linked to COVID-19 (Dey et al., 2020; Sun et al., 2020). According to WHO guidelines in June 2020, chest CT has a relatively high sensitivity for COVID-19 compared to chest X-rays (WHO, 2020). It is because COVID-19 mainly causes respiratory tract infections but can affect any organ in the body (Amit et al., 2021; Dey et al., 2020; Islam et al., 2020). A chest CT scan was frequently used in the diagnosis and disease prognosis of COVID-19 (Ai et al., 2020; Dey et al., 2020; Islam et al., 2020). The COVID-19 diagnosis involves a combination of epidemiological history, clinical manifestations, early chest CT examinations, and RT-PCR, with a particular emphasis on definite epidemiological history and early chest CT findings when positive RT-PCR tests lag, or test results are negative but clinically positive signs are shown (Ai et al., 2020; Rong et al., 2021). Only a few studies were conducted on a limited number of chest CT image findings among Bangladeshi COVID-19 patients (Biswas et al., 2021; Clump et al., 2020). It is unclear whether CT should be used as a first-line imaging technique and can be used as a preliminary test to detect the diagnosis quickly and to determine lung condition simultaneously.

However, chest abnormalities associated with COVID-19 differ from those associated with SARS and MERS and are also related to the disease extent and clinical findings. Therefore, detecting common and uncommon imaging findings on chest CT examinations is clinically important (Sun et al., 2020). Moreover, different countries are affected by different strains, and immunity can be different, so the presentation of signs, symptoms and chest findings may vary. Since the onset of COVID-19 in December 2019, many studies have reported the clinical characteristics and chest imaging appearances of COVID-19, specifically describing a variety of abnormalities in the lungs (Sun et al., 2020).

Bangladesh is considered one of the 25 most vulnerable countries and possesses the potential risk for the virus's rapid spread (Mohiuddin, 2020). The country confirmed the first COVID-19 case in its territory on March 8, 2020 (Dey et al., 2020; Mamun et al., 2021). Currently, Bangladesh is facing widespread community transmission. It has experienced a sharp rise in positive cases with a relatively lower recovery rate than neighbouring countries (Dey et al., 2020; Islam et al., 2020). The outbreak is evolving very rapidly in Bangladesh. The country was experiencing an increase in cases during the third wave of the pandemic (Amit et al., 2021). Therefore, we aim to explore the clinical and chest image findings of COVID-19 patients in Bangladesh.

MATERIALS AND METHOD

This cross-sectional study was conducted at Chattogram Maa o Shishu Hospital (CMOSH). CMOSH is a tertiary hospital located in Chittagong Port City, Bangladesh. Purposive sampling was used to recruit the patients. Initially, 251 COVID-19 patients aged 18 years

and above who were diagnosed with COVID-19 for the first time were recruited from June 2020 to July 2021. Nine patients whose history of radiological information was unknown were excluded, leaving 242 cases eligible for further analysis. Patients with severe illnesses were excluded from this study. Face-to-face interviews were conducted to collect socio-demographic and comorbidity data, i.e., age, gender, education level, residence status, presence of comorbidities such as diabetes mellitus, hypertension, chronic obstructive pulmonary disease, chronic kidney disease, ischemic heart disease, chronic liver disease, malignancy and hypertension and immunocompromised status. A chest CT scan was done at admission with symptoms of fever/cough for 3 to 5 days or more. Clinical and imaging findings such as fever, body ache, dyspnoea, cough, sore throat, fatigue, diarrhoea, headache, anosmia, and CT images were extracted from the patient's medical records. All CT images were reviewed and inferred by well-trained radiologists at the hospital.

Age was classified into five categories: 18–≤ 40 years, 41–60, 61–80, >80 and unknown. Morbid obesity was classified as "yes" or "no" based on patients having a body mass index of 40 or more 40 (kg/m^2).

For further analysis, COVID-19 patients were re-categorised into positive and negative radiological findings. Positive radiological findings were defined as any features in the CT scan, ground glass opacities (bilateral/subplural/peripheral), and/or crazy paving appearance, and/or consolidation, and/or traction bronchiectasis. Negative radiological findings were defined as the absence of chest CT findings, i.e., ground glass, crazy paving, consolidation and traction bronchiectasis.

This study was approved by the Ethical Review Committee of Chittagong Medical College, Chittagong, Bangladesh (CMC/PG/2021/174). Written informed consent was obtained from all the participants before taking part in this study.

Statistical Analysis

Descriptive statistics (frequencies and percentages) were used to present the socio-demographics, clinical features, and chest CT image findings among the COVID-19 patients. Differences in the categorised demographic, clinical features, and chronic illness variables between patients with positive and negative radiological findings were tested using the Chi-squared test. Values were considered statistically significant when $p < 0.05$. Data were analysed using the Statistical Package for Social Sciences (SPSS Inc, Chicago, IL) version 21.0.

Statistical Power

We estimated to recruit about 200 positive patients with CT reports during the 12 months of enrolment in CMOSH. A previous study recorded that among Covid-19 patients, about 53.3% of patients had positive radiological (CT) findings (Ieong et al., 2020). A sample of 148

COVID-19 patients with a 53.3 % frequency of radiological findings in the population can achieve 80% statistical power at a 5% significance level. Recruitment of even 208 patients achieved 99% statistical power at a 5% significance to detect a significant difference.

RESULTS

A total of 242 confirmed COVID-19 patients who had complete information were included in this study. The background characteristics of the participants are shown in Table 1. In total, 63.2% (n=153) of the patient were aged 60 years or below, and male 66.1% (n=160) and 61.2% resided in urban areas.

Table 2 shows that 66.1% of the patients had at least one comorbidity. Almost half of our patients had hypertension 49.2% (n=119), 46.3% (n=112) had diabetes mellitus, 8.7% (n=21) had obstructive pulmonary disease, 6.6% (n=16) patients had ischemic heart disease, 3.3% (n=8) patients had chronic kidney disease, 0.8% (n=2) had malignancy, and 0.4% (n=1) were immunocompromised.

Table 1
Sociodemographic characteristics of COVID-19 patients (n = 242)

Variables	n (%)
Age	
40 or less	46 (19.0%)
41–60	107 (44.2%)
61 and above	82 (33.9%)
Unknown	7 (2.9%)
Gender	
Male	160 (66.1%)
Female	82 (33.9%)
Residence	
Urban	148 (61.2%)
Rural	81 (33.5 %)
Unknown	13 (5.4 %)

Table 2
Comorbidities for patients with COVID-19 (n = 242)

Variables	n (%)
Comorbidity	
Yes	160 (66.1%)
No	74 (30.6%)
Unknown	8 (3.3%)
Hypertension	
Yes	119 (49.2%)
No	116 (47.9%)
Unknown	7 (2.9%)
Diabetes	
Yes	112 (46.3%)
No	123 (50.8%)
Unknown	7 (2.9%)
Chronic Obstructive Pulmonary Disease	
Yes	21 (8.7%)
No	214 (88.4%)
Unknown	7 (2.9%)
Chronic Kidney Disease	
Yes	8(3.3%)
No	227 (93.8)
Unknown	7 (2.9%)
Morbid obesity	
Yes	3(1.2%)
No	231 (95.5%)
Unknown	8 (3.3%)
Ischemic Heart Disease	
Yes	16 (6.6%)
No	219 (90.5%)
Unknown	7 (2.9%)
Malignancy	
Yes	2(0.8%)
No	231 (95.5%)
Unknown	9 (3.7%)
Immunocompromised State	
Yes	1 (0.4%)
No	232 (95.9%)
Unknown	9 (3.7%)

Most patients are with a fever of 91.3% (n=221) and a cough of 76.0% (n=184) (Table 3). Only a few patients had dyspnoea 15.7% (n=38), body ache (5.4%), sore throat (3.3%), fatigue (3.7%), diarrhoea (2.5%), headache (4.1%), and anosmia (4.5%).

Table 3
Clinical features (signs and symptoms) of COVID-19 patients (n= 242)

Variable name	Yes	No	Unknown
Fever	221 (91.3%)	14 (5.8%)	7 (2.9%)
Body ache	13 (5.4%)	222 (91.7%)	7 (2.9%)
Dyspnoea	38 (15.7%)	203 (83.9%)	1 (0.4%)
Cough	184 (76.0%)	48 (19.8%)	10 (4.1%)
Sore throat	8 (3.3%)	232 (95.9%)	2 (0.8%)
Fatigue	9 (3.7%)	227 (93.8%)	6 (2.5%)
Diarrhoea	6 (2.5%)	230 (95.0%)	6 (2.5%)
Headache	10 (4.1%)	224 (92.6%)	8 (3.3%)
Anosmia	11 (4.5%)	224 (92.6%)	7 (2.9%)

Table 4 shows the chest CT image findings for the 242 patients. The majority (91.3%; n=221) had abnormal CT image findings. Among all the COVID-19 patients (n=242), the majority (86.4%) had ground glass opacities (Bilateral and/or subpleural and/or peripheral); either or any combination of the bilateral, subpleural, peripheral involvements (Figures 1 & 2). 36.4% of patients had the crazy paving appearance, 30.2% had consolidation, and 17.4% of COVID-19 patients had traction bronchiectasis. Out of 221, only 0.8% (n=2) patients exhibited atypical unilateral lung involvement (Figure 3).

According to the radiological findings, patients having any kind of chest image findings in the CT scan were grouped into either the positive (n=221, 91.3%) or negative (n=21, 8.7%) radiological findings group (Table 5). These two groups' demographic characteristics and clinical features were analysed to explore the potential risk factors of COVID-19. No statistically significant difference existed between these two radiological groups in the socio-demographic and patient comorbidities or chronic illness factors. Clinical features, i.e., fever (93.7%) were significantly (P<0.05), and cough [$\chi^2(1) = 3.939$, $p= 0.04$] were also significantly more

Table 4
Lung involvement according to the CT scan image findings (n= 242)

Findings	n (%)
Normal chest imaging	**21 (8.7%)**
Abnormal Chest image findings	**221 (91.3%)**
Ground Glass opacities (GGO) (Bilateral and/or Subpeural and/or peripheral)	209 (86.4%)
Crazy Paving Appearance	88 (36.4%)
Consolidation	73 (30.2%)
Traction bronchiectasis	42 (17.4%)
Lung involvement according to the site (in CT scan)	
Unilateral	2 (0.8%)
Bilateral	219 (90.5%)
Not applicable (normal lung)	21 (8.7%)

common (78.3%) among patients with positive radiological findings compared to those with negative radiological findings. The two groups had no significant difference in dyspnoea, body ache, sore throat, fatigue, diarrhoea, headache, and anosmia.

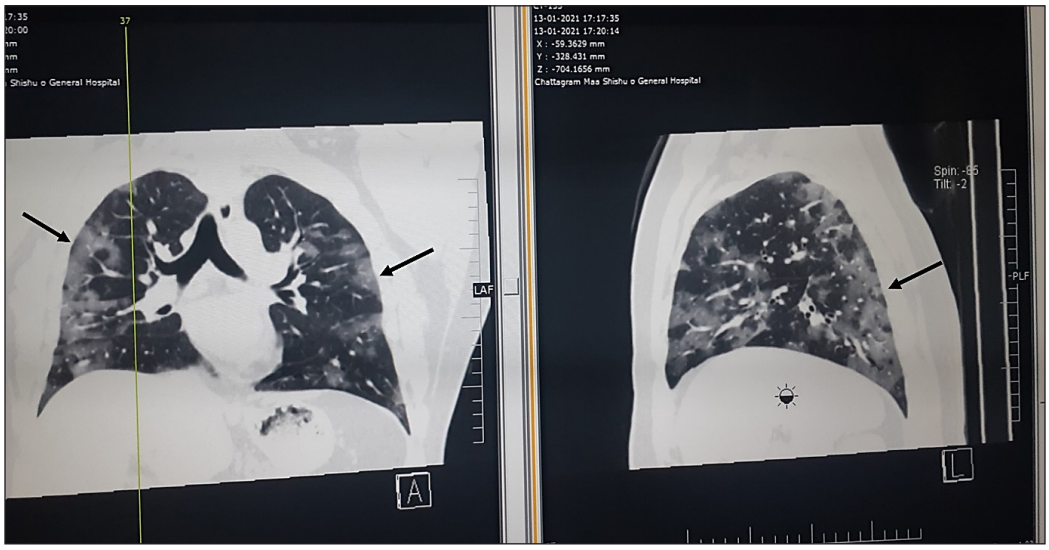

Figure 1. Bilateral multifocal subpleural peripheral ground glass opacities with a crazy paving appearance at all lobes of both lungs - typical COVID-19 CT findings

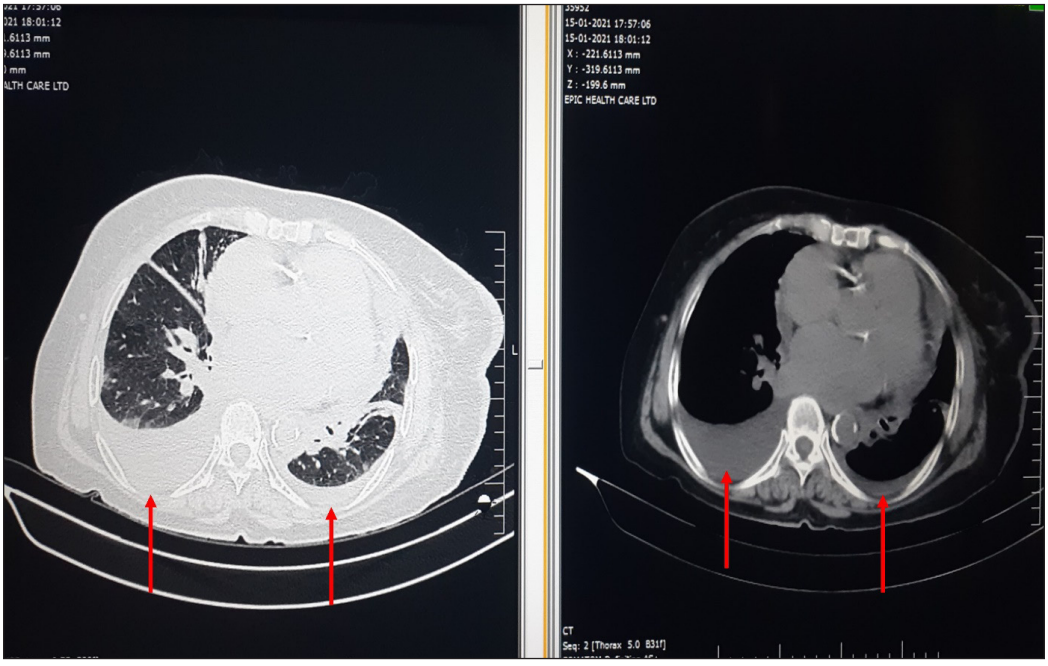

Figure 2. Bilateral ground glass opacities at basal segments of both lungs with bilateral pleural effusion, more on right COVID-19 with bilateral pleural effusion

Figure 3. Unilateral ground glass opacities, crazy paving appearance and consolation at right lower lobe-atypical COVID-19 CT findings

Table 5
Relationship between socio-demographic characteristics, comorbidities, symptom variables, and radiological (CT scan) findings of COVID-19 patients (n= 242)

Variables	Negative Radiological Findings group (n =21)	Positive Radiological Findings group (n =221)	Chi-square value (df)	*P* value
Socio-demographic Variables				
[a]Age				
18 –≤40	**6 (28.6%)**	**41 (19.2%)**	**1.775 (2)**	**0.412**
41–60	**7 (33.3%)**	**99 (46.3%)**		
61 and above	**8 (38.1%)**	**74 (34.6%)**		
Unknown	**0 (0.0%)**	**7 (3.2%)**		
[a]Gender				
Male	**12 (57.1%)**	**148 (67.0%)**	**0.826 (1)**	**0.36**
Female	**9 (42.9%)**	**73 (33.0%)**		
[a]Residences				
Urban	**14 (66.7%)**	**134 (60.61%)**	**1.493 (1)**	**0.47**
Rural	**5 (23.8%)**	**76 (34.4%)**		
Unknown	**2 (9.5%)**	**11 (5.0%)**		
Comorbidity Variables				
[a]Comorbidity (1 or more)				
Yes	**11 (52.4%)**	**149(67.4%)**	**2.73 (1)**	**0.098**
No	**10 (47.6%)**	**64 (29.0%)**		

Table 5 *(continue)*

Variables	Negative Radiological Findings group (n =21)	Positive Radiological Findings group (n =221)	Chi-square value (df)	*P* value
Unknown	**0 (0.0%)**	**8 (3.6%)**		
[b]**Ischemic Heart Disease**				
Yes	**1 (4.8%)**	**15 /(6.8%)**	**-**	**1**
No	**20 (95.2%)**	**199 (90%)**		
Unknown	**0 (0.0%)**	**7 (3.2%)**		
[a]**Diabetes**				
Yes	**7 (33.3%)**	**105 (47.5%)**	**1.897 (1)**	**0.168**
No	**14 (66.7%)**	**109 (49.3%)**		
Unknown	**0 (0.0%)**	**7 (3.2%)**		
[a]**Hypertension**				
Yes	**7 (33.3%)**	**112 (50.7%)**	**2.763 (1)**	**0.096**
No	**14 (66.7%)**	**102(46.2%)**		
Unknown	**0 (0.0%)**	**7 (3.2%)**		
[b]**Chronic Obstructive Pulmonary Disease**				
Yes	**2 (9.5%)**	**19 (8.6%)**	**-**	**1**
No	**19 (90.5%)**	**195 (88.2%)**		
Unknown	**0 (0.0%)**	**7 (3.2%)**		
[b]**Chronic Kidney Disease**				
Yes	**0 (0%)**	**8 (3.6%)**	**-**	**1**
No	**21 (100.0%)**	**206 (93.2%)**		
Unknown	**0 (0%)**	**7 (3.2%)**		
[b]**Morbid obesity**				
Yes	**0 (0.0%)**	**3 (1.4%)**	**-**	**1**
No	**21 (100.0%)**	**210 (95.0%)**		
Unknown	**0 (0.0%)**	**8 (3.6%)**		
Symptom Variables				
[b]**Fever**				
Yes	**14 (66.7%)**	**207 (93.7%)**	**-**	**0.01***
No	**4 (19.0%)**	**10 (4.5%)**		
Unknown	**3 (14.3%)**	**4 (1.8%)**		
[b]**Body ache**				
Yes	**3 (14.3%)**	**10 (4.5%)**	**-**	**0.076***
No	**16 (76.2%)**	**206 (93.6%)**		
Unknown	**2 (9.5%)**	**4 (1.8%)**		
[b]**Dyspnoea**				
Yes	**3 (14.3%)**	**35 (15.9%)**	**-**	**1**
No	**18 (85.7%)**	**185 (84.1%)**		
[a]**Cough**				

Table 5 *(continue)*

Variables	Negative Radiological Findings group (n =21)	Positive Radiological Findings group (n =221)	Chi-square value (df)	*P* value
Yes	**11 (52.4%)**	**173 (78.3%)**	**3.939 (1)**	**0.04***
No	**7 (33.3%)**	**41 (18.6%)**		
Unknown	**3 (14.3%)**	**7 (3.2%)**		
[b]Sore throat				
Yes	**1 (4.8%)**	**7 (3.2%)**	**-**	**0.52**
No	**20 (95.2%)**	**212 (95.9%)**		
Unknown	**0 (0.0%)**	**2 (0.9%)**		
[b]Fatigue				
Yes	**1 (4.8%)**	**8 (3.6%)**	**-**	**0.51**
No	**17 (81.0%)**	**210 (95.5%)**		
Unknown	**3 (14.3%)**	**3 (1.4%)**		
[b]Diarrohoea				
Yes	**1 (4.8%)**	**5 (2.3%)**	**-**	**0.39**
No	**18 (85.7%)**	**212 (95.9%)**		
Unknown	**2 (9.5%)**	**4 (1.8%)**		
[b]Headache				
Yes	**2 (9.5 %)**	**8 (3.6%)**	**-**	**0.17**
No	**16 (76.2%)**	**208 (94.1%)**		
Unknown	**3 (14.3%)**	**5 (2.3%)**		
[b]Anosmi				
Yes	**1 (4.8%)**	**10 (4.5%)**	**-**	**0.59**
No	**17 (81.0%)**	**207 (93.7%)**		
Unknown	**3 (14.3%)**	**4 (1.8%)**		

Note. Categorical data are expressed as a percentage
P values were calculated using the [a]Chi-square and [b]Fisher's exact test for the categorical variables. Df: degree of freedom.
*Significantly different at P <0.05.

DISCUSSION

Most patients have fever (91.3%) and cough (76%). Only a few patients had dyspnoea (15.7%), body aches (5.4%), sore throat (3.3%), fatigue (3.7%), diarrhoea (2.5%), headache (4.1%), and anosmia (4.5%). We found a significant prevalence of fever and cough symptoms among patients with positive radiological findings compared to those with negative radiological findings. Most patients (91.3%, n=221) had abnormal CT image findings, while 8.7 % (n=21) of the chest images were normal.

Among 242 patients, almost half (107, 44.2%) were in the 41–60 age group and predominantly male (66.1%). Similar findings were reported by another Bangladeshi study

where 43% were in the 40–60 age group, and 66.5% were male participants (Biswas et al., 2021), and by a study on the American population that the median age of the patients was 63years old (Guan et al., 2020).

Most patients have a fever (91.3%) and cough (76 %), similar to another study that reported that 93.3% of cases had a fever and 86.1% had a cough. Another study reported admission symptoms of mild-to-moderate cases which is in contrast to a Bangladesh study that included many non-critical patients who had a fever (79%), weakness (68%), cough (45%), altered sensation of taste or smell (35%), headache (32%) and body ache (32%) (Rong et al., 2021).

Among the abnormal chest image findings, out of 221 patients, the majority (86.4%) had ground glass opacities (Bilateral and/or subpleural and/or peripheral) and crazy paving appearance (36.4%). In total, 30.2% had consolidation, and 17.4% had traction bronchiectasis. Only 0.8% exhibited atypical unilateral lung involvement. Our findings align with previous studies (Biswas et al.,.2021), which reported that 34.9% had patchy bilateral opacities and 32.1% had consolidation. Another study found that the hallmark of COVID-19 infection in high-resolution CT included ground glass opacities and consolidation, ground glass opacities and crazy paving, and consolidation with parenchymal bands (Clump et al., 2020)

No statistically significant difference existed between the positive and negative radiological groups in the socio-demographic and patient comorbidities or chronic illness factors. Clinical features, i.e., fever (93.7%) and cough (78.3%), were significantly more common ($P<0.05$) among the patients with positive radiological findings compared to those with negative radiological findings, which indicates acute lung infection.

In this cross-sectional study, we included both RT-PCR positive and confirmed cases and those with clinical and radiologically (CT) COVID-19 cases. Prior studies stated that a CT scan was a more sensitive diagnostic tool than RT-PCR, which can detect 98% of asymptomatic patients (Cocconcelli et al., 2020; Fang et al., 2020). During this study, there was a rapid surge of patients having typical COVID-19 symptoms. Nevertheless, these were difficult to diagnose due to the limited availability and time required to obtain results from the RT-PCR. So many hospitals use a CT scan as a tool for triage, especially in the emergency department. A CT scan was done for patients with typical symptoms and needing admission. It was also done for high-risk patients with typical symptoms to start treatment early and prevent complications.

There are several limitations and strengths in our study. One of the weaknesses might be selection bias. We selected those with CT scans and were more likely to include moderate to severe patients. A few repeat CTs were done but not included in this study. Comparison with follow-up scans was beyond the scope of this study. We could not obtain most patients' laboratory data (e.g., CRP & D-Dimer) and outcome information. Although the percentage of lung affected and CT severity score was not included, we included many COVID-19 patients with CT scans.

CONCLUSION

We found that the COVID-19 patients presented more with fever and cough in the hospital. Males and aged groups of more than 40 years were more affected. Most patients had lung involvement. A chest CT scan was one of the radiological options for screening when RT-PCR was lagging or when test results were negative but clinically showing positive signs. It was useful for detecting the progression of COVID-19 in high-risk and low-risk groups to initiate early clinical management and prevent any life-threatening complications during the early stages of the pandemic.

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