Original Article

Persistent respiratory symptoms and lung function abnormalities in recovered patients of COVID-19

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ABSTRACT

Background and Objectives: COVID-19 is a disease caused by SARS-CoV-2 which belongs to a family of coronaviruses. After the acute phase of illness, the majority of the patients recover quickly but, in some cases, symptoms can persist for a variable duration, bringing into light another entity known as post-COVID syndrome. The objective was to estimate the burden of various persistent respiratory symptoms and lung function abnormalities among recovered patients of COVID-19 and also to correlate them with initial disease severity, demographic factors and comorbidities. **Methods:** Eighty-five post-COVID patients were recruited as per inclusion/exclusion criteria. Detailed history taking, physical examination and spirometry were done in all patients and data were correlated with baseline disease severity. **Results:** Fatigue and breathlessness were the most common symptoms followed by cough, chest pain and fever. Persistent symptoms and their severity were significantly higher in severe/moderate cases. Spirometry was abnormal in 45.88% of subjects and the most common pattern was restrictive type. It was seen that the likelihood of persistent symptoms and abnormal lung function increased significantly with the severity of COVID-19, age, comorbidities, hospital stay duration and steroid/oxygen therapy. **Conclusion:** The current study estimated the burden and array of various pulmonary sequelae encountered by post-COVID patients and elicited various risk factors associated with their occurrence after recovery from active infection. Awareness of these symptoms/sequelae and their risk factors is necessary for their follow-up and timely management, as the threat of this relatively new virus has still not abated.

KEY WORDS: Complications, COVID-19, persistent symptoms, pulmonary function, risk factors

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INTRODUCTION

The Coronavirus disease 2019 (COVID-19), caused by Novel Corona Virus SARS-CoV-2 was initially detected in December 2019 in the Chinese province, of Wuhan and later declared a Public Health Emergency of International Concern in January 2020, and further declared a Global Pandemic in March 2020. So, this relatively new virus has been rapidly spreading worldwide, affecting the economy as well as exhausting the health care resources and emerged as one of the most deleterious diseases known to mankind.[1]

Although the virus is now known to affect various organ systems, lung injury is the most common presentation since the respiratory system is the primary target of the

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virus. Patients present with a broad range of symptoms ranging from asymptomatic infection to severe illness, and the severity of illness may depend upon various risk factors.[2]

After the acute phase of illness, the majority of the patients recover quickly but, in some cases COVID-19 symptoms can persist for several weeks and months, bringing into light another entity commonly known as post-COVID syndrome or long-COVID.[3] The SARS-CoV-2 virus damages the lungs in certain ways leading to pulmonary complications, potentially long-lasting symptoms and functional disabilities.[4] The extent and severity of injury, duration of symptoms and disabilities may vary depending on several patient-related factors. There are several case reports from people of various age categories and disease severity who do not regain their previous health status following COVID-19 infection.[5] Incidence of persistent symptoms in recovered patients ranges from 10% to 35% and, among patients who had severe disease with hospital admission the rates are much higher.[5] The spectrum of post-COVID persistent symptoms includes fatigue, breathlessness, olfactory and gustatory dysfunction, chest pain, myalgia, fever sleep and mental disorders. New symptoms or syndromes may also develop after an initial asymptomatic or mild disease.[5] Thus the persistent symptoms are not only related to the respiratory system but also involve other systems of the body. During the disease, there is a systemic inflammatory response which affects different organ systems to varying degrees. Although the pathogenesis of the post-COVID syndrome is still largely unknown, studies postulate that it is multifactorial and prolonged inflammation has a key role in it.[5] Previously, patients who recovered from SARS and MERS were reported to have reduced exercise capacity, persistent symptoms and impaired pulmonary functions, which were known to last for months to years.[6-8]

Since the outbreak of this disease, most studies and attention have focused on how to control transmission of the virus, management of critically ill patients in acute care settings and probabilities of developing an effective vaccine against this new threat.[9] Few studies conducted in Western countries point out that many COVID-19 survivors face persistent symptoms as well as abnormal pulmonary functions and comorbidities may have a role in it.[10-14] It is crucial to elucidate the multifactorial pathogenesis, incidence and prognosis of persistent symptoms and abnormal pulmonary functions after initial recovery from COVID-19 for therapeutic and prognostic implications.[6]

The number of COVID-19 cases is still rising altogether, and the share of patients who have survived the disease is also scaling up, but beating the initial phase of sickness may be just the first of many battles for those who have endured the active infection. Not only the active cases but also these post-COVID-19 subjects facing lingering symptoms and disabilities need to be evaluated and managed comprehensively for a holistic recovery.[15,16] The studies on the burden, risk factors and various other aspects of persistent respiratory symptoms and pulmonary function abnormalities in post-COVID-19 patients of the Indian population are very limited. Hence the present study was planned to evaluate different persistent respiratory symptoms and lung function abnormalities faced by the survivors who recovered from active COVID-19 infection and also, to correlate these with the initial disease severity, demographic factors and comorbidities, focusing mainly on the pulmonary aspect of post-COVID syndrome.

MATERIAL AND METHODS

The study was conducted in the Department of Pulmonary, Critical Care and Sleep Medicine, Government Medical College and Hospital, Sector 32, Chandigarh. It was a cross-sectional study conducted over one and a half years. Recovered patients of COVID-19 who came to the hospital due to any reason were consecutively enrolled. Patients were said to have recovered from COVID-19 when their active infection had resolved and they were fulfilling the severity-based recovery criteria as mentioned in the Govt of India guidelines.[17]

Sample size: The optimum sample size was calculated by considering the 70% prevalence of persistent respiratory symptoms according to the available literature.[12] Assuming the Confidence interval as 95% and margin of error as 10% the required sample size came out to be 85.

Inclusion criteria: Recovered COVID-19 patients above 18 years, diagnosed positive at least one month before enrolment, by either RTPCR or Rapid antigen testing.

Exclusion criteria**:** Active cases of COVID-19, patients with previous chronic lung diseases, patients who didn't give consent and patients not having records of baseline COVID-19 disease.

Duration of study: January 2021 to July 2022.

Methodology: Written informed consent was taken from all patients. The study was approved by the institutional ethics committee of GMCH. Detailed history and physical examination were done and their demographic and clinical profile recorded. The BMI of the patients were classified according to WHO for the Asian population.[18] Current respiratory symptoms like dyspnoea, cough, chest pain, fatigue and fever were evaluated. The severity of dyspnoea was assessed according to the modified Medical Research Council (mMRC) grading system.[19] History of COVID-19 illness was taken from the patients as well as confirmed from their case records. Baseline COVID-19 severity, duration of hospitalisation if any, use of oxygen/ventilator management, and use of steroids/antivirals were noted. Categorisation of disease severity at the time of infection was done based on National Guidelines issued by the Ministry of Health and Family Welfare, Directorate General

of Health Services, Government of India (Version 3, dated 13.06.2020).[20]

Thereafter all patients underwent Spirometry as per standard guidelines.[21] If lung function was abnormal, the type of abnormality was also characterised, as Restrictive, Obstructive or Mixed pattern. Forced expiratory volume in first-second (FEV_1), Forced vital capacity (FVC) and ratio of FEV_1/FVC was measured.

The persistent respiratory symptoms under study and lung function parameters were described and compared with the baseline initial COVID-19 disease severity. These were also compared with different demographic and clinical parameters for any possible association.

Statistical analysis

The presentation of the Categorical variables was done in the form of numbers and percentages. However, the quantitative data were presented as the mean ± SD and as the median with 25th and 75th percentiles (interquartile range). The data normality was checked by using the Kolmogorov-Smirnov test. In the cases in which the data was not normal, we used non-parametric tests. The association of the qualitative variables were analysed using the Chi-Square test. If any cell had an expected value of less than five, Fisher's exact test was used. The association of the variables which were quantitative and normally distributed in nature were analysed using ANOVA (for more than two groups) and the Independent *t* test (for two groups). The association of the variables which were quantitative and not normally distributed in nature were analysed using the Kruskal Wallis test (for more than two groups) and Mann-Whitney Test (for two groups). The data entry was done in the Microsoft EXCEL spreadsheet and the final analysis was done with the use of Statistical Package for Social Sciences (SPSS) software, version 25.0. For statistical significance, a *P*-value of less than 0.05 was considered statistically significant.

RESULTS

The mean age of study subjects was 54.87 ± 14.1 years and range 24–87 years. The majority of patients belonged to middle and old-age groups. The gender distribution was almost equal (43 males, 42 females). The mean BMI of study subjects was 25.95 ± 5.77 kg/m^2. The majority of patients (n = 43) belonged to the obese category and had some sort of comorbidities. Diabetes (n = 29) was the most common comorbidity followed by hypertension (n = 25). The majority had no addictions, 12 were smokers, and 13 had a habit of alcohol intake.

Out of 85 subjects, the majority had either mild (n = 31) or moderate (n = 35) disease. The majority (n = 67) were hospitalised during the treatment period. The mean duration of hospital stay of study subjects was 10.29 ± 6.61 days. During the active COVID-19 infection phase, out of 85 patients, many received steroid therapy (n = 56) and oxygen support (n = 54). Only a few received antiviral therapy (n = 5) and non-invasive ventilator support (n = 3). No patients were treated with invasive mechanical ventilation. Fatigue (n = 74) was the most common persistent symptom, followed by breathlessness (n = 58), cough (n = 49), chest pain (n = 19) and fever (n = 8). The severity of breathlessness was categorised using MMRC grading of dyspnoea. Normal spirometry was seen in 46 patients. Among the abnormal spirometry group (n = 39), the most common pattern was restrictive type (n = 37) [Table 1].

Current respiratory symptoms of breathlessness, cough, fatigue, chest pain and fever were compared with initial disease severity. It was found that patients with more severe disease were more likely to have persistent breathlessness (*P*-value <0.0001), fatigue (*P*-value = 0.021) and chest pain (*P* value = 0.036) and, it was statistically significant. It was also observed that patients with more severe disease are more likely to have higher grades of dyspnoea and there is a statistically significant association (*P*-value <0.0001). Current spirometry inference and spirometry parameters were compared with initial disease severity. It was inferred that patients with more severe disease were more likely to have abnormal spirometry (*P*-value <0.0001). Also, patients with more severe diseases are more likely to have lower FEV_1 (%) and FVC (%), (*P*-value <0.0001). [Table 2]

We compared demographic factors with the persistent symptom of breathlessness. We found out that the likelihood of having persistent breathlessness increases significantly with age (*P*-value = 0.004). Gender and BMI had no significant association with persistent breathlessness (*P*-value = 0.874 and 0.803

Table 1: Disease factors

Parameter	Group	Frequency (n)	Percentage
Disease severity	Mild	31	36.47%
	Moderate	35	41.18%
	Severe	19	22.35%
Hospital stay	Hospitalised	67	78.82%
	Non-Hospitalised	18	21.18%
Treatment details	Steroid therapy	56	65.88%
	Antiviral therapy	5	5.88%
	Oxygen therapy	54	63.53%
	NIV support	3	3.53%
Persistent symptoms	Breathlessness	58	68.24%
	Cough	49	57.65%
	Fatigue	74	87.06%
	Chest pain	19	22.35%
	Fever	8	9.41%
mMRC grade of dyspnoea	Grade 0	24	28.24%
	Grade 1	16	18.82%
	Grade 2	29	34.12%
	Grade 3	16	18.82%
	Grade 4	0	0.00%
Spirometry inference	Normal	46	54.12%
	Pure Restrictive pattern	37	43.53%
	Mixed pattern	2	2.35%
	Pure Obstructive pattern	0	0.00%

mMRC - Modified Medical Research Council

respectively). Patients with comorbidities are more likely to have persistent breathlessness and it was statistically significant (*P*-value = 0.014). The proportion of patients given steroid therapy and oxygen therapy was significantly higher in patients with breathlessness as compared to patients without breathlessness, (*P*-value <.0001). Median (25^{th} –75^{th} percentile) duration of hospital stay was significantly higher in patients with breathlessness [15 (10.25–16)] as compared to patients without breathlessness [3 (0–12)], (*P*-value <.0001) [Table 3].

We compared demographic factors with the persistent symptoms of fatigue. We found out that as age increases the chance of having persistent fatigue increases significantly (*P*-value = 0.029). Gender and BMI did not show any association with persistent fatigue in recovered patients (*P*-values 0.52 and 0.49 respectively). The proportion of patients with fatigue was higher in patients with comorbidity, but the association was not statistically significant (*P*-value = 0.051). The proportion of patients given steroid therapy and oxygen therapy was significantly higher in patients with fatigue as compared to patients without fatigue, (*P*-value = 0.015). Median (25^{th}–75^{th} percentile) duration of hospital stay was significantly higher in patients with fatigue [13 (6.25–16)] as compared to patients without fatigue [0 (0–11.5)], (*P*-value = 0.01) [Table 4].

On comparing various demographic and disease characteristics with spirometry it was seen that older post-COVID patients had a higher chance of having abnormal lung function (*P*-value = 0.024). Gender, BMI and comorbidities didn't show any association with pulmonary function. The proportion of patients given steroid therapy (*P*-value <0.0001) and oxygen therapy (*P*-value <0.0001) was significantly higher in patients with abnormal lung function compared to normal. Antiviral therapy and ventilator requirement had no significant association with spirometry. Median (25^{th}–75^{th} percentile) duration of hospital stay was significantly higher in patients with abnormal spirometry [15 (12–16.5)] as compared to patients with normal spirometry [7.5 (0–13.75)], (*P*-value <.0001) [Table 5].

Table 2: Association of various patient parameters with disease severity

Parameter	COVID-19 Disease severity			Total	*P*
	Mild (*n*=31)	Moderate (*n*=35)	Severe (*n*=19)		
Patients with breathlessness	11	28	19	58	<0.0001†
Patients without breathlessness	20	7	0	27	
Patients with cough	17	21	11	49	0.914†
Patients without cough	14	14	8	36	
Patients with fatigue	23	32	19	74	0.021*
Patients without fatigue	8	3	0	11	
Patients with chest pain	3	8	8	19	0.036*
Patients without chest pain	28	27	11	66	
Patients with fever	2	4	2	8	0.803*
Patients without fever	29	31	17	77	
mMRC Grade 0	20	4	0	24	<0.0001*
mMRC Grade 1	8	8	0	16	
mMRC Grade 2	3	17	9	29	
mMRC Grade 3	0	6	10	16	
Normal spirometry pattern	27	19	0	46	<0.0001*
Restrictive spirometry pattern	4	16	17	37	
Mixed spirometry pattern	0	0	2	2	
FEV_1(%) (Mean±SD)	111.71±22.22	86.66±21.39	63.63±18.59	90.65±27.77	<0.0001‡
FVC (%) (Mean±SD)	100.94±20.17	79.74±20.02	60.89±14.49	83.26±24.21	<0.0001‡
FEV_1/FVC (%) (Mean±SD)	110.97±11.03	109.51±13	105.89±21.3	109.24±14.58	0.49‡
Age (Mean±SD)	58.09±12.41	47.96±15.28	54.87±14.11		0.004§

*Fisher's exact test, †Chi-square test, ‡ANOVA, §Independent *t*-test. mMRC-Modified Medical Research Council. FEV_1: Forced expiratory volume in one second. FVC: Forced vital capacity. SD-Standard deviation

Table 3: Association of various demographic and disease factors with persistent breathlessness in study subjects

Demographic characteristics	Patients with breathlessness (*n*=58)	Patients without breathlessness (*n*=27)	Total	*P*
Age (Mean±SD)	58.09±12.41	47.96±15.28	54.87±14.11	0.004§
Female	29	13	42	0.874†
Male	29	14	43	
BMI (Mean±SD)	25.84±6.07	26.18±5.18	25.95±5.77	0.803§
Patients with comorbidities	38	10	48	0.014†
Patients without comorbidities	20	17	37	
Steroid therapy received	48	8	56	<.0001†
Antiviral therapy received	4	1	5	1*
Oxygen therapy received	47	7	54	<.0001†
NIV support received	3 (5.17%)	0 (0%)	3	0.548*
Median duration of hospital stay	15	3	12	<0.0001¶

†Chi-square test, §Independent *t*-test, *Fisher's exact test, ¶Mann Whitney test. BMI - Body mass index, SD - Standard deviation

The moderate and severe category patients ($n = 54$) were subdivided into two groups, one which received both steroid and antiviral drugs ($n = 5$) deemed to be the appropriate treatment for this category of patients as per Government of India guidelines and the second group that received only steroids not antiviral ($n = 49$) (inappropriately treated). Incidence of post-COVID complications were compared between them. Incidence of cough, chest pain, fever and spirometry abnormalities were higher in patients who received only steroids while incidence of breathlessness and fatigue was higher in patients who received both steroid and antiviral drugs. However, these correlations were not statistically significant [Table 6].

DISCUSSION

SARS-CoV-2 is a relatively new virus, and the lung is its primary target. Even after the acute phase, the virus is known to cause a variety of persistent symptoms and complications. Although significant advances have already been made in understanding about active phase of the disease, much has still to be learned about the post-COVID sequelae, its pathogenesis and risk factors.

In this study, we found out that fatigue and breathlessness are the most common symptoms among post-COVID-19 patients, followed by cough, chest pain and fever and similar findings were reported in other studies.[11] Since SARS-CoV-2 predominantly affects the lungs, persistent symptoms related to the respiratory system are more common. The proportion of patients with breathlessness, fatigue and chest pain was significantly higher in severe/moderate cases. Similar findings were seen in a few other studies done in China and England.[22-25] Thus we can infer that the higher the severity of COVID-19 infection, the more significant the injury caused to the lungs and the longer the delay in recovery leading to persistent symptoms. The severity of persistent dyspnoea increased significantly as the initial COVID-19 disease severity increased. Similar findings were obtained in studies from Italy and China.[24,26] The More severe the disease, the more extensive the parenchymal damage caused to the lung and, the resultant pulmonary fibrosis affects the pulmonary function and gas exchange leading to persistent symptoms and dyspnoea. Approximately 9% of study subjects had fever as post-COVID persistent symptoms, where we ruled out other causes of fever. Patients with fever were evaluated and treated appropriately. Blood and sputum investigations as well as CT chest were done for the patients with persistent fever to evaluate for TB or fungal infections. When found positive such patients were excluded from the study as per exclusion criteria.

In our study, 45.88% of subjects had abnormal spirometry and the most common pattern was restrictive type. Similar findings were obtained in a study conducted in Germany

Table 4: Association of various demographic and treatment factors with persistent fatigue

Demographic characteristics	Patients with fatigue (n=74)	Patients without fatigue (n=11)	Total	P
Age (Mean±SD)	56.15±13.64	46.27±14.89	54.87±14.11	0.029§
Female	38	4	42	0.52*
Male	36	7	43	
BMI (Mean±SD)	26.11±5.92	24.82±4.79	25.95±5.77	0.49§
Patients with comorbidities	45	3	48	0.051*
Patients without comorbidities	29	8	37	
Steroid therapy received	52	4	56	0.04*
Antiviral therapy received	5	0	5	1*
Oxygen therapy received	51	3	54	0.015*
NIV support received	3	0	3	1*
Median duration of hospital stay	13	0	12	0.01¶

*Fisher's exact test, §Independent *t*-test, ¶Mann Whitney test. BMI - Body mass index, SD - Standard deviation

Table 5: Association of various demographic and treatment characteristics with spirometry

Demographic characteristics	Spirometry inference		Total	P
	Normal (n=46)	Abnormal (n=39)		
Age				
Mean±SD	51.72±14.99	58.59±12.16	54.87±14.11	0.024§
Female	22	20	42	
Male	24 (52.17%)	19	43	0.751†
BMI				
Mean±SD	26.79±5.59	24.95±5.9	25.95±5.77	0.143§
Patients with comorbidities	23	25	48	0.191†
Patients without comorbidities	23	14	37	
Steroid therapy	21	35	56	<0.0001*
Antiviral therapy	2	3	5	0.692*
Oxygen therapy	19	35	54	<0.0001*
Ventilator support	0	3	3	0.148*
Median	7.5	15	12	<0.0001¶

†Chi-square test, §Independent *t*-test, *Fisher's exact test, ¶Mann Whitney test. BMI - Body mass index. SD-standard deviation

Table 6: Incidence of post-COVID complications in moderate/severe category patients who received only steroids in comparison to patients who received both steroid and antiviral drugs

Parameters	Received both steroid and antiviral (*n*=5)	Received only steroids but not antiviral (*n*=49)	*P*
Disease severity			
Moderate	2 (40%)	33 (67.35%)	0.331*
Severe	3 (60%)	16 (32.65%)	
Spirometry			
Normal	2 (40%)	17 (34.69%)	1*
Abnormal	3 (60%)	32 (65.31%)	
Symptoms			
Breathlessness	4 (80%)	43 (79.63%)	0.515*
Cough	2 (40%)	30 (87.76%)	0.387*
Fatigue	5 (100%)	46 (93.88)	1*
Chest pain	0	16 (32.65%)	0.306*
Fever	0	6 (11.11%)	1*

*Fisher's Exact test

and Spain.[13,14] The damage caused by the virus to the lungs will reflect in the pulmonary function. After the initial inflammatory stage of COVID-19 pneumonia, the disease can progress to the fibrotic stage. The restrictive pattern commonly seen in post-COVID patients can be attributed to this pulmonary fibrosis.[5] Thus the restrictive pattern can be due to post-COVID pulmonary fibrosis or may be pseudo-restriction due to weakness of respiratory muscles. Spirometry was done in all patients following the standardised pattern, confirming proper technique and adequate blow-out time. Patients with more severe COVID-19 had a higher chance of having abnormal spirometry, also lower FEV_1 and FVC. Similar results were obtained from studies in Thailand, China, Italy and Spain.[6,13,22,26,27] The most fearsome complication after acute COVID-19 is the development of pulmonary fibrosis which causes restrictive patterns on spirometry and also leads to activity limitation in patients. The higher the extent of fibrosis, the greater the limitation in pulmonary function.

The likelihood of having persistent breathlessness, fatigue and abnormal lung function increases significantly with age and the presence of comorbidities. Gender and BMI do not have any association with the presence of breathlessness or fatigue. These findings were similar to studies conducted in Tamil Nadu, China and Spain.[10,24,25,28] Currently we do not have any previous study to compare the effect of comorbidities on post-COVID-19 lung function. Damage caused to respiratory epithelium and pulmonary microvasculature are important features of COVID-19 pneumonia, which will cause hypoxemia and breathlessness.[5] The exact mechanism of post-COVID-19 fatigue is still unclear, but it has been hypothesised that prolonged pro-inflammatory response associated with SARS-CoV-2 infection may be the root cause of the plethora of post-COVID symptoms including fatigue.[10]

Duration of hospital stay as well as steroid therapy and oxygen therapy received during active COVID-19 is significantly related to post-COVID persistent breathlessness, fatigue and abnormal lung function. Antiviral therapy and ventilator requirement had no significant association with the presence of breathlessness, fatigue or abnormal lung function. These findings were similar to various studies done among post-COVID patients.[24,25,29] To the best of our knowledge there are no studies which compare post-COVID pulmonary function with demographic factors and comorbidities. Corticosteroids, oxygen support etc., are usually given to moderate and severe category patients. In our study, all active COVID-19 patients were treated as per guidelines issued by Govt of India. Even though about 22% of patients were of severe disease category, antiviral therapy was given only to those patients who had no contraindications for therapy and who gave consent for the same. Incidence of cough, chest pain, fever and spirometry abnormalities were higher in patients who received only steroids while incidence of breathlessness and fatigue was higher in patients who received both steroid and antiviral drugs. However, these correlations were not statistically significant, which may be due to the low sample size of our study. Patients with severe diseases need more intensive care and close monitoring and, a longer time is taken by such sick patients to recover. The severe underlying pneumonia in these patients receiving steroids, oxygen support etc., may be the root cause of the development of abnormal lung function after recovery. We could not find any association between NIV use during active COVID-19 infection and post-COVID persistent symptoms, which may be due to the small sample size of our study.

The present study analysed the persistent respiratory symptoms and lung function abnormalities in recovered patients of COVID-19 and is one of the first studies conducted in the Indian population. The strength of our study is that it has tried to find associations between various demographic, disease-specific and pulmonary function parameters and also, has thrown light into certain comparisons where no such previous data was available. The results of the present study can help and guide for further research in this area.

This study has a few limitations. Only limited literature was available when the study was planned and the sample size was calculated statistically. A small sample size might have failed to prove a correlation between certain variables that showed borderline significance and a larger sample size may help to validate the results. The majority of the cases enrolled belonged to the non-severe (mild/moderate) category. Ours was a hospital-based study where we enrolled those patients who came to the hospital and hence it may be impractical to generalise the results. Six-minute walk tests and HRCT chest were done only where indicated, not done for all patients, which are limitations of our study. Symptoms during active COVID-19 disease were collected retrospectively and there is a risk of recall bias. However, the study has shown that follow-up of post-COVID patients is necessary and they should be managed comprehensively for a holistic recovery.

CONCLUSION

Our study showed that fatigue and breathlessness are the most common symptoms among post-COVID-19 patients, followed by cough, chest pain and fever. The proportion of patients with breathlessness, fatigue and chest pain was significantly higher in severe/moderate cases. Patients with more severe disease had a higher chance of having abnormal spirometry and the most common pattern was restrictive type. The likelihood of having persistent breathlessness, fatigue and abnormal lung function increases significantly with age and the presence of comorbidities. Duration of hospital stay as well as steroid and oxygen therapy received during active COVID-19 is significantly related to post-COVID persistent breathlessness, fatigue and abnormal lung function.

Awareness of symptoms/sequelae and their risk factors following COVID 19 illness is necessary for their follow-up and timely management, as the threat of this relatively new virus has still not been averted.

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Conflicts of interest
There are no conflicts of interest.

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