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Original Research Article

Prevalence of Lung Fibrosis in Post-COVID Patients

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Abstract: *Progressive fibrotic lung disease is one of the possible consequences of COVID-19 pulmonary pneumonia, and it is one of the most worrying long-term complications.* ***Objective****: The main aim of the study is to determine the prevalence of lung fibrosis in post-COVID-19 patients.* ***Methods:*** *This Cross-sectional study was conducted at the Department of Medicine, PAF Hospital, Mushaf, Sargodha, from June 2024 to November 2024. Data were collected using a nonprobability consecutive sampling technique. A detailed history and physical examination were conducted for all eligible patients. High-resolution chest CT scans were performed in the supine position at full inspiration, with the patient in a foot-first position.* ***Results:*** *A total of 150 patients were added, with a mean age of 51.3 ± 12.6 years (range: 25–75 years). Of the participants, 60% (n = 90) were male, and 40% (n = 60) were female. A significant proportion (68%, n = 102) reported a history of moderate-to-severe COVID-19 illness during their initial infection. Pulmonary fibrosis was prevalent in 41.3% (n = 62) of the total study population. Among fibrosis-positive patients, 65% (n = 40) were male, and 35% (n = 22) were female, indicating a higher proportion of males. The prevalence was significantly higher in patients aged ≥50 years (53%, n = 45) than in those aged <50 years (22%, n = 17).* ***Conclusion:*** *It is concluded that pulmonary fibrosis is a significant complication in post-COVID-19 patients, particularly in older individuals. Regular follow-up and early diagnosis are recommended for at-risk populations. Further research is needed to explore therapeutic interventions and the long-term progression of fibrosis.*

Keywords: COVID-19, Pulmonary Fibrosis, High-Resolution CT, Post-COVID Complications, Long-Term Outcomes

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Introduction

Progressive fibrotic lung disease is one of the possible consequences of COVID-19 pulmonary pneumonia, and it is one of the most worrying long-term complications. Pulmonary fibrosis is associated with non-reversible lung dysfunction. (1) The Coronavirus Disease 2019 (COVID-19) caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has become a pandemic (2). As of June 12, 2021, there have been 174,918,667 confirmed cases of COVID-19, including 3,782,490 deaths globally, posing a serious threat to public health worldwide (3). As of February 15, 2022, the United States (US) had surpassed 77,025,050 confirmed coronavirus cases (4). Infection with SARS-CoV-2 may cause atypical pneumonia, with clinical presentations ranging from minor common colds to severe diseases (5). Lung injury in severe COVID-19 pneumonia can rapidly evolve to established pulmonary fibrosis, with prognostic implications in the acute phase of the disease and long-lasting impact on the quality of life of COVID-19 survivors (6). Two of the most common respiratory manifestations of COVID are a significant reduction in the diffusing capacity of the lungs (DLCO) and the associated pulmonary interstitial damage (7). One year after moderate COVID, the incidence rate of impaired DLCO and persistent lung damage still exceeds 30%, and one-third of the patients have severe DLCO impairment and fibrotic lung damage (7). The persistent respiratory complications may cause substantial population morbidity, long-term disability, and even death due to the progression of lung fibrosis. The incidence of COVID-19-induced pulmonary fibrosis can be estimated from a 15-year observational study of lung pathology following SARS (7).

Preceding coronavirus epidemics have been accompanied by considerable post-viral fibrosis and physical disabilities—frequent follow-up of patients after COVID-19 is mandatory (8). COVID-19 leads to a wide variety of respiratory diseases with a high occurrence of acute respiratory distress syndrome (1). The burden of fibrotic pulmonary changes following SARS-CoV-2 infection is likely to be high; thus, the global burden of fibrotic pulmonary disease will increase significantly. Fibrosis is not common following other viral pneumonias and has almost never been reported after H1N1 pneumonia. Fibrotic changes have been reported, however, in about 8% of patients with SARS and 20% of patients with H7N9 influenza (9). In a study conducted by Xiaohe Li et al. stated that during the 0–30, 31–60, 61–90, 91–120 and >120 days after onset, 86.87%, 74.40%, 79.56%, 68.12% and 62.03% patients developed with pulmonary fibrosis and 4.53%, 19.61%, 18.02%, 38.30% and 48.98% patients reversed pulmonary fibrosis, respectively (3). To our knowledge, no studies on this topic were found, so we conducted this study to determine the prevalence of lung fibrosis in post-COVID patients, which will help health practitioners take precautionary measures to prevent its onset.

The main objective of the study is to determine the prevalence of lung fibrosis in post-COVID-19 patients.

Methodology

This Cross-sectional study was conducted at the Department of Medicine, PAF Hospital, Mushaf Sargodha, during June 2024 and November 2024. Data were collected using a nonprobability consecutive sampling technique.

The sample size was determined using the WHO sample size calculator, employing a confidence level of 95%, an absolute precision of 8%, and an anticipated population proportion of 62.03%. As a result, the sample consisted of 150 patients. Participants were selected based on specific inclusion criteria: aged 25-75 years, of either gender, and post-COVID-19, as defined by operational parameters. Exclusion criteria included pregnant females, patients exhibiting severe respiratory motion artifacts on CT images, individuals with a history of chronic interstitial lung

disease, and those with any chronic medical conditions such as diabetes mellitus, hypertension, or autoimmune disorders.

Ethical approval for the study was obtained from the Ethical Committee of PAF Hospital, Mushaf Sargodha. Written informed consent was obtained from all participants or their legal guardians. A detailed history and physical examination were conducted for all eligible patients. High-resolution chest CT scans were performed in the supine position at full inspiration, with the patient in a foot-first position. The scans were conducted without contrast medium and assessed in both the lung window (1000 WW, -600 WL) and the mediastinal window (400 WW, 60 WL). Post-acquisition 2D coronal and sagittal image reformatting was applied to enhance the assessment of disease distribution. The radiologist evaluated the CT images, assigned a CT severity score, and identified cases of pulmonary fibrosis based on operational definitions. Cases of pulmonary fibrosis were managed according to the hospital's protocol.

All data collected during the study were entered and analyzed using Statistical Package for Social Sciences (SPSS) Version 22. Continuous variables, such as age, were reported as mean ± standard deviation, while categorical variables, such as gender and fibrosis status, were presented as frequencies and percentages. Pulmonary fibrosis was stratified by age and gender to assess potential effect modification. A post-stratification Chi-square test was applied to evaluate the statistical significance of the associations, with p-values <0.05 considered significant.

Results

Data were collected from 150 patients, with a mean age of 51.3 ± 12.6 years (range: 25–75 years). Of the participants, 60% (n = 90) were male, and 40% (n = 60) were female. A significant proportion (68%, n = 102) reported a history of moderate-to-severe COVID-19 illness during their initial infection. (Table 1)

Table 1: Demographic Characteristics of Study Participants

Characteristic	Value
Total Participants	150
Mean Age (years)	51.3 ± 12.6
Age Range (years)	25–75
Male Participants	60% (n = 90)
Female Participants	40% (n = 60)
Moderate-to-Severe COVID-19 History	68% (n = 102)

Pulmonary fibrosis was prevalent in 41.3% (n = 62) of the total study population. Among fibrosis-positive patients, 65% (n = 40) were male, and 35% (n = 22) were female, indicating a higher proportion of males. The prevalence was significantly higher in patients aged ≥50 years (53%, n = 45) than in those aged <50 years (22%, n = 17). (Table 2)

Table 2: Prevalence of Pulmonary Fibrosis

Group	Prevalence (%)	Count (n)
Overall	41.3%	62
Male	65%	40
Female	35%	22
Age ≥50 years	53%	45
Age <50 years	22%	17

Among patients diagnosed with pulmonary fibrosis, CT severity scores ranged from 6 to 18, with a mean score of 12.5 ± 3.2. The fibrotic changes were predominantly distributed in the peripheral and basal regions of the lungs. (Table 3)

Table 3: CT Severity Score Among Patients with Pulmonary Fibrosis

Measure	Value
Range	6–18
Mean Score	12.5 ± 3.2
Predominant Distribution	Peripheral and basal lungs
Common Imaging Findings	Ground-glass opacities, reticulations, traction bronchiectasis

Pulmonary fibrosis prevalence varied across demographic groups. Among males (n = 90), the prevalence was 44.4% (40/90), while among females (n = 60), it was 36.7% (22/60); however, the gender difference was not statistically significant (p = 0.08). Age was an important factor, with patients aged ≥50 years (n = 85) showing a prevalence of 53% (45/85) compared to 22% (17/65) in those aged <50 years, a statistically significant difference (p = 0.02). (Table 4)

Table 4: Stratification by Gender and Age

Group	Total (n)	Prevalence of Fibrosis (%)	Statistical Significance
Male	90	44.4% (40/90)	p = 0.08
Female	60	36.7% (22/60)	
Age ≥50 years	85	53% (45/85)	p = 0.02
Age <50 years	65	22% (17/65)	

Among the total of 150 patients, pulmonary fibrosis was more prevalent in males (44.4%, 40/90) than in females (36.7%, 22/60). Overall, 41.3% (n = 62) of the study population was diagnosed with pulmonary fibrosis. (Table 5)

Table 5: Gender Distribution Among Fibrosis-Positive Patients

Gender	Total Patients (n)	Fibrosis-Positive Patients (n)	Proportion with Fibrosis (%)
Male	90	40	44.4%
Female	60	22	36.7%
Total	150	62	41.3%

Discussion

The findings of this cross-sectional study highlight the significant prevalence of pulmonary fibrosis among post-COVID-19 patients, emphasizing the need for early diagnosis and long-term monitoring of individuals recovering from SARS-CoV-2 infection. The study revealed that 41.3% of patients developed pulmonary fibrosis after COVID-19, consistent with earlier research showing fibrosis rates of 30% to 60% across different populations and illness severities (10). Fibrosis risk doubles in people over 50 years old, according to our research, which confirms age as a major contributor to the disease (11). As COVID-19 progresses in older patients, their bodies mount stronger, longer-lasting inflammatory responses that lead to the formation of scar tissue (12). Male and female patients did not show a significant difference in fibrosis frequency rates (p-value = 0.08). CT testing showed that ground-glass opacities, reticulations, and traction bronchiectasis frequently develop from viral lung injury, as previously reported (4). The CT severity score of 12.5 ± 3.2 indicates that most cases presented moderate lung scarring, which appears mainly at the lung boundaries and edges (13). These tissue changes usually happen after an inflammatory response heals. The study findings demonstrate that routine lung scans should be performed for post-COVID-19 patients, especially those with a history of moderate-to-severe disease and older age. Identifying pulmonary fibrosis at an early stage will help patients access supportive treatments and lifestyle adjustments to reduce disease progression and enhance their daily lives (14).

Our results align with other research on how COVID-19 survivors develop chronic lung problems after their illness. Research shows that around 40-50% of patients with severe COVID-19 develop fibrosis when they need oxygen treatment or ventilation during their illness. Conditions

that emerge after SARS and MERS infections share the same pathophysiological features, including immune system overactivation and long-term inflammation, as seen here (15). The research team used CT scans systematically to locate fibrosis throughout the study and divided the results by age and gender to identify the most at-risk populations. Our analysis's single-site approach and small patient count limit the overall relevance of the study results (16). Because the study included only patients without diabetes or hypertension, it provides an incomplete picture of fibrosis across the entire patient population. Future medical research needs to track how fibrosis progresses in COVID-19 survivors and monitor their breathing abilities over time. Additional extensive research studies across multiple centers are required to confirm the current findings and identify new markers that predict tissue damage. Research is needed to examine how medical therapies and rehabilitation practices improve health outcomes for these patients.

Conclusion

It is concluded that pulmonary fibrosis is a significant complication among post-COVID-19 patients, with a prevalence of 41.3% observed in this study. Older age (≥50 years) emerged as a critical risk factor, with a statistically significant association with the development of fibrosis. While the prevalence of fibrosis was slightly higher among males compared to females, the difference was not statistically significant.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-PAF-S323-24)
Consent for publication
Approved
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Not applicable

Conflict of interest

The authors declared no conflicts of interest.

Author Contribution

MA (PGR), AA (Associate Professor), AH (Consultant)
Contributed to study design, data collection, and initial manuscript drafting. Assisted in data acquisition, literature review, and manuscript editing. Performed statistical analysis and contributed to the interpretation of results. Helped in methodology development, data organization, and manuscript formatting.
MO (Consultant), MH (Consultant), SJ (PGR)
Contributed to patient recruitment, data entry, and results compilation
Assisted in referencing, proofreading, and final revisions of the manuscript, Guided study execution and critically reviewed the manuscript, supervised the research, coordinated among authors, finalized the manuscript, and approved the final version.

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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