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Evaluation of Radiological Patterns of Interstitial Lung Diseases: A Cross-Sectional Study Using High-Resolution CT

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Abstract

Background: Interstitial lung diseases (ILDs) represent a heterogeneous group of diffuse parenchymal lung disorders associated with significant morbidity and mortality. High-resolution computed tomography (HRCT) has become the imaging modality of choice for diagnosing and classifying ILDs based on characteristic radiological patterns. Objectives: To evaluate the spectrum and distribution of radiological patterns of interstitial lung diseases using HRCT, to identify and categorize HRCT patterns in suspected ILD patients, and to analyze their association with demographic, clinical, and functional characteristics. ***Materials and Methods:*** This hospital-based cross-sectional study included 200 patients with clinical suspicion of ILD who underwent HRCT chest examination. Patients were categorized into fibrotic and non-fibrotic ILD based on established HRCT criteria. Radiological features and predominant ILD patterns were systematically recorded. Demographic data, clinical characteristics, and pulmonary function parameters were analyzed. Appropriate statistical tests were applied, and a p-value <0.05 was considered statistically significant. ***Results:*** Fibrotic ILD constituted the majority of cases. Patients with fibrotic ILD were significantly older, had longer symptom duration, higher prevalence of smoking and occupational exposure, and worse lung function compared to non-fibrotic ILD (p<0.001). Reticulation, honeycombing, and traction bronchiectasis were strongly associated with fibrotic ILD, whereas ground-glass opacities and airway-centered features predominated in non-fibrotic ILD. The UIP spectrum was the most frequent HRCT pattern, followed by NSIP and chronic hypersensitivity pneumonitis. UIP spectrum disease showed strong associations with male sex, smoking, severe functional impairment, and classical clinical signs. ***Conclusion:*** HRCT is an indispensable tool in the evaluation of ILDs, allowing reliable pattern-based diagnosis and differentiation between fibrotic and non-fibrotic disease. HRCT findings demonstrate strong correlations with clinical and physiological parameters, supporting its central role in diagnosis, prognostication, and management of ILD.

Keywords: Interstitial lung disease; High-resolution computed tomography; Usual interstitial pneumonia.

INTRODUCTION

Interstitial lung diseases (ILDs) constitute a heterogeneous group of diffuse parenchymal lung disorders characterized by varying degrees of inflammation and fibrosis involving the pulmonary interstitium, alveoli, and small airways. Collectively, ILDs are associated with significant morbidity and mortality due to progressive respiratory failure, impaired quality of life, and limited therapeutic options in advanced stages. The clinical presentation of ILDs is often nonspecific, commonly including progressive dyspnea, chronic cough, and exercise intolerance, making early and accurate diagnosis challenging in routine clinical practice.[1]

High-resolution computed tomography (HRCT) of the chest has emerged as the cornerstone imaging modality for the evaluation of ILDs. Unlike conventional chest radiography, HRCT provides exquisite spatial resolution that allows detailed assessment of lung parenchymal architecture, enabling identification of characteristic radiological patterns. These patterns such as usual interstitial pneumonia (UIP), nonspecific interstitial pneumonia (NSIP), organizing pneumonia, hypersensitivity pneumonitis, and sarcoidosis often correlate strongly with underlying histopathology and clinical prognosis. In many cases, HRCT findings are sufficiently specific to obviate the need for invasive diagnostic procedures such as surgical lung biopsy, particularly when interpreted in conjunction with clinical and serological data within a multidisciplinary discussion framework.[2]

Radiological pattern recognition on HRCT plays a pivotal role not only in diagnosis but also in disease

stratification, prognostication, and management planning. For example, a UIP pattern is typically associated with idiopathic pulmonary fibrosis and portends a poorer prognosis, whereas NSIP patterns are often linked with connective tissue disease–associated ILD and demonstrate better treatment responsiveness. Similarly, the presence of ground-glass opacities, reticulations, honeycombing, traction bronchiectasis, and mosaic attenuation provides critical clues regarding disease activity, chronicity, and reversibility. Accurate interpretation of these patterns requires systematic analysis and familiarity with established radiological criteria.[3]

Despite the growing reliance on HRCT, there remains considerable variability in the prevalence and distribution of ILD patterns across different populations and geographic regions. In developing countries, delayed presentation, environmental exposures, occupational risk factors, post-infectious sequelae, and limited access to specialized care may influence the spectrum of ILDs encountered. Furthermore, real-world data from tertiary care centers are essential to understand local disease patterns and optimize diagnostic algorithms tailored to regional needs.[4]

Aim

To evaluate the spectrum and distribution of radiological patterns of interstitial lung diseases using high-resolution computed tomography of the chest.

Objectives

1. To identify and categorize HRCT patterns of interstitial lung diseases in patients with suspected ILD.
2. To determine the relative frequency of various radiological patterns observed on HRCT.

To analyze the association of HRCT patterns with basic demographic and clinical characteristics.

MATERIALS AND METHODS

Source of Data

The data were obtained from patients clinically suspected to have interstitial lung disease who were referred for HRCT chest examination to the Department of Radiodiagnosis of a tertiary care hospital.

Study Design

This was a hospital-based cross-sectional observational study.

Study Location

The study was conducted in the Department of Radiodiagnosis in collaboration with the Department of Pulmonary Medicine at a tertiary care teaching hospital.

Study Duration

The study was carried out over a period of 12 months, from January 2024 to December 2024.

Sample Size

A total of 200 consecutive patients fulfilling the inclusion criteria were included in the study.

Inclusion Criteria

- Patients aged ≥18 years.
- Patients with clinical suspicion of interstitial lung disease based on symptoms such as progressive dyspnea or chronic cough.
- Patients referred for HRCT chest for evaluation of diffuse parenchymal lung disease.
- Patients who provided informed consent.

Exclusion Criteria

- Patients with acute pulmonary infections at the time of imaging.
- Patients with known pulmonary malignancy or lung metastasis.
- Patients with poor-quality or incomplete HRCT scans.
- Pregnant women.

Procedure and Methodology

All enrolled patients underwent HRCT of the thorax using a multidetector CT scanner. Scans were acquired at full inspiration with the patient in the supine position using thin collimation sections. Images were reconstructed using high-spatial-frequency algorithms and reviewed in lung and mediastinal windows. Additional prone or expiratory scans were obtained when required. HRCT images were independently evaluated by experienced radiologists, and radiological patterns were classified according to standard international criteria.

Sample Processing

HRCT images were stored in the Picture Archiving and Communication System (PACS). Relevant imaging features such as ground-glass opacities, reticulations, honeycombing, nodules, traction bronchiectasis, and distribution patterns were systematically documented using a structured proforma.

Data Collection

Demographic details, clinical history, and HRCT findings were recorded in a predesigned case record form. Each case was assigned a predominant HRCT pattern based on overall imaging appearance.

Statistical Methods

Data were entered into Microsoft Excel and analyzed using appropriate statistical software. Categorical variables were expressed as frequencies and percentages, while continuous variables were summarized as mean ± standard deviation. Associations between HRCT patterns and selected variables were assessed using chi-square test or Fisher's exact test, with a p-value <0.05 considered statistically significant.

RESULTS

Table 1: Spectrum and distribution of ILD on HRCT in the study cohort (N=200)

Variable	Total (N=200) n(%) / Mean(SD)	Fibrotic ILD (n=117)	Non-fibrotic ILD (n=83)	Test of significance	Effect size (95% CI)	p-value
Age (years)	56.5 (12.6)	59.2 (11.4)	52.6 (13.1)	Welch t = 3.70	Mean diff = +6.6 (3.1 to 10.1)	<0.001
Male sex	128 (64.0)	81 (69.2)	47 (56.6)	χ^2 (2-prop z=1.83)	RR = 1.22 (0.98 to 1.53)	0.067
Ever-smoker	94 (47.0)	66 (56.4)	28 (33.7)	χ^2 (z=3.17)	RR = 1.67 (1.19 to 2.35)	0.002
Occupational exposure (dust/fumes)	58 (29.0)	41 (35.0)	17 (20.5)	χ^2 (z=2.24)	RR = 1.71 (1.05 to 2.79)	0.025
Connective tissue disease (CTD)	44 (22.0)	18 (15.4)	26 (31.3)	χ^2 (z=2.68)	RR = 0.49 (0.29 to 0.84)	0.007
Symptom duration (months)	15.9 (9.9)	18.3 (10.2)	12.6 (8.7)	Welch t = 4.06	Mean diff = +5.7 (2.9 to 8.5)	<0.001
Resting SpO_2 (%)	92.9 (3.4)	92.1 (3.6)	94.0 (2.8)	Welch t = -3.85	Mean diff = -1.9 (-2.9 to -0.9)	<0.001
FVC (% predicted)	66.9 (15.7)	63.4 (14.8)	71.9 (15.2)	Welch t = -3.97	Mean diff = -8.5 (-12.7 to -4.2)	<0.001
DLCO (% predicted)	49.8 (13.8)	45.7 (12.9)	55.6 (13.4)	Welch t = -5.21	Mean diff = -9.9 (-13.6 to -6.2)	<0.001

Table 1 shows that among 200 suspected ILD patients evaluated on HRCT, fibrotic ILD constituted the larger subgroup (n=117) compared with non-fibrotic ILD (n=83). The fibrotic ILD group was significantly older (59.2±11.4 vs 52.6±13.1 years), with a mean age difference of +6.6 years (95% CI 3.1 to 10.1; p<0.001). Although males were more common overall (64.0%) and in the fibrotic group (69.2% vs 56.6%), this difference did not reach statistical significance (RR 1.22, 95% CI 0.98 to 1.53; p=0.067). Ever-smoking was significantly associated with fibrotic ILD (56.4% vs 33.7%; RR 1.67, 95% CI 1.19 to 2.35; p=0.002), as was occupational dust/fume exposure (35.0% vs 20.5%; RR 1.71, 95% CI 1.05 to 2.79; p=0.025). In contrast, connective tissue disease (CTD) was more frequent in the non-fibrotic group (31.3% vs 15.4%), showing a significantly lower relative risk of CTD among fibrotic ILD (RR 0.49, 95% CI 0.29 to 0.84; p=0.007). Clinically, fibrotic ILD had longer symptom duration (18.3±10.2 vs 12.6±8.7 months; mean difference +5.7, 95% CI 2.9 to 8.5; p<0.001) and worse physiological impairment, with lower resting SpO_2 (92.1±3.6 vs 94.0±2.8; mean difference -1.9, 95% CI -2.9 to -0.9; p<0.001), lower FVC% predicted (63.4±14.8 vs 71.9±15.2; mean difference -8.5, 95% CI -12.7 to -4.2; p<0.001), and lower DLCO% predicted (45.7±12.9 vs 55.6±13.4; mean difference -9.9, 95% CI -13.6 to -6.2; p<0.001).

Table 3: Relative frequency of radiological ILD patterns on HRCT (N=200)

HRCT pattern	n (%)	95% CI for proportion	Test of significance	p-value
Definite UIP	56 (28.0)	22.2% to 34.6%	z = +8.49 vs 10%	<0.001
Probable UIP	31 (15.5)	11.1% to 21.2%	z = +2.59 vs 10%	0.010
NSIP	44 (22.0)	16.8% to 28.2%	z = +6.06 vs 10%	<0.001
Chronic hypersensitivity pneumonitis	28 (14.0)	9.8% to 19.6%	z = +1.89 vs 10%	0.059
Sarcoidosis	16 (8.0)	5.0% to 12.6%	z = -0.94 vs 10%	0.347
Organizing pneumonia	11 (5.5)	3.1% to 9.6%	z = -2.12 vs 10%	0.034
Lymphoid interstitial pneumonia	6 (3.0)	1.4% to 6.4%	z = -3.30 vs 10%	<0.001
Smoking-related ILD (RB-ILD/DIP)	7 (3.5)	1.7% to 7.0%	z = -3.06 vs 10%	0.002
Acute interstitial pneumonia pattern	1 (0.5)	0.1% to 2.8%	z = -4.48 vs 10%	<0.001

Table 2: HRCT categorization based on key imaging features (N=200)

HRCT feature	Total n(%)	Fibrotic (n=117) n(%)	Non-fibrotic (n=83) n(%)	Test of significance	RR (95% CI)	p-value
Reticulation	142 (71.0)	103 (88.0)	39 (47.0)	χ^2 (z=6.30)	1.87 (1.48 to 2.38)	<0.001
Honeycombing	71 (35.5)	62 (53.0)	9 (10.8)	χ^2 (z=6.14)	4.89 (2.58 to 9.27)	<0.001
Traction bronchiectasis	92 (46.0)	71 (60.7)	21 (25.3)	χ^2 (z=4.89)	2.40 (1.61 to 3.57)	<0.001
Ground-glass opacity	107 (53.5)	48 (41.0)	59 (71.1)	χ^2 (z=4.18)	0.58 (0.45 to 0.75)	<0.001
Mosaic attenuation / air-trapping	60 (30.0)	27 (23.1)	33 (39.8)	χ^2 (z=2.54)	0.58 (0.38 to 0.89)	0.011
Centrilobular nodules	47 (23.5)	19 (16.2)	28 (33.7)	χ^2 (z=2.88)	0.48 (0.29 to 0.80)	0.004
Consolidation / perilobular opacities	36 (18.0)	14 (12.0)	22 (26.5)	χ^2 (z=2.64)	0.45 (0.25 to 0.83)	0.008
Emphysema	47 (23.5)	36 (30.8)	11 (13.3)	χ^2 (z=2.88)	2.32 (1.26 to 4.29)	0.004

Table 2 categorizes ILD cases based on key HRCT imaging features and demonstrates a clear separation between fibrotic and non-fibrotic disease. Reticulation was the most frequent feature overall (71.0%) and was markedly higher in fibrotic ILD (88.0% vs 47.0%; RR 1.87, 95% CI 1.48 to 2.38; p<0.001). Honeycombing highly suggestive of established fibrosis was strongly associated with fibrotic ILD (53.0% vs 10.8%; RR 4.89, 95% CI 2.58 to 9.27; p<0.001). Similarly, traction bronchiectasis was significantly more common in fibrotic ILD (60.7% vs 25.3%; RR 2.40, 95% CI 1.61 to 3.57; p<0.001). Conversely, ground-glass opacities (GGO) were more prominent in non-fibrotic ILD (71.1% vs 41.0%), with a significantly lower probability in the fibrotic group (RR 0.58, 95% CI 0.45 to 0.75; p<0.001), suggesting relatively more inflammatory or potentially reversible disease in the non-fibrotic spectrum. Mosaic attenuation/air-trapping (39.8% vs 23.1%; p=0.011), centrilobular nodules (33.7% vs 16.2%; p=0.004), and consolidation/perilobular opacities (26.5% vs 12.0%; p=0.008) were also significantly more frequent in non-fibrotic ILD, supporting airway-centered or organizing patterns in that subgroup. Emphysema was significantly associated with fibrotic ILD (30.8% vs 13.3%; RR 2.32, 95% CI 1.26 to 4.29; p=0.004).

Table 3 presents the relative frequency of HRCT-defined radiological ILD patterns. The most common pattern was definite UIP (28.0%, 95% CI 22.2%–34.6%), followed by NSIP (22.0%, 95% CI 16.8%–28.2%), and probable UIP (15.5%, 95% CI 11.1%–21.2%). Chronic hypersensitivity pneumonitis accounted for 14.0% (95% CI 9.8%–19.6%) and was borderline in statistical comparison against the reference prevalence (p=0.059). Sarcoidosis represented 8.0% (95% CI 5.0%–12.6%) and did not differ significantly (p=0.347). Less frequent patterns included organizing pneumonia (5.5%), smoking-related ILD (3.5%), lymphoid interstitial pneumonia (3.0%), and acute interstitial pneumonia (0.5%).

Table 4: Association of UIP pattern with demographic & clinical characteristics (N=200)

Variable	UIP spectrum (n=87)	Non-UIP (n=113)	Test of significance	Effect size (95% CI)	p-value
Age (years) Mean(SD)	62.8 (9.8)	51.9 (13.2)	Welch t = 6.70	Mean diff = +10.9 (7.7 to 14.1)	<0.001
Male sex n(%)	67 (77.0)	61 (54.0)	χ^2 (z=3.36)	RR = 1.43 (1.16 to 1.75)	<0.001
Ever-smoker n(%)	53 (60.9)	41 (36.3)	χ^2 (z=3.46)	RR = 1.68 (1.25 to 2.26)	<0.001
CTD present n(%)	9 (10.3)	35 (31.0)	χ^2 (z=3.49)	RR = 0.33 (0.17 to 0.66)	<0.001
Symptom duration (months) Mean(SD)	20.4 (10.8)	12.9 (8.5)	Welch t = 5.25	Mean diff = +7.5 (4.7 to 10.3)	<0.001
Resting SpO_2 (%) Mean(SD)	91.6 (3.8)	94.1 (2.6)	Welch t = -5.01	Mean diff = -2.5 (-3.4 to -1.6)	<0.001
FVC (% predicted) Mean(SD)	60.2 (13.9)	73.8 (14.9)	Welch t = -6.63	Mean diff = -13.6 (-17.6 to -9.6)	<0.001
DLCO (% predicted) Mean(SD)	42.1 (11.8)	56.4 (13.2)	Welch t = -8.30	Mean diff = -14.3 (-17.8 to -10.8)	<0.001
Clubbing n(%)	49 (56.3)	24 (21.2)	χ^2 (z=5.11)	RR = 2.65 (1.78 to 3.96)	<0.001
Bibasal crackles n(%)	76 (87.4)	62 (54.9)	χ^2 (z=4.93)	RR = 1.59 (1.32 to 1.92)	<0.001

Table 4 specifically evaluates factors associated with the UIP spectrum (definite+probable UIP; n=87) compared with non-UIP patterns (n=113). UIP patients were significantly older (62.8±9.8 vs 51.9±13.2 years; mean difference +10.9, 95% CI 7.7 to 14.1; p<0.001) and more often male (77.0% vs 54.0%; RR 1.43, 95% CI 1.16 to 1.75; p<0.001). Ever-smoking was also significantly higher in the UIP spectrum (60.9% vs 36.3%; RR 1.68, 95% CI 1.25 to 2.26; p<0.001), while CTD was significantly less common (10.3% vs 31.0%; RR 0.33, 95% CI 0.17 to 0.66; p<0.001), supporting the classic demographic

and etiologic profile of UIP/IPF-leaning disease. UIP cases had longer symptom duration (20.4±10.8 vs 12.9±8.5 months; mean difference +7.5, 95% CI 4.7 to 10.3; p<0.001) and significantly worse oxygenation and lung function, including lower resting SpO_2 (-2.5%), lower FVC% predicted (-13.6%), and lower DLCO% predicted (-14.3%), all with p<0.001. Clinically, clubbing (56.3% vs 21.2%; RR 2.65, 95% CI 1.78 to 3.96; p<0.001) and bibasal crackles (87.4% vs 54.9%; RR 1.59, 95% CI 1.32 to 1.92; p<0.001) were much more frequent in UIP, reinforcing the strong clinico-radiological concordance of UIP phenotype with more advanced fibrotic disease.

DISCUSSION

Spectrum of fibrotic versus non-fibrotic ILD (Table 1). In this cohort, fibrotic ILD constituted nearly three-fifths of cases, with patients being significantly older than those with non-fibrotic ILD. This age predilection mirrors observations by Delaney L et al.(2024)[5], who reported that fibrotic ILDs particularly UIP/IPF predominantly affect older individuals. Male predominance was observed in the fibrotic group, though it narrowly missed statistical significance, a finding similar to that reported by Brixey AG et al.(2024)[6], where male excess was present but varied across populations. Smoking and occupational exposure were significantly associated with fibrotic ILD in the present study, supporting prior evidence linking tobacco smoke and inhalational exposures to fibrotic lung remodeling and UIP-like patterns. Conversely, connective tissue disease was more frequent in non-fibrotic ILD, consistent with CTD-ILD commonly manifesting as NSIP or inflammatory patterns rather than established fibrosis. Longer symptom duration and significantly worse oxygenation and lung function (lower FVC and DLCO) in fibrotic ILD align with earlier studies demonstrating delayed presentation and irreversible physiological impairment once fibrosis is established Neto FA et al.(2025)[7].

HRCT imaging features distinguishing fibrotic and non-fibrotic ILD (Table 2). Reticulation, honeycombing, and traction bronchiectasis were strongly associated with fibrotic ILD, findings that are pathognomonic of architectural distortion and irreversible fibrosis. Khanna D et al.(2022)[8] emphasized these features as hallmarks of fibrotic lung disease on HRCT, particularly in UIP. The markedly higher prevalence of honeycombing in fibrotic ILD in the current study is comparable to data reported by Delaney L et al.(2024)[5], underscoring its diagnostic specificity. In contrast, ground-glass opacities, mosaic attenuation, centrilobular nodules, and consolidation were significantly more common in non-fibrotic ILD, suggesting inflammatory, airway-centered, or potentially reversible disease processes such as hypersensitivity pneumonitis or organizing pneumonia. Similar imaging distributions were reported by Neto FA et al.(2025)[7], who noted that GGO-predominant patterns often correlate with better treatment responsiveness. The association of emphysema with fibrotic ILD in this study is in keeping with descriptions of combined pulmonary fibrosis and emphysema (CPFE), particularly in smokers, as reported by Felder FN et al.(2023)[9].

Relative frequency of HRCT patterns (Table 3). UIP spectrum (definite and probable UIP combined) represented the largest proportion of ILD patterns, followed by NSIP. This distribution closely parallels findings from tertiary care cohorts reported by Almeida RF et al.(2020)[1], where UIP and NSIP together accounted for the majority of ILDs. Chronic hypersensitivity pneumonitis formed a substantial subset, reflecting environmental and occupational exposures common in developing regions. Less frequent patterns such as organizing pneumonia, LIP, smoking-related ILD, and acute interstitial pneumonia were also observed, consistent with their reported lower prevalence in large registries Gaillandre Y et al.(2023)[3]. These data collectively highlight the heterogeneity of ILD and the necessity of pattern-based HRCT classification.

Association of UIP spectrum with demographic and clinical variables (Table 4). Patients with UIP spectrum disease were significantly older, predominantly male, and more often smokers classic epidemiological features of UIP/IPF described in multiple landmark studies Agarwala S et al.(2020)[2]. The significantly lower prevalence of CTD among UIP patients further supports the idiopathic nature of UIP compared with NSIP-dominant CTD-ILD. UIP patients also demonstrated longer symptom duration, more severe hypoxemia, and markedly reduced FVC and DLCO, reflecting advanced, progressive disease. Clinical signs such as clubbing and bibasal crackles were strongly associated with UIP, echoing observations by Tateishi T et al.(2020)[10], who identified these findings as common bedside correlates of fibrotic ILD. The strong clinico-radiological concordance seen in this study reinforces the prognostic significance of UIP pattern recognition on HRCT.

CONCLUSION

This cross-sectional study demonstrates that high-resolution computed tomography (HRCT) is a pivotal and highly effective modality for evaluating interstitial lung diseases (ILDs) by enabling accurate identification and classification of radiological patterns. In the present cohort, fibrotic ILDs constituted the predominant subgroup and were characterized by older age, longer symptom duration, higher prevalence of smoking and occupational exposure, and significantly worse physiological impairment, as reflected by reduced oxygen saturation and pulmonary function parameters. HRCT features such as reticulation, honeycombing, and traction bronchiectasis showed a strong association with fibrotic ILD, whereas ground-glass opacities, mosaic

attenuation, centrilobular nodules, and consolidation were more frequently observed in non-fibrotic ILDs, suggesting potentially reversible or inflammatory disease processes.

The usual interstitial pneumonia (UIP) spectrum emerged as the most common HRCT pattern, followed by nonspecific interstitial pneumonia (NSIP) and chronic hypersensitivity pneumonitis, underscoring the heterogeneous nature of ILDs encountered in a tertiary care setting. Patients with UIP spectrum disease exhibited distinct demographic and clinical characteristics, including male predominance, smoking association, advanced age, more severe functional impairment, and classic clinical signs such as clubbing and bibasal crackles. Overall, the study reinforces the crucial role of HRCT in non-invasive ILD diagnosis, phenotyping, and risk stratification, thereby guiding clinical decision-making and reducing the need for invasive diagnostic procedures when interpreted in appropriate clinical context.

LIMITATIONS OF THE STUDY

1. Being a cross-sectional study, temporal progression of disease and longitudinal outcomes could not be assessed.
2. Histopathological correlation was not available for all cases, and diagnosis was primarily based on HRCT patterns and clinical correlation.
3. The study was conducted at a single tertiary care center, which may limit the generalizability of findings to other populations or primary care settings.
4. Referral bias may have influenced the higher proportion of fibrotic ILD and UIP patterns in the study cohort.
5. Inter-observer variability in HRCT interpretation was not formally analyzed.
6. Environmental and occupational exposure histories were self-reported and therefore subject to recall bias.

Advanced serological and genetic markers were not uniformly available for all patients, which may have influenced etiological classification.

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