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Characterizing non-cystic fibrosis bronchiectasis: spirometry indices and disease burden by FACED score

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Abstract

This study aimed to characterize the clinical, radiological, and severity profile by spirometry indices and evaluate the clinical and structural disease burden stratified by FACED [FEV1% predicted (F), age (A), chronic colonization by *Pseudomonas aeruginosa* (C), extension of the disease by radiological assessment (E), and dyspnea (D)] severity in patients with non-cystic fibrosis (CF) bronchiectasis. A retrospective review of 125 patients with non-CF bronchiectasis who underwent a pulmonary lung function test at the Aga Khan University Hospital (Karachi, Pakistan) was conducted. Spirometry patterns were normal, obstructive, restrictive, and mixed. FACED classifications were mild (0-2) and moderate-severe disease (3). *Pseudomonas aeruginosa* was found in 26.40%. Obstructive ventilatory disorder (54.40%) was the most frequent finding. Symptom duration of >10 years was relatively frequent in the obstructive group (34.69%; p=0.012). Moderate-to-severe disease (FACED 3) was most prevalent in the obstructive pattern (60.29%; p=0.012). Patients with moderate-to-severe disease more frequently reported longer symptom duration compared with those with mild disease (p=0.015). Non-CF bronchiectasis patients with obstructive ventilatory disease may present with a longer duration of symptoms and disease severity. Patients with moderate-severe disease had longer symptom duration, with trends towards higher lung parenchymal injury (residual fibrosis on high-resolution computed tomography) and hospitalization due to respiratory infection.

Key words: bronchiectasis, lung function, spirometry, forced expiratory volume, *Pseudomonas aeruginosa*, lower middle-income country.

Introduction

Bronchiectasis is a chronic lung condition following aggressive necrotizing infection and inflammation that can bring about permanent changes in the structure of the airway and can damage the surrounding lung parenchyma. It causes pathologic thickening and dilation of the bronchial wall clinically presenting as cough and sputum production [1,2]. The disease is characterized by the overproduction of mucus with decreased clearance leading to a purulent cough with copious amounts of foul-smelling sputum making patients prone to recurrent infections. It is perilous in populations with pre-existing respiratory conditions such as chronic obstructive pulmonary disease (COPD) or asthma [3,4].

Cole's 'vicious cycle' is a key concept in understanding the pathophysiology of bronchiectasis. This model underlines four main factors that drive the disease: airway infections, inflammation, problems with mucus clearance, and structural lung damage. More recently, it has been renamed as the "vicious vortex" model because these factors are so closely connected, with each one influencing the others. Therefore, both genetic factors and environmental influences may play a role in the development and worsening of bronchiectasis [5].

Initial investigations conducted in a patient presenting with symptoms suspicious of bronchiectasis include chest radiograph, lung function tests (forced expiratory volume in the first second [FEV_1], forced vital capacity [FVC], lung volumes, and diffusion capacity), and sputum bacteriological culture. These provide a clue about the diagnosis but lack sensitivity and specificity [6,7]. Previously diagnosed by bronchogram or resected lung tissue by pathologists, the current gold standard for diagnosis of bronchiectasis is high-resolution computed tomography (HRCT) [8].

Bronchiectasis can have numerous underlying causes, but in nearly 50% of cases, no specific cause is found. Possible causes include past infections like severe pneumonia or tuberculosis, genetic conditions such as cystic fibrosis (CF) and primary ciliary dyskinesia (PCD), aspiration-related syndromes, immune system deficiencies (both primary and secondary), hypersensitivity disorders like allergic bronchopulmonary aspergillosis (ABPA), and autoimmune or connective tissue diseases [9,10].

Bronchiectasis is known to cause disrupted airflow leading to lung function abnormalities. It is widely described as an obstructive ventilatory disorder; however, patients have been seen to have other patterns of lung function abnormality on spirometry [11,12]. Limited data is available regarding the clinical patterns of bronchiectasis in developing countries that could prove crucial to the disease course and management. Furthermore, the utility of FACED score to assess the severity of non-CF bronchiectasis in low-resource settings like Pakistan is non-existent. The FACED score includes five key variables [13]: FEV_1 (% predicted) [F], Age [A], Chronic colonization with *Pseudomonas aeruginosa* [C], radiological Extension of disease

(number of lobes involved) [E], and Dyspnea (mMRC scale) [D]. It would be ideal to understand how well FACED score reflects real-world disease impact by examining clinical and structural disease burden by FACED severity groups in patients with non-CF bronchiectasis. Therefore, the present study was performed to serve two purposes: 1) to characterize clinical, radiological, and severity profile by spirometry indices, and 2) to evaluate clinical and structural disease burden (symptom duration, radiological changes, and hospitalizations) stratified by FACED severity in patients with non-CF bronchiectasis.

Materials and Methods

Ethics approval

Before commencing the study, an ethical approval was obtained from the Ethical Review Committee (ERC) of the Aga Khan University Hospital (AKUH) (ERC # 2022-7529-21827). As this study was a retrospective evaluation, written informed consent was waived.

Study design, patients, and setting

A retrospective observational research study was conducted. Data of non-CF bronchiectasis patients who underwent pulmonary function test (PFT) between 2000 and 2021 were retrieved from the Health Information Management System (HIMS) database of the AKUH, Karachi, Pakistan. The AKUH is one of the largest not-for-profit tertiary care hospitals in Pakistan with more than 700 beds [14,15]. Patients were divided into four categories according to their spirometry patterns: normal, obstructive, restrictive, and mixed.

Inclusion and exclusion criteria

Individuals aged 18 years or older with clinically suspected bronchiectasis which was confirmed on HRCT scans were eligible for review in the study provided that their PFT results were accessible. Patients with cystic fibrosis-associated bronchiectasis, presence of active malignancy, primary diagnosis of pulmonary fibrosis or pulmonary interstitial disease, or those who lacked data related to FACED score were excluded from the study.

Pulmonary function tests

Spirometry was performed in accordance with American Thoracic Society (ATS)/European Respiratory Society (ERS) guidelines [16]. Only post-bronchodilator values were used for interpretation. All tests were conducted during clinically stable periods, with no exacerbation or change in medication within the last four weeks. Patients were classified into ventilatory patterns based on the following criteria: 1) Normal pattern was defined as post-bronchodilator FEV_1/FVC 0.70 and FVC 80% predicted, 2) Obstructive pattern was defined as post-

bronchodilator $FEV_1/FVC < 0.70$, 3) Restrictive pattern was defined as $FEV_1/FVC \geq 0.70$ and FVC <80% predicted, and 4) Mixed pattern was defined as $FEV_1/FVC < 0.70$ and FVC <80% predicted.

FACED score (bronchiectasis severity)

Bronchiectasis severity was determined through the FACED score. The FACED score was calculated using five variables [13]: FEV_1 (% predicted), Age, Chronic colonization with *Pseudomonas aeruginosa*, radiological Extension of disease (number of lobes involved), and Dyspnea (mMRC scale). FEV_1 was based on post-bronchodilator values. Age was recorded at the time of spirometry. Chronic *Pseudomonas aeruginosa* infection was defined as the presence of *Pseudomonas aeruginosa* in two or more sputum cultures collected at least three months apart within a 12-month period. Radiological assessment was performed using HRCT scan and determined the involvement of number of lobes, with each lobe considered individually. Dyspnea was assessed using the Modified Medical Research Council (mMRC) dyspnea scale. The FACED score can range from 0-7 and bronchiectasis can be divided into three severity groups: mild bronchiectasis (0-2 points), moderate bronchiectasis (3-4 points), and severe bronchiectasis (5-7 points). Due to small patient count, we combined moderate and severe bronchiectasis groups together.

Microbiology examination

Microbiological assessment was performed on sputum or lower tract (bronchoalveolar lavage) specimens as per standard methods. Bacterial and fungal cultures were conducted. All samples were subjected to initial Gram staining, and sputum cultures were processed only if they met the Murray and Washington quality criteria [17]. Pathogenic microorganisms identified were *Pseudomonas aeruginosa*, *Haemophilus influenzae*, and *Aspergillus spp*. Organisms were identified via standard microbiological procedures in line with institutional laboratory protocols.

Statistical analysis

Data entry, management, and analysis were performed using IBM SPSS (Statistical Package for Social Sciences) version 19.0 (IBM Corp., Armonk, NY, USA) and Stata/MP 17.0 (Stata Corporation, College Station, TX, USA). Categorical variables were expressed as frequencies and percentages, while numerical variables were presented as mean ± standard deviations. Categorical variables were compared using Pearson Chi-squared test or Fisher exact test. One-way analysis of variance (ANOVA) test was performed to determine if there were any statistically significant differences of mean among PFT groups. Bonferroni or Games-Howell

post hoc corrections were applied to adjust *p* values depending on the assumption of equal variances. All statistical tests were two-sided, and $p < 0.05$ were regarded as statistically significant.

Results

A total of 125 participants were included in our study meeting the inclusion criteria of a diagnosis of non-CF bronchiectasis using HRCT and available spirometry parameters. Baseline demographic and clinical characteristics of patients are shown in Table 1. The mean age of participants was 55.43 ± 18.14 years with a mean BMI of 24.33 ± 6.86 kg/m^2. A total of 60.00% (n=75) of the participants were female, and 3.31% (n=4) of the patients were current smokers. The most common comorbidity was hypertension (n=48, 38.40%), followed by asthma (n=32, 25.60%) and diabetes mellitus (n=23, 18.40%). Nearly two-third (n=76, 65.52%) of the patients had unilateral involvement of the lung. *Pseudomonas aeruginosa* growth was detected in 26.40% (n=33) of the patients, followed by *Aspergillus* (n=18, 14.40%) and *Hemophilus influenzae* (n=12, 9.60%).

Among the 125 patients with non-CF bronchiectasis, the obstructive spirometric pattern was most common (n=68, 54.40%), followed by mixed (n=28, 22.40%), restrictive (n=19, 15.20%), and normal spirometry (n=10, 8.00%). Baseline demographic characteristics were similar across spirometric groups, including age (p=0.135), male sex (p=0.796), body mass index (p=0.405), smoking status (p=0.282), and biomass exposure (p=0.772). With respect to comorbidities, asthma and COPD showed a significant association with spirometric pattern, being most prevalent in the obstructive group (n=23, 33.82%; p=0.044) and (n=15, 22.06%; p=0.019), respectively. Spirometric parameters differed significantly across PFT patterns. Mean FEV_1% predicted was highest in patients with normal spirometry (93.0±14.2%) and lowest in the obstructive group (46.8±22.1%), with intermediate values in restrictive (62.1±16.2%) and mixed patterns (53.9±13.4%) (p<0.001). Similar significant differences were observed for FEV_1 (p<0.001), FVC (p=0.001), FVC % Predicted (p<0.001), and FEV_1/FVC % (p<0.001). Microbiological findings, including isolation of *Pseudomonas aeruginosa*, *Haemophilus influenzae*, and *Aspergillus spp.*, were comparable across spirometric groups (p=0.318, p=0.650, and p=0.874, respectively). Table 2 compares baseline demographic and clinical characteristics of patients by spirometry indices.

Symptoms were frequent across all spirometric patterns and did not differ significantly between groups (Table 3). Cough was reported in most patients, including those with normal spirometry (n=9, 90.00%), obstructive (n=46, 67.65%), restrictive (n=15, 78.95%), and mixed patterns (n=23, 82.14%) (p=0.320). Dyspnea was observed more frequently in patients with mixed (n=18, 64.29%) and obstructive patterns (n=35, 51.47%), though this difference was not

statistically significant (p=0.505). The prevalence of hemoptysis, fever, wheeze, and clubbing was comparable across spirometric categories (p>0.05). Symptom duration varied significantly according to spirometric pattern (p=0.012). A symptom duration of more than 10 years was more commonly reported in patients with obstructive (n=17, 34.69%) and mixed patterns (n=8, 33.33%), whereas patients with restrictive pattern most frequently reported symptom duration of less than one year (n=7, 46.67%). Radiological characteristics were similar among all PFT patterns. Bilateral lung involvement was observed in patients with normal (n=4, 40.00%), obstructive (n=22, 34.92%), restrictive (n=6, 33.33%), and mixed spirometry (n=8, 32.00%) (p=0.979). Residual fibrosis on HRCT (p=0.974) and hospitalizations due to respiratory infections (p=0.958) did not differ significantly across groups. According to FACED score, moderate-to-severe disease (FACED 3) was most prevalent in patients with an obstructive pattern (n=41, 60.29%), compared with mixed (n=10, 35.71%), restrictive (n=6, 31.58%), and normal spirometry (n=2, 20.00%) (p=0.012).

Table 4 summarizes clinical and structural disease burden markers stratified by FACED severity in patients with non-CF bronchiectasis. Clinical and structural disease burden differed according to FACED severity. Patients with moderate-to-severe disease (FACED 3) more frequently reported longer symptom duration compared with those with mild disease (p=0.015). A symptom duration of more than 10 years was observed in patients with moderate-to-severe FACED scores (n=19, 38.78%) compared with mild disease (n=10, 20.83%), whereas symptom duration of less than one year was more common in the mild group (n=14, 29.17%) than in the moderate-to-severe group (n=4, 8.16%). Patterns of lung involvement on imaging were comparable between FACED categories (p=0.360). Residual fibrosis on HRCT (n=28, 52.83%; p=0.061) and hospitalizations due to respiratory infections (n=21, 43.75%; p=0.183) were more frequently observed in patients with moderate-to-severe FACED scores compared with those with mild disease, although this difference did not reach statistical significance.

Discussion

Non-CF bronchiectasis is a progressive lung pathology with substantial morbidity and mortality [18]. Therefore, identifying patients at risk of poor prognosis is critical for timely intervention. The present study provides insight into the clinical, radiological, and severity profile of non-CF bronchiectasis patients on basis of their spirometry patterns, and for the first time captures how well FACED score reflects the actual disease impact by examining the differences in clinical and structural disease burden by FACED severity groups in patients with non-CF bronchiectasis. Over half (54.40%) of the patients with non-CF bronchiectasis exhibited obstructive ventilatory disorder on spirometry. The frequency of positive culture for *Pseudomonas aeruginosa* was predominant. No significant differences were observed in

clinical symptoms and radiological characteristics based on spirometry. On the other hand, patients with obstructive ventilatory disease demonstrated longer duration of symptoms and disease severity (FACED 3). Interestingly, on FACED severity, patients with moderate-severe non-CF bronchiectasis had longer duration of symptoms, with trends towards higher lung parenchymal damage (residual fibrosis on HRCT) and hospitalization burden due to respiratory infection.

Bronchiectasis is considered to be a type of obstructive lung disease with a generally obstructive spirometry pattern [19]. In our study sample, the majority of the patients (54.40%) had obstructive spirometry with lowest FEV_1 % Predicted and FEV_1/FVC % than other spirometry indices, followed by a mixed pattern. This finding closely aligns with a recent research study by Kim *et al.* (2022) who reported approximately 52% of patients with obstructive ventilatory disorder in their research study [12]. Another study from India reported 62.7% of the patients with obstructive defect [20]. The obstructive pattern in bronchiectasis patients has been attributed to the aberrant mucociliary function, excessive mucus production, and obstructive plugging of the airways [21,22]. In addition, mixed pattern disease is also a common presentation on spirometry in patients with bronchiectasis. Our study had 22.4% of the patients with mixed ventilatory defect which coincided narrowly with findings of Singh *et al.* (2021) [20], Khalid *et al.* (2000) [23], and Sevgili *et al.* (2009) [22] i.e., 21.6%, 23%, and 24.3%, respectively. Mixed ventilatory defect represents the combination of obstructive (airflow limitation owing to mucus plugging and narrowing) and restrictive (reduced lung volume owing to scarring of lung parenchyma) ventilatory disorder [20,22,23].

Hypertension (38.40%) and asthma (25.60%) emerged as common comorbidities. According to Bronchiectasis Aetiology Comorbidity Index (BACI), asthma is associated with higher mortality that might be attributed to increased number of exacerbations [24-26]. Even though cardiovascular disease is not included in BACI, studies have shown that 20% death in bronchiectasis are of cardiovascular origin. Chronic systemic inflammation, hypoxemia, and pulmonary hypertension in bronchiectasis may contribute to an elevated cardiovascular risk. Given this, regular cardiovascular assessments and targeted management strategies are important for improving outcomes in patients with non-cystic bronchiectasis [27-29].

Notably, 65.52% of the patients had unilateral disease involvement. Studies have shown that non-CF bronchiectasis presents mostly as bilateral involvement of the lung which is contrasting to our particular sample size. Bilateral disease is often associated with extensive airway damage, recurrent infections, and worse lung function outcomes [29,30]. The finding that 65.52% of patients in this study had unilateral disease involvement contrasts with this established pattern and may suggest differences in underlying etiologies, environmental exposures, or disease severity in this specific population. One possible explanation for this

discrepancy could be that the study sample included a higher proportion of post-infectious bronchiectasis cases, which are more likely to present with localized lung damage. Further comparative studies are needed to understand whether regional or genetic factors contribute to this finding. It would also be beneficial to assess how unilateral versus bilateral disease involvement affects clinical outcomes, exacerbation rates, and treatment responses in bronchiectasis patients.

Moreover, *Pseudomonas aeruginosa* was identified in 26.40% of the cases, highlighting its role in bronchiectasis exacerbations and severity. The common organisms associated with non-CF bronchiectasis are *Pseudomonas aeruginosa*, *Haemophilus influenza*, *Streptococcus pneumonia*, and *Staphylococcus aureus*. Other organisms such as *Mycobacterium tuberculosis* and *Mycoplasma pneumonia* have also been linked [31]. In the adult population, it has been observed that *Pseudomonas aeruginosa* is generally the culprit that coincides with our study population. A study performed in the same center earlier showed the same results along with other studies around the world [32-34]. On the other hand, in the pediatric population, *Haemophilus influenza* is more prevalent according to the scientific literature [31,35].

We also assessed bronchiectasis severity using the FACED score. The FACED score (FEV_1 % predicted [F], Age [A], Chronic colonization with *Pseudomonas aeruginosa* [C], radiological Extension of disease by calculating number of lobes involved [E], and Dyspnea using mMRC scale [D]) is a five point easy-to-use tool that assists in prognosis and clinical decision making of patients with non-CF bronchiectasis [13]. Our study demonstrated high proportion of patients with moderate-severe disease, according to FACED score (3), in non-CF bronchiectasis patients with obstructive ventilatory disorder. The plausible explanation of this finding in our study could be low FEV_1, relatively high chronic colonization of *Pseudomonas aeruginosa*, and involvement of >2 lobes which are characteristic features of non-CF bronchiectasis with obstructive ventilatory disorder. Interestingly, FACED is widely used for prognostic stratification in patients with non-CF bronchiectasis. However, its ability to reflect underlying clinical and structural disease burden has not been studied. In this study, patients were categorized into mild and moderate-severe disease based on FACED severity, and markers of clinical and structural burden (symptom duration, radiological changes, and hospitalizations) were compared between two groups. Patients in the moderate-severe FACED category demonstrated significantly longer symptom duration and non-significant trends towards higher rates of residual fibrosis on HRCT and hospitalization due to respiratory infection. These findings imply that increasing FACED severity may reflect greater cumulative burden of disease, indicating that FACED may capture broader clinical and structural impact beyond its established prognostic role.

This research study has few limitations which require readers to exercise caution while interpreting findings. Firstly, single center and small sample size of the study may affect generalization of the findings. Secondly, observational study design may introduce potential biases. There could also be an issue of selection bias because patients may not be representative of broader population of non-CF bronchiectasis. Only patients with moderate to severe disease present in hospital settings. Thirdly, subjectivity in interpretation of HRCT findings may have affected the precision of FACED score. Finally, we acknowledge that we did not use other multidimensional scoring systems like the Bronchiectasis Severity Index (BSI) and E-FACED. Our selection of the FACED score was based on its simplicity and availability of pertinent data; however, this might limit the comprehensiveness of severity assessment compared to more detailed tools.

Conclusions

In conclusion, over half (54.40%) of the non-CF bronchiectasis patients in our cohort had obstructive pattern on spirometry. Longer duration of symptoms and disease severity were key features in patients with non-CF bronchiectasis with obstructive ventilatory disease. Patients with moderate-severe non-CF bronchiectasis had longer duration of symptoms, with trends towards higher lung parenchymal injury (residual fibrosis on HRCT) and hospitalization burden due to respiratory infection, implying that FACED score is able to capture actual disease burden. Further research work is needed to cement the clinical utility of FACED score in low-resource settings.

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Table 1. Baseline demographic and clinical characteristics of patients with non-CF bronchiectasis.

Baseline Variables	n = 125
Age (Years, Mean ± SD)	55.43 ± 18.14
Gender (Male)	50 (40.00%)
BMI (Kg/m^2)	24.33 ± 6.86
Smoking Status[†]	
Never Smoker	103 (85.12%)
Ex-Smoker	14 (11.57%)
Current Smoker	4 (3.31%)
Biomass Exposure[†]	7 (7.37%)
Comorbidities	
Diabetes Mellitus	23 (18.40%)
Hypertension	48 (38.40%)
IHD	15 (12.00%)
Asthma	32 (25.60%)
COPD	17 (13.60%)
CVA	3 (2.40%)
Chronic Renal Failure	1 (0.80%)
Depression	4 (3.20%)
Lung Involvement[†]	
Unilateral	76 (65.52%)
Bilateral	40 (34.48%)
Spirometry Indices (Mean ± SD)	
FEV_1, L	1.31 ± 0.70
FEV_1, % Predicted	54.49 ± 22.70
FVC, L	1.82 ± 0.87
FVC, % Predicted	61.63 ± 23.05
FEV_1/FVC, %	71.96 ± 14.34
Bronchiectasis (Spirometry Pattern)	
Normal	10 (8.0%)
Obstructive	68 (54.4%)
Restrictive	19 (15.2%)
Mixed	28 (22.4%)
Microbiology	
Pseudomonas aeruginosa	33 (26.40%)
Hemophilus influenzae	12 (9.60%)
Aspergillus	18 (14.40%)

CF, cystic fibrosis; SD, standard deviation; BMI, body mass index; IHD, ischemic heart disease; COPD, chronic obstructive pulmonary disease; CVA, cerebrovascular accident; FVC, forced vital capacity; FEV_1, forced expiratory volume in 1 second. [†]Data was not available: Smoking Status (n=4), Biomass Exposure (n=30), and Lung Involvement (n=9).

Table 2. Baseline demographic and clinical characteristics of patients with non-CF bronchiectasis according to PFT pattern.

Clinical Variables	Normal (n = 10)	Obstructive (n = 68)	Restrictive (n = 19)	Mixed (n = 28)	p
Age (Years, Mean ± SD)	51.00 ± 21.89	56.43 ± 18.29	61.37 ± 12.62	50.57 ± 18.88	0.135††
Gender (Male)	5 (50.00%)	28 (41.18%)	6 (31.58%)	11 (39.29%)	0.796
BMI (Kg/m^2)	27.17 ± 7.94	23.69 ± 6.07	23.77 ± 6.06	25.25 ± 8.61	0.405
Smoking Status†					
Never Smoker	9 (90.00%)	54 (83.08%)	16 (88.89%)	24 (85.71%)	0.282*
Ex-Smoker	1 (10.00%)	10 (15.38%)	2 (11.11%)	1 (3.57%)	
Current Smoker	0 (0.0%)	1 (1.54%)	0 (0.0%)	3 (10.71%)	
Biomass Exposure†	0 (0.0%)	4 (8.33%)	2 (13.33%)	1 (4.35%)	0.772*
Comorbidities					
Diabetes Mellitus	2 (20.00%)	11 (16.18%)	5 (26.32%)	5 (17.86%)	0.744*
Hypertension	5 (50.00%)	28 (41.18%)	7 (36.84%)	8 (28.57%)	0.582
IHD	2 (20.00%)	7 (10.29%)	2 (10.53%)	4 (14.29%)	0.719*
Asthma	1 (10.0%)	23 (33.82%)	1 (5.26%)	7 (25.00%)	**0.044***
COPD	1 (10.0%)	15 (22.06%)	0 (0.0%)	1 (3.57%)	**0.019***
CVA	0 (0.0%)	1 (1.47%)	2 (10.53%)	0 (0.0%)	0.138*
Chronic Renal Failure	0 (0.0%)	1 (1.47%)	0 (0.0%)	0 (0.0%)	1.000*
Depression	1 (10.00%)	1 (1.47%)	0 (0.0%)	2 (7.14%)	0.135*
Spirometry Values (Mean ± SD)					
FEV_1, L	2.31 ± 0.74	1.09 ± 0.53	1.34 ± 0.74	1.42 ± 0.68	**<0.001**
FEV_1, % Predicted	93.00 ± 14.16	46.84 ± 22.10	62.05 ± 16.15	53.89 ± 13.35	**<0.001**††
FVC, L	2.80 ± 0.85	1.77 ± 0.81	1.48 ± 0.77	1.77 ± 0.84	**0.001**
FVC, % Predicted	93.20 ± 10.52	61.41 ± 25.43	54.68 ± 16.48	55.57 ± 13.61	**<0.001**††
FEV_1/FVC, %	81.80 ± 5.09	61.34 ± 10.45	90.19 ± 6.17	80.73 ± 5.08	**<0.001**††
Microbiology					
Pseudomonas aeruginosa	4 (40.00%)	20 (29.41%)	5 (26.32%)	4 (14.29%)	0.318*
Hemophilus influenzae	1 (10.00%)	8 (11.76%)	2 (10.53%)	1 (3.57%)	0.650*
Aspergillus	2 (20.00%)	9 (13.24%)	3 (15.79%)	4 (14.29%)	0.874*

CF, cystic fibrosis; PFT, pulmonary function test; SD, standard deviation; BMI, body mass index; IHD, ischemic heart disease; COPD, chronic obstructive pulmonary disease; CVA, cerebrovascular accident; FVC, forced vital capacity; FEV_1, forced expiratory volume in 1 second. †Data was not available: Smoking Status (n = 4), Biomass Exposure (n = 30), and Lung Involvement (n=9). *Fisher's Exact Test. ††Levene's test indicated unequal variances across groups, so Welch's ANOVA *p* values are reported. For unequal variances, pairwise comparisons were performed using the Games-Howell procedure.

†Pairwise Comparisons:

FEV_1, (L): Normal vs Obstructive, $p < 0.001$; Normal vs Restrictive, $p = 0.001$; and Normal vs Mixed, $p = 0.001$.
FEV_1 Predicted (%): Normal vs Obstructive, $p < 0.001$; Normal vs Restrictive, $p < 0.001$; Normal vs Mixed, $p < 0.001$; and Obstructive vs Restrictive, $p = 0.010$.
FVC, (L): Normal vs Obstructive, $p = 0.002$; Normal vs Restrictive, $p = 0.001$; and Normal vs Mixed, $p = 0.005$.
FVC Predicted (%): Normal vs Obstructive, $p < 0.001$; Normal vs Restrictive, $p < 0.001$; Normal vs Mixed, $p < 0.001$.
FEV_1/FVC (%): Normal vs Obstructive, $p < 0.001$; Normal vs Restrictive, $p = 0.006$; Obstructive vs Restrictive, $p < 0.001$; Obstructive vs Mixed, $p < 0.001$; and Restrictive vs Mixed, $p < 0.001$.

Table 3. Symptoms, radiological characteristics, and disease severity in patients with non-CF bronchiectasis according to PFT pattern.

Clinical Variables	Normal (n = 10)	Obstructive (n = 68)	Restrictive (n = 19)	Mixed (n = 28)	p
Symptoms					
Cough	9 (90.00%)	46 (67.65%)	15 (78.95%)	23 (82.14%)	0.320*
Sputum	7 (70.00%)	42 (61.76%)	11 (57.89%)	19 (67.86%)	0.876*
Hemoptysis	3 (30.00%)	12 (17.65%)	3 (15.79%)	6 (21.43%)	0.734*
Fever	4 (40.00%)	26 (38.24%)	9 (47.37%)	7 (25.00%)	0.434*
Dyspnea	4 (40.00%)	35 (51.47%)	9 (47.37%)	18 (64.29%)	0.505*
Wheeze	4 (40.00%)	27 (39.71%)	7 (36.84%)	15 (53.57%)	0.603*
Clubbing	0 (0.0%)	2 (2.99%)	0 (0.0%)	1 (3.57%)	1.000*
Symptom Duration†					
<1 Year	2 (22.22%)	3 (6.12%)	7 (46.67%)	6 (25.00%)	
1-5 Years	4 (44.44%)	15 (30.61%)	3 (20.00%)	4 (16.67%)	**0.012***
6-10 Years	3 (33.33%)	14 (28.57%)	1 (6.67%)	6 (25.00%)	
>10 Years	0 (0.0%)	17 (34.69%)	4 (26.67%)	8 (33.33%)	
Lung Involvement†					
Unilateral	6 (60.00%)	41 (65.08%)	12 (66.67%)	17 (68.00%)	0.979*
Bilateral	4 (40.00%)	22 (34.92%)	6 (33.33%)	8 (32.00%)	
Residual Fibrosis (HRCT)†	4 (44.44%)	25 (41.67%)	7 (46.67%)	12 (46.15%)	0.974
Hospitalizations (Respiratory Infection)†	2 (28.57%)	19 (40.43%)	5 (35.71%)	8 (34.78%)	0.958*
FACED Score					
Mild (0-2)	8 (80.00%)	27 (39.71%)	13 (68.42%)	18 (64.29%)	**0.012***
Moderate-Severe (3)	2 (20.00%)	41 (60.29%)	6 (31.58%)	10 (35.71%)	

CF, cystic fibrosis; PFT, pulmonary function test; FACED, forced expiratory volume in 1 second (F), age (A), chronic colonization by *Pseudomonas aeruginosa* (C), extension for the disease by radiological assessment (E), dyspnea (D); HRCT, high resolution computed tomography. †Data was not available: Symptom Duration (n=28), Lung Involvement (n=9), Residual Fibrosis on HRCT (n=15), and Hospitalizations due to Respiratory Infection (n=34). *Fisher's Exact Test.

Table 4. Clinical and structural disease burden markers by FACED severity in patients with non-CF bronchiectasis.

Clinical Variables	Mild, 0-2 (n = 66)	Moderate-Severe, 3 (n = 59)	p
Symptom Duration†			
<1 Year	14 (29.17%)	4 (8.16%)	
1-5 Years	15 (31.25%)	11 (22.45%)	**0.015**
6-10 Years	9 (18.75%)	15 (30.61%)	
>10 Years	10 (20.83%)	19 (38.78%)	
Lung Involvement†			
Unilateral	35 (61.40%)	41 (69.49%)	0.360
Bilateral	22 (38.60%)	18 (30.51%)	
Residual Fibrosis (HRCT)†	20 (35.09%)	28 (52.83%)	0.061
Hospitalizations (Respiratory Infection)†	13 (30.23%)	21 (43.75%)	0.183

FACED, forced expiratory volume in 1 second (F), age (A), chronic colonization by *Pseudomonas aeruginosa* (C), extension for the disease by radiological assessment (E), dyspnea (D); CF, cystic fibrosis; and HRCT, high resolution computed tomography. †Data was not available: Symptom Duration (n=28), Lung Involvement (n=9), Residual Fibrosis on HRCT (n=15), and Hospitalizations due to Respiratory Infection (n=34). *Fisher's Exact Test.