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Monaldi Arch Chest Dis 2026 [Online ahead of print]

To cite this Article:

Dilka E, Duraku E, Simaku A, Kapisyzi P. **Fractional exhaled nitric oxide in non-cystic fibrosis bronchiectasis: an exploratory prospective observational study.** *Monaldi Arch Chest Dis* doi: 10.4081/monaldi.2026.3873

Submitted: 26-12-2026

Accepted: 24-07-2026

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**Fractional exhaled nitric oxide in non-cystic fibrosis bronchiectasis:
an exploratory prospective observational study**

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Contributions: Eugerta Dilka: conceptualization, investigation, patient recruitment, data collection, and writing of the original draft. Eva Duraku: methodology, interpretation of findings, and critical revision of the manuscript. Artan Simaku: statistical analysis, interpretation of results, and manuscript review and editing. Perlat Kapisyzi: conceptualization, scientific supervision, and critical revision of the manuscript. All authors approved the final version and agree to be accountable for the work.

Conflict of interest: the authors declare no conflicts of interest.

Ethics approval and consent to participate: the study was approved by the Ethics Committee of the University of Medicine, Tirana, Albania (Protocol No. 226/2, dated 16 December 2019), before patient recruitment began. The study was conducted in accordance with the Declaration of Helsinki. Written informed consent to participate was obtained from all participants.

Informed consent: written informed consent was obtained from all participants before enrolment.

Patient consent for publication: not applicable. The manuscript presents anonymized aggregate data and contains no identifiable individual information or images.

Availability of data and materials: the data supporting the findings of this study are available from the corresponding author upon reasonable request, subject to applicable institutional requirements and participant confidentiality safeguards.

Funding: this research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Declaration of generative artificial intelligence and artificial intelligence-assisted technologies in the writing process: the authors declare that no generative artificial intelligence or artificial intelligence-assisted technologies were used in writing this manuscript.

Abstract

Fractional exhaled nitric oxide (FeNO) is a non-invasive biomarker of type 2 airway inflammation, but its role in non-cystic fibrosis bronchiectasis remains uncertain. This study explored the associations of FeNO with peripheral blood eosinophils, pulmonary function, high-resolution computed tomography (HRCT)-defined morphology, and short-term post-treatment change in adults with non-cystic fibrosis bronchiectasis.

We conducted an exploratory prospective observational study including 152 adults with clinically and HRCT-confirmed non-cystic fibrosis bronchiectasis admitted to a national tertiary pulmonary center. FeNO was measured using a standardized single-flow technique. Pulmonary function testing, blood eosinophil assessment, and HRCT evaluation were performed. Descriptive statistics, between-group comparisons, correlation analyses, and exploratory multivariable linear regression were used. A subgroup underwent repeat FeNO assessment after antibiotic treatment.

Mean FeNO was 12.1 ± 7.9 ppb. FeNO correlated positively with blood eosinophil percentage ($r=0.41$, $p<0.001$) and MEF50% predicted ($r=0.48$, $p<0.001$) and inversely with total lung capacity % predicted ($r=-0.39$, $p<0.001$). FeNO distributions differed across ventilatory patterns (overall Kruskal-Wallis $p=0.030$) and HRCT morphology groups (overall Kruskal-Wallis $p=0.040$); the exploratory cylindrical versus cystic/saccular comparison yielded $p=0.023$ (unadjusted). In exploratory multivariable regression, blood eosinophil percentage remained associated with FeNO ($\beta=1.12$, 95% confidence interval: 0.29-1.95; $p=0.009$). Among 55 reassessed patients, FeNO decreased from 12.1 ± 6.8 to 7.0 ± 3.1 ppb after antibiotic treatment ($p=0.010$).

FeNO was generally low in adults with non-cystic fibrosis bronchiectasis but showed exploratory associations with eosinophilic inflammation, selected pulmonary function parameters, HRCT morphology, and short-term post-treatment change. Larger longitudinal studies with standardized severity classification, microbiological characterization, and predefined outcomes are needed before FeNO can be recommended for routine clinical use.

Key words: bronchiectasis, FeNO, eosinophilic inflammation, pulmonary function, observational study.

Introduction

Bronchiectasis is a chronic respiratory disorder characterized by abnormal and irreversible bronchial dilatation, impaired mucociliary clearance, recurrent infection, and persistent airway inflammation [1,2]. Although high-resolution computed tomography (HRCT) has improved diagnostic accuracy, bronchiectasis remains clinically heterogeneous, with substantial variation in etiology, microbiology, exacerbation risk, lung function impairment, and inflammatory profile [3,4].

Fractional exhaled nitric oxide (FeNO) is a non-invasive biomarker commonly used to assess type 2 airway inflammation in asthma [5,6]. Its role in non-cystic fibrosis bronchiectasis is less clearly established. Bronchiectasis is often associated with neutrophilic inflammation and chronic bacterial infection, but recent studies suggest that eosinophilic inflammatory signals may be present in a subset of patients [7-10]. This has generated interest in whether FeNO could provide additional information when interpreted together with blood eosinophils, pulmonary function testing, and imaging findings.

There is a biological rationale for studying FeNO in bronchiectasis. Nitric oxide production may be influenced by epithelial inducible nitric oxide synthase activity, eosinophilic inflammation, airway infection, oxidative stress, mucus retention, and coexisting airway disease [11]. These mechanisms may operate differently across bronchiectasis subgroups, which may partly explain why published findings on FeNO in bronchiectasis have been heterogeneous [12,13].

In this context, the present study was designed as an exploratory prospective observational analysis of FeNO in adults with non-cystic fibrosis bronchiectasis. The primary objective was to describe FeNO levels in this cohort and to examine their association with peripheral blood eosinophils. Secondary objectives were to explore the relationships of FeNO with pulmonary function parameters, HRCT-defined bronchiectasis morphology, and short-term post-treatment change in a subgroup of patients reassessed after antibiotic therapy. The study was not designed to establish diagnostic accuracy, treatment-response thresholds, or FeNO-guided management algorithms; rather, it aimed to generate descriptive and hypothesis-generating data on the potential relevance of FeNO within the multidimensional assessment of bronchiectasis.

Materials and Methods

Study design, setting, objectives, and analytical framework

This exploratory prospective observational study was conducted during 2020–2024 at the University Hospital “Shefqet Ndroqi” in Tirana, Albania, a national reference centre for pulmonary diseases. Bronchiectasis remains an underrecognized but clinically significant condition in the country. During the same period, a total of 613 patients were hospitalized with a confirmed diagnosis of bronchiectasis, accounting for 4.1% of all inpatient admissions.

The primary endpoint was baseline FeNO level, assessed as a continuous variable and in relation to peripheral blood eosinophil percentage. The primary analysis examined the association between FeNO and blood eosinophils. Secondary exploratory analyses evaluated FeNO according to ventilatory pattern, selected pulmonary function parameters, HRCT-defined bronchiectasis morphology, and change after antibiotic treatment in the subgroup with repeated FeNO assessment. No FeNO-based diagnostic, prognostic, or treatment-decision threshold was predefined. Therefore, all analyses were interpreted as exploratory and hypothesis-generating.

Study population and eligibility criteria

A total of 152 adult patients with non-cystic fibrosis bronchiectasis were enrolled. Bronchiectasis diagnosis was based on compatible chronic respiratory symptoms together with HRCT evidence of bronchial dilatation, consistent with internationally accepted diagnostic principles for adult bronchiectasis [1,14]. HRCT confirmation required one or more characteristic radiological features, including an increased broncho-arterial ratio, lack of normal bronchial tapering, and/or visualization of bronchi in the peripheral lung fields [14]. Patients with cystic fibrosis-related bronchiectasis were not included.

Inclusion criteria were: age ≥ 18 years; HRCT-confirmed non-cystic fibrosis bronchiectasis; clinical stability at the time of FeNO and pulmonary function testing; and ability to perform technically acceptable respiratory manoeuvres. Exclusion criteria were: cystic fibrosis-related bronchiectasis; inability to complete FeNO or pulmonary function testing; use of systemic or inhaled corticosteroids or Beta2-agonists within 12 hours before testing; and acute clinical instability at the time of baseline assessment. Patients with incomplete FeNO or pulmonary function data were excluded from analyses requiring those variables.

Available baseline variables included age, sex, smoking status, FeNO, blood eosinophil percentage, pulmonary function parameters, ventilatory pattern, and HRCT-defined bronchiectasis morphology. Data on bronchiectasis duration, prior-year exacerbation frequency, chronic microbiological colonization, and long-term maintenance treatment were not consistently available and were therefore not incorporated into the main analyses.

Measurement of fractional exhaled nitric oxide

FeNO levels were measured using the NIOX MINO® device, an electrochemical analyzer designed for standardized FeNO assessment. Measurements were performed before spirometry and other forced expiratory manoeuvres, in accordance with ATS/ERS recommendations for FeNO measurement [5,6]. A constant expiratory flow rate of 0.05 L/s was used. Patients were instructed to avoid food, beverages, exercise, smoking exposure, and nitrate-rich meals for at least four hours before testing. Measurements were carried out between 09:00 and 12:00 whenever possible to reduce circadian variability. FeNO was analysed as a continuous variable in parts per billion. No FeNO threshold was predefined for diagnosis, treatment allocation, or therapeutic decision-making in this study.

Pulmonary function testing

Pulmonary function testing was conducted using a JAEGER body plethysmograph after FeNO measurement, to avoid potential effects of forced expiratory manoeuvres on FeNO values. Spirometry and body plethysmography were performed according to ATS/ERS technical standards [15]. The assessed variables included FEV1, FVC, FEV1/FVC ratio, PEF, RV, TLC, RV/TLC, airway resistance, and mid-expiratory flows including MEF25, MEF50, and MEF75. Values were expressed as percentages of predicted values according to age, sex, height, and European reference equations. Ventilatory patterns were classified descriptively as normal, small-airway obstruction, mild obstruction, moderate obstruction, severe obstruction, moderate restriction, or severe restriction, based on pulmonary function interpretation. These categories were used for exploratory comparison of FeNO levels and were not intended to define disease severity.

Laboratory testing

Peripheral blood samples were collected for routine leukocyte counts, with specific extraction of blood eosinophil percentage as a peripheral marker of eosinophilic inflammatory activity. Eosinophilia was defined descriptively as blood eosinophils >4% of total leukocytes. Because induced sputum cytology, bronchoalveolar lavage, and airway tissue biomarkers were not systematically available, blood eosinophil percentage was used as an indirect marker and was not considered equivalent to direct airway inflammatory phenotyping.

HRCT assessment and bronchiectasis morphology

All patients underwent chest radiography and high-resolution computed tomography. HRCT was used as the reference imaging method for confirming bronchiectasis and for describing radiological morphology. Bronchiectasis was classified morphologically as cylindrical, varicose, or cystic/saccular according to the predominant HRCT pattern. When more than one morphology was present, the predominant pattern was recorded for analysis. HRCT-based morphology was used as an exploratory radiological variable. Formal multidimensional severity indices such as the Bronchiectasis Severity Index or FACED score were not calculated [16,17] because several required variables, including prior exacerbation frequency, chronic colonization status, and detailed clinical severity variables, were not consistently available.

Post-treatment FeNO reassessment

A subgroup of patients underwent repeat FeNO measurement after antibiotic treatment as part of clinical follow-up. This subgroup analysis was exploratory. Antibiotic treatment was not randomized or standardized by study protocol, and treatment regimens were determined by the treating physicians according to clinical judgement and local practice. Therefore, changes in FeNO after treatment were interpreted as short-term within-patient changes rather than evidence of a validated FeNO-based treatment-monitoring strategy.

Ethical considerations and reporting standards

The study was conducted in accordance with the Declaration of Helsinki and applicable institutional requirements. The protocol was approved by the Ethics Committee of the University

of Medicine, Tirana (Protocol No. 226/2, dated 16 December 2019), before patient recruitment began in 2020. Written informed consent was obtained from all participants before enrolment. Patient data were anonymized before analysis, and results are reported only in aggregate form. The manuscript was prepared in accordance with the STROBE recommendations for observational studies [18].

Statistical analysis

Data were analyzed using MedCalc® Statistical Software version 23.3.7. Continuous variables were summarized as mean $\pm$ standard deviation and median (interquartile range), with minimum–maximum values where relevant. Categorical variables were summarized as n (%). All reported correlation analyses used Pearson product–moment correlation, and the effective complete-case sample size was $n = 152$ for each reported correlation. Two-sided p-values were calculated from the reported correlation coefficient and effective sample size.

The primary analysis examined the Pearson correlation between FeNO and blood eosinophil percentage. Secondary correlations between FeNO and pulmonary function parameters were evaluated using the same method. Because FeNO distributions were skewed and group sizes were unequal, overall comparisons across ventilatory-pattern and HRCT-morphology groups used the Kruskal–Wallis test. The cylindrical versus cystic/saccular comparison was reported separately as an exploratory Mann–Whitney U comparison without multiplicity adjustment. For patients with repeated FeNO measurements after antibiotic treatment, a paired pre–post comparison was performed. A two-sided p-value ≤ 0.05 was considered statistically significant.

An exploratory multivariable linear regression model was constructed with FeNO as the dependent variable. Independent variables were selected based on clinical relevance and availability in the dataset and included blood eosinophil percentage, age, sex, smoking status, FEV1 % predicted, TLC % predicted, and HRCT-defined morphology. The purpose of this model was to assess whether the main association between FeNO and eosinophilic inflammation persisted after adjustment for available covariates. Because key bronchiectasis severity and treatment-related variables were unavailable, the model was interpreted as exploratory rather than predictive or causal.

Results

Baseline characteristics of the study population

A total of 152 adults with HRCT-confirmed non-cystic fibrosis bronchiectasis were included in the analysis. Baseline demographic, inflammatory, pulmonary function, and radiological characteristics are summarized in Table 1. The cohort included patients with a range of ventilatory patterns, most commonly small-airway obstruction and normal spirometry, followed by mild obstruction, moderate obstruction, severe obstruction, moderate restriction, and severe restriction. Data on bronchiectasis duration, previous exacerbation frequency, chronic microbiological colonization, and long-term maintenance treatment were not consistently available and were therefore not included in the baseline table.

Distribution of FeNO levels

Mean FeNO in the total cohort was 12.1 ± 7.9 ppb, with values ranging from 5 to 45 ppb. Overall, FeNO values were mostly within a low range, although variability was observed across inflammatory, functional, and radiological subgroups. FeNO was therefore retained as a continuous variable for the main exploratory analyses.

Association between FeNO and peripheral blood eosinophils

FeNO showed a moderate positive Pearson correlation with blood eosinophil percentage ($n = 152$, $r = 0.41$, $p < 0.001$), indicating that higher FeNO values tended to occur in patients with higher peripheral eosinophil percentages (*Supplementary Table 1*, Figure 1). Because sputum cytology and bronchoalveolar lavage were not available, this finding should be interpreted as an association with peripheral eosinophilic activity rather than direct evidence of airway inflammatory phenotyping.

FeNO according to HRCT-defined bronchiectasis morphology

FeNO distributions differed across the three predominant HRCT morphology groups (overall Kruskal–Wallis $p = 0.040$) (*Supplementary Table 2*, Figure 2). Median FeNO was 11.0 ppb in cylindrical, 8.5 ppb in varicose, and 7.0 ppb in cystic/saccular bronchiectasis. The separate exploratory cylindrical versus cystic/saccular comparison yielded $p = 0.023$ (Mann–Whitney U

test, unadjusted). Given the unequal subgroup sizes and absence of formal HRCT severity scoring, these findings should be interpreted as exploratory.

FeNO according to ventilatory pattern

FeNO distributions differed across ventilatory-pattern groups (overall Kruskal–Wallis $p = 0.030$) (*Supplementary Table 3*). However, the severe-obstruction, moderate-restriction, and severe-restriction groups contained relatively few participants and showed differing dispersion. These subgroup findings should therefore be interpreted cautiously and as exploratory.

Correlations between FeNO and pulmonary function parameters

Correlations between FeNO and selected pulmonary function parameters are shown in Table 2. Using the reported coefficients and effective $n = 152$, FeNO was not correlated with FEV1 % predicted, FVC % predicted, or FEV1/FVC. FeNO correlated inversely with TLC % predicted ($r = -0.39$, $p < 0.001$) and positively with RV, RV/TLC, MEF25, MEF50, MEF75, and Raw; the largest functional correlation was with MEF50 % predicted ($r = 0.48$, $p < 0.001$). These exploratory, unadjusted associations should not be interpreted causally.

Exploratory multivariable analysis

In an exploratory multivariable linear regression model adjusted for available demographic, smoking, functional, inflammatory, and radiological variables, blood eosinophil percentage remained independently associated with FeNO level (Beta = 1.12, 95% CI: 0.29 to 1.95; $p = 0.009$) (Table 3). TLC % predicted was inversely associated with FeNO (Beta = -0.07, 95% CI: -0.13 to -0.01; $p = 0.041$), and cylindrical bronchiectasis morphology was associated with higher FeNO values compared with the reference morphology group (Beta = 3.18, 95% CI: 0.30 to 6.06; $p = 0.031$). Age, sex, smoking status, and FEV1 % predicted were not significantly associated with FeNO. The model explained a modest proportion of FeNO variability (adjusted $R^2 = 0.24$), and findings should be interpreted cautiously because several important bronchiectasis-related confounders were unavailable.

Change in FeNO after antibiotic treatment

Among the 55 patients who underwent repeat FeNO assessment after antibiotic treatment, mean FeNO decreased from 12.1 ± 6.8 ppb before treatment to 7.0 ± 3.1 ppb after treatment, corresponding to a mean reduction of 5.1 ppb ($p = 0.010$). A decrease in FeNO was observed in 43 patients (78.2%), while FeNO remained unchanged in 8 patients (14.5%) and increased in 4 patients (7.3%). Because antibiotic regimens and reassessment timing were determined by routine clinical practice rather than by a standardized study protocol, this finding should be interpreted as an exploratory within-patient change rather than validation of FeNO as a treatment-monitoring biomarker.

Discussion

This exploratory prospective observational study evaluated FeNO in adults with HRCT-confirmed non-cystic fibrosis bronchiectasis. The main finding was that FeNO values were generally low in the overall cohort, but showed a moderate positive association with peripheral blood eosinophil percentage. Additional exploratory analyses suggested associations between FeNO and selected pulmonary function parameters, HRCT-defined morphology, and short-term change after antibiotic treatment in a reassessed subgroup [19,20]. These findings should be interpreted as descriptive and hypothesis-generating, rather than as evidence that FeNO can currently be used as a stand-alone tool for bronchiectasis diagnosis, phenotyping, or treatment monitoring.

The low mean FeNO level observed in this cohort is consistent with the concept that bronchiectasis is commonly dominated by neutrophilic inflammation and chronic infection rather than by type 2 airway inflammation [19]. However, the observed association between FeNO and peripheral eosinophil percentage suggests that a subset of patients may have measurable eosinophilic inflammatory activity [7-10,21,22]. Because this study did not include induced sputum cytology, bronchoalveolar lavage, or airway tissue biomarkers, peripheral eosinophilia cannot be considered equivalent to direct airway eosinophilic inflammation. Therefore, the relationship between FeNO and blood eosinophils should be interpreted as an indirect signal that requires confirmation in studies incorporating direct airway inflammatory markers.

The exploratory multivariable analysis suggested that the association between FeNO and blood eosinophil percentage was not fully explained by the available demographic, smoking, functional, and radiological variables. Nevertheless, the model explained only a modest proportion of FeNO

variability, and several clinically important bronchiectasis-related confounders were unavailable, including disease duration, prior exacerbation frequency, chronic microbiological colonization, maintenance treatment exposure, and standardized bronchiectasis severity scores. As a result, the adjusted findings should not be interpreted as establishing an independent clinical phenotype, but rather as supporting the need for more comprehensive longitudinal analyses.

FeNO was not significantly correlated with FEV1, FVC, or FEV1/FVC, suggesting that it may not reflect overall airflow limitation in this cohort. The inverse association with TLC and positive associations with RV, RV/TLC, MEF25, MEF50, MEF75, and Raw may indicate relationships with selected aspects of lung-volume alteration and small-airway dysfunction. Most coefficients were weak, apart from the moderate correlation with MEF50, and all analyses were exploratory and unadjusted. In bronchiectasis, pulmonary function impairment may reflect airway dilatation, mucus retention, chronic infection, air trapping, parenchymal involvement, and comorbid airway disease; FeNO alone cannot distinguish these mechanisms.

Differences in FeNO according to HRCT-defined bronchiectasis morphology were also observed, with higher values in patients with cylindrical bronchiectasis than in those with cystic/saccular morphology. This finding may reflect differences in disease stage, airway structure, inflammatory activity, or residual epithelial function across morphological patterns. However, the study did not include formal HRCT severity scoring, lobar extent quantification, or standardized bronchiectasis severity indices such as BSI or FACED. Therefore, the morphology-related finding should be considered exploratory and not sufficient to define a radiological-inflammatory phenotype.

A decrease in FeNO after antibiotic treatment was observed in the reassessed subgroup. This within-patient change is compatible with the possibility that airway inflammatory activity may change after treatment of infection or exacerbation. However, antibiotic regimens were not randomized or standardized by protocol, timing of reassessment was based on clinical follow-up, and the subgroup was not designed as a treatment-response validation cohort. Consequently, this finding should not be interpreted as proof that FeNO is a validated monitoring biomarker in bronchiectasis. Rather, it suggests that longitudinal FeNO trajectories may be worth evaluating in future studies with predefined treatment protocols and standardized follow-up intervals.

The present results are broadly consistent with recent literature suggesting that bronchiectasis is biologically heterogeneous and that eosinophilic inflammatory signals may be present in a subset of patients [7-10,21,22]. Several studies have reported links between FeNO, blood eosinophils,

type 2 biomarkers, disease activity, or treatment-related outcomes in chronic airway diseases. However, published findings remain heterogeneous, and FeNO thresholds validated in asthma cannot be directly transferred to bronchiectasis. In bronchiectasis, FeNO may be influenced by infection, mucus burden, oxidative stress, airway remodeling, smoking, corticosteroid exposure, and coexisting asthma or COPD. These factors highlight the need for cautious interpretation and disease-specific validation [5,6,12,13].

The clinical relevance of FeNO in bronchiectasis therefore remains uncertain. The present study does not establish FeNO as a diagnostic test, severity marker, or treatment-guiding tool. Its value in this cohort is best understood as an additional non-invasive measurement that showed associations with selected inflammatory, functional, and radiological variables. Whether FeNO can improve clinical classification, predict exacerbations, identify corticosteroid-responsive disease, or guide follow-up requires larger multicentre longitudinal studies with standardized bronchiectasis classification, microbiological characterization, severity scoring, treatment documentation, and multivariable adjustment [23].

Overall, the findings support further investigation of FeNO as part of a multidimensional assessment of bronchiectasis, particularly in settings where advanced airway inflammatory testing is not routinely available. However, any potential role for FeNO in clinical phenotyping or monitoring should be considered preliminary until validated in appropriately designed studies.

Limitations

This study has some limitations. First, it was conducted in a single tertiary pulmonary centre and included hospitalized adults with non-cystic fibrosis bronchiectasis; therefore, the findings may not be fully generalizable to milder outpatient populations.

Second, although bronchiectasis was confirmed by HRCT, complete etiological classification, chronic microbiological colonization, prior exacerbation history, maintenance treatment, and validated severity scores such as BSI and FACED were not consistently available. This limited disease stratification and adjustment for bronchiectasis-specific confounders.

Third, inflammatory assessment was based on FeNO and peripheral blood eosinophil percentage, without systematic use of direct airway inflammatory markers such as induced sputum cytology or bronchoalveolar lavage. Therefore, these findings should be interpreted as indirect exploratory associations rather than definitive evidence of airway inflammatory phenotyping.

Finally, the analyses were exploratory, some subgroup comparisons included small numbers of patients, and the post-antibiotic reassessment was not randomized or protocol-standardized. Long-term outcomes were not evaluated. Larger multicentre longitudinal studies with standardized classification, microbiological assessment, severity scoring, and predefined clinical outcomes are needed to clarify the role of FeNO in bronchiectasis.

Future directions

Future studies should evaluate FeNO in bronchiectasis using longitudinal and multicentre designs with standardized diagnostic, etiological, microbiological, and severity classification [23]. Incorporating BSI or FACED scores, exacerbation history, chronic colonization status, maintenance treatment exposure, and HRCT severity scoring would allow more robust assessment of whether FeNO adds clinically meaningful information beyond established predictors.

Further research should also compare FeNO with direct airway inflammatory markers, including induced sputum cytology, bronchoalveolar lavage, and airway microbiological profiles. This would help clarify whether FeNO identifies a true eosinophilic airway phenotype or primarily reflects overlapping systemic and local inflammatory processes.

Finally, FeNO-guided management strategies should not be assumed from observational data. They require prospective studies with predefined FeNO thresholds, standardized treatment algorithms, longitudinal follow-up, and clinically relevant outcomes such as exacerbation frequency, symptom burden, quality of life, lung function decline, hospitalization, and treatment response. Only such studies can determine whether FeNO has practical value in bronchiectasis care.

Conclusions

In this exploratory prospective observational study of adults with HRCT-confirmed non-cystic fibrosis bronchiectasis, FeNO levels were generally low but showed associations with peripheral blood eosinophil percentage, selected pulmonary function parameters, HRCT-defined morphology, and short-term post-treatment change in a reassessed subgroup. These findings suggest that FeNO may provide additional descriptive information within a multidimensional assessment of bronchiectasis.

However, the study does not establish FeNO as a diagnostic, prognostic, phenotyping, or treatment-monitoring tool. The absence of standardized bronchiectasis severity scoring, incomplete etiological and microbiological characterization, limited treatment data, and the exploratory nature of the analyses restrict clinical interpretation. Further multicentre longitudinal studies with standardized classification frameworks, direct airway inflammatory markers, microbiological assessment, and predefined clinical outcomes are needed before FeNO can be recommended for routine clinical decision-making in bronchiectasis.

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Table 1. Baseline demographic, inflammatory, functional, and radiological characteristics of the study population.

Characteristic	Total cohort, n=152
Age, years, mean $\pm$ SD	58.7 $\pm$ 14.6
Age, years, median (IQR)	60.0 (48.0-70.0)
Female sex, n (%)	81 (53.3)
Male sex, n (%)	71 (46.7)
Current or former smoking, n (%)	49 (32.2)
Never smoking, n (%)	103 (67.8)
FeNO, ppb, mean $\pm$ SD	12.1 $\pm$ 7.9
FeNO, ppb, median (IQR)	9.5 (7.0-15.0)
FeNO range, ppb	5-45
Blood eosinophils, %, mean $\pm$ SD	3.2 $\pm$ 2.1
Blood eosinophils, %, median (IQR)	2.8 (1.6-4.6)
Blood eosinophilia >4%, n (%)	49 (32.2)
Leukocytes, $\times 10^9/L$, mean $\pm$ SD	8.9 $\pm$ 3.1
CRP, mg/L, median (IQR)	12.5 (5.8-28.4)
ESR, mm/h, median (IQR)	32.0 (18.0-51.0)
FEV1, % predicted, mean $\pm$ SD	67.8 $\pm$ 21.4
FVC, % predicted, mean $\pm$ SD	74.6 $\pm$ 19.8
FEV1/FVC ratio, mean $\pm$ SD	68.9 $\pm$ 12.7
PEF, % predicted, mean $\pm$ SD	63.5 $\pm$ 22.1
TLC, % predicted, mean $\pm$ SD	91.7 $\pm$ 18.6
RV, % predicted, mean $\pm$ SD	128.4 $\pm$ 39.7
RV/TLC, %, mean $\pm$ SD	47.8 $\pm$ 11.9
Raw, % predicted, median (IQR)	148.0 (112.0-196.0)
MEF25, % predicted, mean $\pm$ SD	34.9 $\pm$ 18.7
MEF50, % predicted, mean $\pm$ SD	42.6 $\pm$ 21.5
MEF75, % predicted, mean $\pm$ SD	55.8 $\pm$ 24.3
Normal ventilatory pattern, n (%)	34 (22.4)
Small-airway obstruction, n (%)	38 (25.0)
Mild obstruction, n (%)	26 (17.1)
Moderate obstruction, n (%)	18 (11.8)
Severe obstruction, n (%)	12 (7.9)
Moderate restriction, n (%)	16 (10.5)
Severe restriction, n (%)	8 (5.3)
Cylindrical bronchiectasis, n (%)	103 (67.8)
Varicose bronchiectasis, n (%)	28 (18.4)
Cystic/saccular bronchiectasis, n (%)	21 (13.8)
Reassessed after antibiotic treatment, n (%)	55 (36.2)

Values are presented as mean $\pm$ SD, median (IQR), range, or n (%), as appropriate. FeNO: fractional exhaled nitric oxide; FEV1: forced expiratory volume in 1 second; FVC: forced vital capacity; PEF: peak expiratory flow; TLC: total lung capacity; RV: residual volume; Raw: airway resistance; MEF: maximal expiratory flow; CRP: C-reactive protein; ESR: erythrocyte sedimentation rate.

Table 2. Correlations between FeNO and pulmonary function parameters.

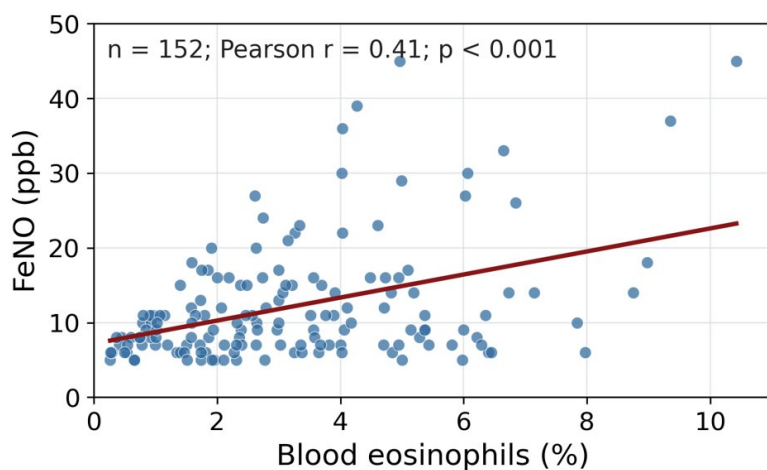
Pulmonary parameter	function	n	Correlation with FeNO	p-value	Interpretation
FEV1, % predicted		152	$r = 0.11$	0.177	No statistically significant correlation
FVC, % predicted		152	$r = 0.09$	0.270	No statistically significant correlation
FEV1/FVC ratio		152	$r = 0.07$	0.391	No statistically significant correlation
TLC, % predicted		152	$r = -0.39$	<0.001	Moderate inverse correlation
RV, % predicted		152	$r = 0.18$	0.026	Weak positive correlation
RV/TLC, %		152	$r = 0.21$	0.009	Weak positive correlation
MEF25, % predicted		152	$r = 0.29$	<0.001	Weak-to-moderate positive correlation
MEF50, % predicted		152	$r = 0.48$	<0.001	Moderate positive correlation
MEF75, % predicted		152	$r = 0.25$	0.002	Weak positive correlation
Raw, % predicted		152	$r = 0.16$	0.049	Weak positive correlation

FeNO: fractional exhaled nitric oxide; FEV1: forced expiratory volume in 1 second; FVC: forced vital capacity; TLC: total lung capacity; RV: residual volume; MEF: maximal expiratory flow; Raw: airway resistance. Pearson correlations with effective $n = 152$ and unadjusted two-sided p -values

Table 3. Exploratory multivariable linear regression for FeNO level.

Predictor	β coefficient	Standard error	95% CI	p-value
Blood eosinophils, %	1.12	0.42	0.29 to 1.95	0.009
Age, years	0.03	0.04	-0.05 to 0.11	0.460
Male sex	-0.84	1.21	-3.23 to 1.55	0.488
Current/former smoking	-1.36	1.18	-3.69 to 0.97	0.252
FEV1, % predicted	0.04	0.03	-0.02 to 0.10	0.178
TLC, % predicted	-0.07	0.03	-0.13 to -0.01	0.041
Cylindrical bronchiectasis morphology	3.18	1.46	0.30 to 6.06	0.031

Model summary: adjusted $R^2 = 0.24$; overall model $p = 0.006$. FeNO was analysed as a continuous dependent variable. The model was adjusted for available demographic, smoking, functional, inflammatory, and radiological variables. Reference category for cylindrical bronchiectasis morphology was non-cylindrical morphology.

**Figure 1. Correlation between FeNO and blood eosinophil percentage.**

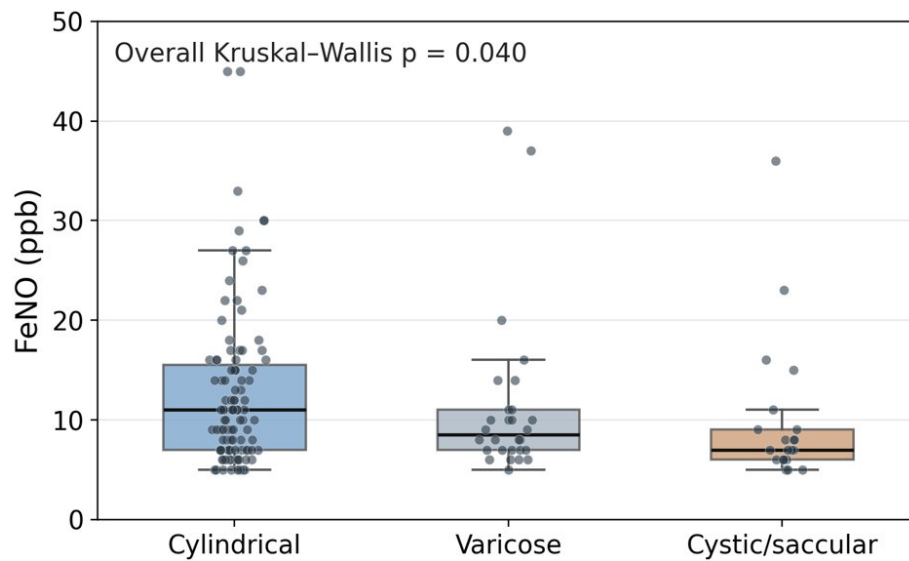


Figure 2. FeNO distributions across cylindrical, varicose, and cystic/saccular bronchiectasis. Boxes show the interquartile range, centre lines show medians, whiskers extend to $1.5 \times$ IQR, and all observations—including values beyond the whiskers—are displayed. Overall Kruskal–Wallis $p = 0.040$.