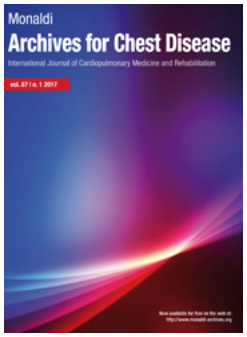

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Physical activity levels and influencing factors in individuals with bronchiectasis: a cross-sectional study

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Abstract

Bronchiectasis is a chronic respiratory condition characterized by irreversible bronchial dilatation, persistent airway inflammation, and impaired mucociliary clearance. Physical activity (PA) plays a key role in improving respiratory health and quality of life, yet objective data on PA levels and their clinical determinants in bronchiectasis are limited. We aimed to assess PA levels using wrist-worn accelerometry in individuals with non-cystic fibrosis (non-CF) bronchiectasis and to explore their association with clinical, functional, and inflammatory parameters.

This cross-sectional study enrolled 27 adults with stable non-CF bronchiectasis (median age: 68.5 years; 40.7% female). Participants wore an AX3 wrist accelerometer for 7 consecutive days and were categorized into light or moderate/vigorous activity groups based on the World Health Organization guidelines. Clinical characteristics, pulmonary function (including airway resistance), and inflammatory markers [eosinophil count, fractional exhaled nitric oxide (FeNO)] were collected and analyzed. Logistic regression models were used to explore associations between these variables and PA levels.

Patients with higher PA levels demonstrated lower airway resistance and reduced markers of type 2 inflammation. In univariate analysis, airway resistance, eosinophil count, FeNO, and age were significantly associated with PA levels. However, none of these factors retained significance in the multivariate model.

Thus, reduced PA in bronchiectasis appears to be influenced by both airway inflammation and physiological factors such as aging. Inflammatory burden and impaired airway mechanics may limit functional capacity, underscoring the need for comprehensive management strategies that address both inflammation and mobility to improve patient outcomes.

Key words: bronchiectasis, physical activity, airway inflammation, actigraphy.

Introduction

Bronchiectasis is a chronic respiratory condition marked by irreversible dilation of the bronchi due to insufficient mucus clearance, leading to recurrent infections and inflammation [1,2]. This persistent inflammation significantly diminishes patients' quality of life and functional capacity, often resulting in progressive lung damage, frequent exacerbations, and increased healthcare usage [3,4]. Traditionally, bronchiectasis diagnosis relies on high-resolution computed tomography (HRCT) and spirometry, although newer methods like the impulse oscillometry system (IOS) are being explored for their enhanced sensitivity in detecting airway changes [5].

A primary symptom of bronchiectasis is the excessive production of thick bronchial secretions, which hampers mucociliary transport and causes frequent exacerbations, reduced lung function, and increased mortality [6]. These exacerbations involve acute worsening of respiratory symptoms, necessitating a comprehensive management approach that includes both pharmacological and non-pharmacological strategies [7].

Physical activity (PA) is widely recommended to mitigate negative health impacts. Major organizations, including the World Health Organization, advise at least 150 minutes of moderate-intensity aerobic physical activity per week or at least 75 minutes of vigorous-intensity aerobic physical activity per week, or an equivalent combination of both. This recommendation aims to enhance overall health and reduce the risk of various chronic diseases [8,9].

PA levels are linked to significant disease outcomes, and there is a focus on developing interventions to increase PA and reduce sedentary time in COPD [10,11]. In bronchiectasis, the relationship between physical activity and disease characteristics is crucial. Regular physical activity can improve mucus clearance, reduce inflammation, enhance respiratory function, and ultimately improve patients' quality of life [12,13]. Despite the recognized benefits, there is limited data specifically on physical activity levels in bronchiectasis patients, highlighting the need for further research in this area [14,15]. Understanding the factors that influence PA in bronchiectasis is essential for developing targeted interventions to improve health outcomes in this population [16,17].

The primary aim of this cross-sectional study was to investigate the impact of bronchiectasis on physical activity levels among individuals. We investigated the impact of bronchiectasis on physical activity and the aim was to evaluate some several respiratory and inflammatory markers in patients with non-CF-bronchiectasis, based on the degree of PA and lifestyle.

Materials and Methods

Study design

This cross-sectional study conducted at the Bronchiectasis Program of Policlinico Bari, Italy, involved 27 participants (>18 years), all diagnosed with non-CF bronchiectasis between March 2022 and March 2023. The participants, who wore an AX3 actigraph (Axivity, UK) on their dominant wirst for 7 consecutive days, were divided into two groups based on their levels of PA: 15 in the light activity group and 15 in the moderate/vigorous activity group (Figure 1).

Participants were included if they were 18 years or older, had a confirmed diagnosis of non-cystic fibrosis bronchiectasis (non-CF BE) based on HRCT within the past three months, and were clinically stable for at least four weeks (no exacerbations or hospitalizations). They were required to wear an AX3 actigraph on their dominant wrist for seven consecutive days, with at least five valid days (≥16 hours/day). Exclusion criteria included cystic fibrosis (CF), primary ciliary dyskinesia (PCD), recent exacerbations or hospitalizations (past four weeks), and severe physical, neurological, or cognitive impairments affecting mobility. Individuals with recent systemic corticosteroid use, advanced COPD, interstitial lung disease, active malignancies, respiratory failure or significant functional limitations were also excluded. Pregnancy and non-adherence to accelerometer wear-time criteria led to exclusion.

This study was conducted in accordance with the principles outlined in the Declaration of Helsinki and received approval from our local center's Institutional Ethics Committee (Ethics Committee Approval No. 159/DG, February 7, 2022). Written informed consent was obtained from all participants for study participation, including permission to publish details of their medical cases.

Assessing physical activity with wrist-worn accelerometry

To objectively assess physical activity (PA) levels, each participant wore an AX3 actigraph (Axivity, UK) on their dominant wrist for seven consecutive days. This device, equipped with a triaxial accelerometer, light sensors, and temperature sensors, continuously recorded movement patterns and intensity throughout the monitoring period. To ensure data validity, participants were required to wear the device for at least 16 hours per day on a minimum of five valid days within the monitoring week. Data collected from the accelerometer was analyzed to classify activity levels based on movement intensity and duration. The raw movement data, measured in milligravity (mg), was processed using the Euclidean Norm Minus One (ENMO) method, with values averaged over 5-second epochs. Negative values were rounded to zero [18]. The study specifically analyzed: weekly duration of moderate to vigorous PA (minutes), in accordance with WHO recommendations and average weekly acceleration levels, expressed in gravitational units (g), to assess movement intensity [8].

In general, activity intensity was classified according to predefined thresholds, such as: a) Sedentary behavior: Defined as minimal movement, with a z-angle change of ≤5 degrees for at least 5 minutes; b) Other inactivity: Defined as movements registering below 30 mg; c) Light activity: Defined as movements exceeding 30 mg ENMO; d) Moderate activity: Defined as movements exceeding 100 mg ENMO; e) Vigorus activity: Defined as movements exceeding 400 mg ENMO [18].

Physical activity measurements

In accordance with WHO PA guidelines [8], participants were categorized based on the amount of moderate to vigorous physical activity (MVPA) accumulated in bouts of at least 10 minutes. The total weekly duration of moderate/vigorous activity (minutes) was calculated for each participant, along with average weekly acceleration levels, expressed in gravitational units (g). By combining accelerometer-based movement analysis with international PA recommendations, this methodology provided an objective and standardized approach to evaluating PA levels in individuals with bronchiectasis [18].

Classification of physical activity levels

For each participant, weekly physical activity (PA) was quantified using accelerometer data. Moderate-to-vigorous physical activity (MVPA) was defined according to WHO recommendations (8), which require at least 150 minutes/week of moderate activity, 75 minutes/week of vigorous activity, or a combination of both in bouts of ≥10 minutes.

After processing raw accelerometer output using ENMO metrics, the total weekly duration of MVPA (minutes/week) was calculated for every participant. Based on this value, patients were categorized into two groups:

Light activity group: participants accumulating <150 minutes/week of MVPA.

Moderate/vigorous activity group: participants accumulating ≥150 minutes/week of MVPA.

This threshold allowed us to distinguish patients who met WHO (8) PA recommendations from those who did not.

Collected data

A comprehensive dataset was collected, covering demographic, clinical, microbiological, inflammatory, and functional parameters, as well as treatment use and PA measurements (Table 1). Key demographic information was gathered, including age and sex distribution, to evaluate potential influences on PA. Participants' medical history was recorded, particularly focusing on coexisting respiratory conditions such as asthma and chronic obstructive pulmonary disease (COPD), which are frequently associated with BE. In addition, data on

cardiovascular disease (CVD), arterial hypertension (AH), nephropathy, malignancies, and metabolic disorders were collected to assess the broader health profile of the cohort.
Lifestyle factors, such as smoking history (pack-years) and occupational exposure to environmental irritants, were documented given their relevance in chronic lung diseases. Furthermore, allergy history and family history of respiratory diseases were assessed to determine potential genetic and immunological predispositions.

Detection and assessment of bronchiectasis

All patients underwent high-resolution computed tomography (HRCT) within three months before starting biological therapy. Scans (0.5–1.5 mm slices) were assessed by an expert radiologist to diagnose bronchiectasis (BE) based on standard criteria, including lack of bronchial tapering, bronchi near the costal pleura, and a broncho-arterial ratio >1:1 (signet-ring sign) [19].
The severity of BE was evaluated using the Bronchiectasis Severity Index (BSI), which incorporates clinical, radiological, and microbiological factors such as FEV1, BMI, exacerbation history, hospitalizations, dyspnea score, radiological extent (≥3 lobes or cystic BE), and Pseudomonas aeruginosa colonization [20]. Additionally, the FACED score was used to assess severity based on FEV1, age, Pseudomonas aeruginosa infection, radiological extent, and dyspnea [21].

Microbiological profile and airway colonization

Participants underwent sputum culture analysis to determine the presence of chronic bacterial colonization, which is a major driver of BE progression and exacerbations. The presence of specific pathogens was recorded, including: Pseudomonas aeruginosa, Stenotrophomonas maltophilia and Acinetobacter spp.Escherichia coli, Nontuberculous mycobacteria (NTM), Fungal colonization, including Aspergillus spp, Other opportunistic microorganisms.

Pulmonary function testing

Lung function was evaluated using spirometry and body plethysmography (Jaeger, Essen, Germany) following standard guidelines [22]. FEV1, FVC, and RV were measured by trained technicians under pulmonologist supervision. The best of three reproducible tests was recorded as a percentage of the predicted value

Inflammatory markers and biomarkers

Blood eosinophil count (absolute and categorized as <150, 150-300, >300 cells/μL), used to assess the presence of type 2 (T2) inflammation [23]. Exhaled Nitric Oxide (FeNO) was

measured using an electrochemical analyzer (Hypair FeNO Medisoft Exp'air, 2010) following ATS-ERS guidelines for online FeNO measurement in adults. The measurement range was 0–600 ppb, using a controlled breathing technique with expiratory resistance and positive mouth pressure to prevent nasal NO contamination. FeNO was recorded at a constant expiratory flow of 50 mL/s, with repeated exhalations until three plateau values differed by no more than 5% [24].

Disease burden assessment

In this study, disease burden was evaluated through multiple clinical parameters that reflect both the acute and chronic aspects of the condition.

One of the primary indicators of disease severity was the frequency of exacerbations, as recurrent episodes often lead to progressive lung function decline and reduced quality of life. Additionally, the number of hospitalizations directly attributable to BE within the study period was recorded to provide insight into the extent of disease-related healthcare utilization. Given the importance of emergency interventions in severe cases, the study also documented the number of emergency department (ED) visits over the past 24 months, offering a broader perspective on acute disease exacerbations requiring urgent medical attention.

***Treatment and medication* use**

To evaluate disease management, the study recorded ongoing pharmacological and non-pharmacological treatments, including: a) Long-term oxygen therapy (LTOT) and non-invasive ventilation (NIV-CPAP) for patients with advanced respiratory impairment; b) Inhaled corticosteroids (ICS), long-acting beta-agonists (LABA), and long-acting muscarinic antagonists (LAMA), commonly prescribed for airway disease control; c) Mucolytics and macrolide therapy, aimed at improving mucus clearance and reducing exacerbations; d) Biologic therapies, used in cases of severe airway inflammation; e) Participation in pulmonary rehabilitation programs, which are known to improve PA levels in chronic respiratory diseases.

Statistical analysis

Continuous variables (such as age, lung function, and inflammatory markers) were tested for normality using the Kolmogorov–Smirnov test. Depending on the data distribution, they were expressed as either mean ± standard deviation (SD) for normally distributed data or median with interquartile range (IQR) for non-normally distributed data.

To compare continuous variables between the two PA groups:normally distributed variables were analyzed using the Student's t-test for independent samples.; non-normally distributed

variables were compared using the Mann–Whitney U test. Categorical variables (such as sex, smoking status, and comorbidities) were expressed as percentages and analyzed using the Chi-square test to determine statistical significance.

To identify predictors of PA levels, univariate binomial logistic regression was performed to explore associations between demographic, clinical, and inflammatory variables with PA classification. Variables found to be significant in the univariate analysis were then included in a multivariate binomial regression model, which adjusted for potential confounders. This approach allowed for the identification of independent determinants of PA levels in BE patients.

All analyses were conducted using SPSS version 26. A p-value <0.050 was considered statistically significant.

Results

Study population and general characteristics

The study included 27 participants with non-cystic fibrosis bronchiectasis (non-CF BE), divided into two groups based on physical activity levels: 14 in the light activity group and 13 in the moderate/vigorous activity group. The median age of the entire cohort was 68.5 years, with those in the light activity group being significantly older (70 vs. 59 years, p=0.038). Patients engaged weekly in moderate-to-vigorous physical activity for an average duration of 498.83 ± 168.74 minute. The mean intensity of these activities, measured through accelerometric and expressed in gravitational units (g), was 310.74 ± 83.53 g (Table 1).

Women represented 40.7% of the total population, with a similar distribution between groups (37.5% in the light group vs. 46.2% in the moderate/vigorous group, p=0.436). Comorbidities such as asthma, COPD, cardiovascular disease, and arterial hypertension were similarly distributed across groups, with no significant differences. (Table 1)

Lifestyle and clinical characteristics—including smoking history, environmental exposures, and presence of GERD or OSAS—were also comparable between the groups.

Comparison between light and moderate/vigorous activity levels

In the analysis comparing participants with different levels of physical activity, several differences were observed in terms of functional and inflammatory parameters. Participants classified in the moderate-to-vigorous activity group had a lower median airway resistance (Raw) value of 120, with an interquartile range (IQR) between 110 and 140, whereas those in the light activity group showed a higher median Raw value of 170, with an IQR between 150 and 180. This difference was statistically significant, with a p-value of 0.014 (Table 1).

Further differences were noted in inflammatory markers. The median value of fractional exhaled nitric oxide (FeNO) was 13 parts per billion (ppb) in the moderate/vigorous activity group, with an IQR of 10 to 18, while in the light activity group the median FeNO level was 24 ppb, with an IQR of 24 to 27. This difference also reached statistical significance, with a p-value of 0.001. Eosinophil counts followed a similar trend. Participants in the moderate/ vigorous group had a median blood eosinophil count of 110 cells per microliter, ranging from 90 to 155 cells/μL (IQR), while those in the light activity group had a higher median count of 210 cells/μL, with an IQR between 152.5 and 337.5. This difference was statistically significant as well, with a p-value of 0.022. (Table 1)

Predictors of physical activity levels: regression analysis

To investigate the factors associated with the likelihood of engaging in moderate-to-vigorous physical activity, a univariate binomial logistic regression analysis was performed. In this analysis, age was found to be significantly associated with physical activity level, with an odds ratio (OR) of 0.902 and a 95% confidence interval (CI) ranging from 0.815 to 0.999 (Table 2). The corresponding p-value was 0.047. Airway resistance, as measured by Raw, was also significantly associated with activity level, showing an OR of 0.969 with a 95% CI between 0.942 and 0.997, and a p-value of 0.032 (Figure 2).

Additional significant associations were observed for blood eosinophil counts and FeNO values. The eosinophil count showed an OR of 0.989, with a 95% CI between 0.979 and 1.000, and a p-value of 0.043. FeNO levels demonstrated an OR of 0.837, with a 95% CI from 0.736 to 0.952, and a p-value of 0.007.

When the variables identified as significant in the univariate analysis were included in a multivariate logistic regression model to adjust for potential confounding factors, none of them retained statistical significance. In the multivariate model, age showed an adjusted odds ratio of 0.864, with a 95% confidence interval from 0.622 to 1.200, and a p-value of 0.383. The other variables, including Raw, eosinophil count, and FeNO, did not show significant associations in the adjusted model.

Discussion and Conclusions

A key finding of this study in a bronchiectasis population is that better control of eosinophilic inflammation and FeNO levels is associated with reduced airway resistance, which in turn facilitates higher levels of moderate to vigorous physical activity (PA) as measured by accelerometer. This significant finding, for the first time, elucidates the relationship between inflammation control and physical activity levels in bronchiectasis patients. Notably, achieving the recommended levels of moderate to vigorous PA, as advised by the WHO [8], not only improves respiratory health but also significantly reduces cardiovascular risk. WHO

recommends at least 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity aerobic physical activity per week, or an equivalent combination of both, to enhance overall health and reduce the risk of various chronic diseases [3,11].

Participants with lower blood eosinophil counts and FeNO levels exhibited lower airway resistance and higher levels of physical activity. These associations were statistically significant in the univariate analysis, indicating that reduced inflammation may correspond with improved respiratory mechanics and greater activity engagement. However, in the multivariate analysis, these variables did not maintain independent predictive value, which may indicate overlapping effects or other clinical characteristics. Previous research has shown that reducing inflammation through various means can lead to improved respiratory function and better exercise tolerance in chronic respiratory disease populations [7,12].

Moreover, the data showed that those in the moderate/vigorous activity group had significantly lower airway resistance compared to those in the light activity group (median 130 vs. 170, $p = 0.018$). This significant difference supports the idea that lower airway resistance, likely a result of better inflammation control, is a key factor in promoting higher physical activity levels [3,12].

Data from our study demonstrated that younger age was significantly associated with higher levels of moderate-to-vigorous physical activity in the univariate analysis, indicating that age plays a key role in determining physical activity engagement among individuals with bronchiectasis. Moreover, it has been shown in other studies that older patients with bronchiectasis tend to have increased airway resistance, reduced lung function, and more severe respiratory symptoms, which can significantly limit their ability to engage in higher-intensity physical activities [25]. However, after adjustment for confounding factors in the multivariate model, age did not retain statistical significance, nor did any of the other variables examined. Despite this, airway resistance and markers of type 2 inflammation, such as blood eosinophil count and FeNO, also showed significant associations with physical activity levels in univariate analysis. These findings suggest that, beyond aging, airway inflammation and functional airway impairment may contribute substantially to reduced physical activity, potentially limiting exercise tolerance and perceived exertion in daily activities. The absence of statistically significant independent predictors in the multivariate model may reflect the interdependence of these variables, where inflammation and airway resistance worsen with age, thereby diluting their isolated effects in a small sample. Nevertheless, our results underscore that increased airway resistance and heightened eosinophilic inflammation appear to be as relevant as age in influencing physical activity behaviors in patients with bronchiectasis. Although several associations, particularly those involving airway resistance, FeNO, and blood eosinophils, reached statistical significance, their clinical relevance should be interpreted with caution. The magnitude of these

differences, while detectable statistically, may not correspond to meaningful improvements in symptoms, exercise tolerance, or daily functioning. The small sample size and the interdependence of the variables further limit the strength and clinical applicability of our findings. Therefore, these results should be considered exploratory and hypothesis-generating rather than definitive evidence of clinically meaningful predictors of physical activity in bronchiectasis.

Accelerometers, particularly the ActiGraph, emerged as the most reliable and valid tool for measuring PA. This device provides objective data on PA levels, which are crucial for assessing the true impact of interventions aimed at increasing PA in bronchiectasis patients. The Bland-Altman plots demonstrated low levels of agreement between accelerometer data and both pedometer counts and self-reported questionnaire results, highlighting the limitations of pedometers and questionnaires in this patient population [10,17]. Previous studies have shown that accelerometers provide a comprehensive analysis of PA by capturing intensity, frequency, and duration of activity, which is particularly relevant for patients with chronic respiratory diseases where PA patterns can be highly variable [26,27].

In terms of feasibility, pedometers and questionnaires were found to be more user-friendly and less intrusive than accelerometers. However, the trade-off between ease of use and accuracy must be considered. Pedometers, although convenient, often failed to capture lower intensity activities and movements that do not involve stepping, which are common in bronchiectasis patients [10,28]. Questionnaires, while providing valuable subjective insights, were prone to recall bias and overestimation or underestimation of PA levels [13-15]. The usability of the ActiGraph accelerometer was generally well-received by participants despite the requirement for continuous wear over several days. This acceptance is critical for ensuring high compliance in longitudinal studies and clinical practice [16,29].

Given the chronic nature of bronchiectasis and the importance of maintaining adequate PA levels to manage symptoms and improve quality of life, accurate PA measurement is essential. The ActiGraph accelerometer should be considered the gold standard for PA assessment in clinical settings and research involving bronchiectasis patients [5,6]. Its ability to provide detailed and objective data can inform personalized interventions aimed at enhancing PA and consequently patient outcomes [4,20-31].

While this study offers meaningful insights into the relationship between physical activity and clinical parameters in individuals with bronchiectasis, several limitations should be acknowledged. The relatively small sample size and the predominance of older adults with moderate to severe disease may restrict the generalizability of the findings to the broader bronchiectasis population. Future research should aim to include larger, more heterogeneous cohorts to confirm these observations across different clinical phenotypes and age groups. Additionally, the cross-sectional nature of the study and the short observation period may not

fully account for seasonal variability in physical activity levels. Longitudinal studies are warranted to assess the stability of physical activity patterns over time and to evaluate the long-term applicability and acceptability of accelerometer-based monitoring in this patient population. Moreover, further investigation is needed to clarify whether improved control of airway inflammation leads to sustained enhancements in physical activity among individuals with bronchiectasis.

These findings underscore the importance of targeting inflammation in the management of bronchiectasis. Effective control of airway inflammation may not only improve respiratory function but also enable patients to participate in more intense physical activities, thereby potentially enhancing their overall health and quality of life. This study suggests that incorporating strategies to manage inflammation, alongside promoting physical activity, could be highly beneficial for patients with bronchiectasis.

In conclusion, our study confirms that accelerometers are the most reliable and practical instruments for assessing physical activity (PA) in patients with bronchiectasis, aiding in the identification and management of PA-related clinical outcomes. Future research should aim to enhance device usability to improve patient adherence and investigate their long-term effectiveness across various patient groups.

References

1. José A, Holland AE, Selman JPR, et al. Home-based pulmonary rehabilitation in people with bronchiectasis: a randomised controlled trial. ERJ Open Res 2021;7:00021-2021.
2. Dos Santos DO, de Souza HCD, Baddini-Martinez JA, et al. Effects of exercise on secretion transport, inflammation, and quality of life in patients with non-cystic fibrosis bronchiectasis: Protocol for a randomized controlled trial. Medicine 2018;97:e9768.
3. Bhat A, Lee AL, Maiya GA, et al. Measurement properties of physical activity in adults with bronchiectasis: a systematic review protocol. F1000Res 2023;12:801.
4. Ozalp O, Inal-Ince D, Calik E, et al. Extrapulmonary features of bronchiectasis: muscle function, exercise capacity, fatigue, and health status. Multidiscip Respir Med 2012;7:3.
5. Gale NS, Bolton CE, Duckers JM, et al. Systemic comorbidities in bronchiectasis. Chron Respir Dis 2012;9:231-8.
6. King PT. The pathophysiology of bronchiectasis. Int J Chron Obstruct Pulmon Dis 2009;4:411-9.

7. Polverino E, Dimakou K, Hurst J, et al. The overlap between bronchiectasis and chronic airway diseases: state of the art and future directions. Eur Respir J 2018;52:1800328.
8. Bull FC, Al-Ansari SS, Biddle S, et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. Br J Sports Med 2020;54:1451-62.
9. Ekelund U, Tarp J, Fagerland MW, et al. Joint associations of accelero-meter measured physical activity and sedentary time with all-cause mortality: a harmonised meta-analysis in more than 44 000 middle-aged and older individuals. Br J Sports Med 2020;54:1499-506.
10. Watz H, Pitta F, Rochester CL, et al. An official European Respiratory Society statement on physical activity in COPD. Eur Respir J 2014;44:1521-37.
11. Demeyer H, Louvaris Z, Frei A, et al. Physical activity is increased by a 12-week semiautomated telecoaching programme in patients with COPD: a multicentre randomized controlled trial. Thorax 2017;72:415-23.
12. Bradley JM, Wilson JJ, Hayes K, et al. Sedentary behaviour and physical activity in bronchiectasis: a cross-sectional study. BMC Pulm Med 2015;15:61.
13. Royle H, Kelly C. 'The likes of me running and walking? No chance': exploring the perceptions of adult patients with bronchiectasis towards exercise. Chronic Illn 2022;19:157-71.
14. Dudgeon EK, Crichton M, Chalmers JD. "The missing ingredient": the patient perspective of health-related quality of life in bronchiectasis: a qualitative study. BMJ Pulm Med 2018;18:81.
15. Alcaraz-Serrano V, Gimeno-Santos E, Scioscia G, et al. Association between physical activity and risk of hospitalisation in bronchiectasis. Eur Respir J 2020;55:1902138.
16. Pehlivan E, Niksarlıoğlu EY, Balcı A, et al. The effect of pulmonary rehabilitation on the physical activity level and general clinical status of patients with bronchiectasis. Turk Thorac J 2019;20:30-5.
17. Lavery K, Neill B, Elborn JS, et al. Self-management in bronchiectasis: the patients' perspective. Eur Respir J 2007;29:541-7.
18. Bortone I, Castellana F, Lampignano L, et al. Activity energy expenditure predicts clinical average levels of physical activity in older population: results from Salus in Apulia Study. Sensors 2020;20:4585.
19. Aliberti S, Goeminne PC, O'Donnell AE, et al. Criteria and definitions for the radiological and clinical diagnosis of bronchiectasis in adults for use in clinical trials: International consensus recommendations. Lancet Respir Med 2022;10:298-306.

20. Chalmers JD, Goeminne PC, Aliberti S, et al. The bronchiectasis severity index. An international derivation and validation study. Am J Respir Crit Care Med 2014;189:576-85.
21. Martínez-García MÁ, De Gracia J, Relat MV, et al. Multidimensional approach to BQNFQ the FACED score. Eur Respir J 2014;43:1357-67.
22. Miller MR, Hankinson J, Brusasco V, Burgos F, et al. Standardisation of spirometry, ATS/ERS Task Force. Practice Guideline. Eur Respir J 2005;26:319-38.
23. GINA. 2024 GINA main report. Available from: https://ginasthma.org/2024-report/
24. American Thoracic Society, European Respiratory Society. ATS/ERS recommendations for standardized procedures for the online and offline measurement of exhaled lower respiratory nitric oxide and nasal nitric oxide. Am J Respir Crit Care Med 2005;171:912-30.
25. José A, Ramos TM, de Castro RAS, et al. Reduced physical activity with bronchiectasis. Respir Care 2018;63:1498-505.
26. Holland AE, Mahal A, Hill CJ, et al. Benefits and costs of home-based pulmonary rehabilitation in chronic obstructive pulmonary disease. Respirology 2013;18:230-7.
27. Cordova-Rivera L, Gibson PG, Gardiner PA, et al. Physical activity associates with disease characteristics of severe asthma, bronchiectasis, and COPD. Respirology 2019;24:352-60.
28. Eakin EG, Glasgow RE, Riley KM. Review of primary care-based physical activity intervention studies. J Fam Pract 2000;49:158-68.
29. Blumenthal JA, Emery CF, Madden DJ, et al. Cardiovascular and behavioral effects of aerobic exercise training in healthy older men and women. J Gerontol 1989;44:M147-57.
30. Spruit MA, Singh SJ, Garvey C, et al. An official American Thoracic Society/European Respiratory Society statement: key concepts and advances in pulmonary rehabilitation. Am J Respir Crit Care Med 2013;188:e13-64.
31. Wilson JJ, Hay J, Kim Y, et al. Measurement of physical activity in patients with chronic obstructive pulmonary disease: a systematic review. J Cardiopulm Rehabil Prev 2011;31:327-39.

Table 1. **Demographic, clinical, and functional characteristics of the study population.**

	Population (n=27)	**Light activity (n=14)**	**Moderate/vigorous activity (n=13)**	**p-value**
Age, median (IQ 25-75)	68.5 (63-75)			**0.038**
Sex F, n (%)	11 (40.7)	5 (37.5)	6 (46.2)	0.436
Group (IQ 25-75) Bronchiectasis Asthma + Bronchiectasis COPD + Bronchiectasis	 9 (33.3) 8 (29.6) 10 (37)	 **3 (21.4)** **5 (35.7)** **6 (42.9)**	 **6 (46.2)** **3 (23.1)** **4 (30.8)**	0.393
BMI (IQ 25-75)	25.5 (21-27)	26 (23-28)	23 (19.6-30)	0.108
SMOKE yes, n (%)	15 (55.6)	9 (64.3)	6 (46.2)	0.288
Pack/Year (IQ 25-75)	0 (0-10)	0 (0-10)	0 (0-0)	0.230
BSI (IQ 25-75)	9 (5-11)	8 (6.5-9.5)	7 (5.5-10)	0.128
FACED (IQ 25-75)	2.5 (1-3)	3 (2-4)	2 (1.5-2)	0.203
Number Involved lobes (IQ 25-75)	2 (2-3)	3 (2-3)	2 (2-4)	0.880
%FEV1 (IQ 25-75)	65 (45-92)	108 (96.5-108.5)	89 (88-117.5)	0.205
FEV1 ml (IQ 25-75)	2.82 (1.12-27.32)	1.73 (1.00-2.56)	2.76 (2.45-3.31)	0.076
%FVC (IQ 25-75)	82 (64.5-94)	109 (97.5-11)	100 (98.5-129)	0.253
FVC l (IQ 25-75)	2.39 (1.68-3.68)	2.18 (2.0-2.4)	3.69 (3.38-4.18)	0.499
FEV1/FVC (IQ 25-75)	80 (64.5-102)	102 (99-102.5)	97 (94.5-98.5)	0.389
%TLC (IQ 25-75)	108 (94-116.5)	88 (86-107)	110 (102.5-131)	0.068
% RV (IQ 25-75)	168.5 (138-178)	89 (87-131)	162 (131.5-168)	0.409
% RV/TLC (IQ 25-75)	155 (142-199.5)	109 (103.5-122.5)	101 (79-106.5)	0.238
%Raw (IQ 25-75)	160 (140-214)	170 (150-180)	120 (110-140)	**0.014**
FeNO 50 (IQ 25-75)	27.5 (17-34)	24 (24-27)	13 (10-18)	**0.001**
Eos count n/microL	200 (134.5-325)	210 (152.5-337.5)	110 (90-155)	**0.022**

OR, odds ratio; CI, confidence interval; BE, bronchiectasis; COPD, chronic obstructive pulmonary disease; GERD, gastroesophageal reflux disease; OSAS, obstructive sleep apnea syndrome; LTOT, long-term oxygen therapy; NIV-CPAP, non-invasive ventilation - continuous positive airway pressure; ICS, inhaled corticosteroids; LABA, long-acting beta-agonists; LAMA, long-acting muscarinic antagonists; BSI, bronchiectasis severity index; FACED, FEV1, age, *Pseudomonas aeruginosa* colonization, extent of bronchiectasis, dyspnea; FEV1, forced expiratory volume in one second; FVC, forced vital capacity; TLC, total lung capacity; RV, residual volume; Raw, airway resistance; FeNO, fractional exhaled nitric oxide; Eos, eosinophils. P-values below 0.050 are considered statistically significant.

Table 2. Univariate and multivariate binomial logistic regression analysis of factors associated with physical activity levels.

	Univariate binomial logistic regression			**Multivariate binomial logistic regression**		
	OR	**95% CI**	**p-value**	**OR**	**95% CI**	**p-value**
Age, median (IQ 25-75)	0.902	0.815-0.999	**0.047**	0.864	0.622-1.200	0.383
Sex F, n (%)	1.543	0.329-7.226	0.582			
BMI	0.870	0.724-1.044	0.135			
COPD	3	0.459-19.52	0.251			
ASTHMA	0.900	0.133-6.080	0.914			
BSI (IQ 25-75)	0.823	0.627-1.081	0.162			
FACED (IQ 25-75)	0.300	0.039-2.284	0.245			
Number Involved lobes (IQ 25-75)	1.032	0.520-2.049	0.928			
%FEV1 (IQ 25-75)	1.024	0.990	1.058			
FEV1 ml (IQ 25 - 75)	2.426	0.864-6.813	0.092			
%FVC (IQ 25 - 75)	1.036	0.990-1.083	0.127			
FVC ml (IQ 25 - 75)	0.984	0.919-1.054	0.649			
FEV1/FVC (IQ 25 - 75)	1.037	0.979-1.099	0.214			
%TLC	1.060	0.989	1.137			
TLC	0.992	0.961-1.024				
% RV (IQ 25 - 75)	1.019	0.994-1.045	0.145			
RV ml (IQ 25 - 75)	0.924	0.719-1.188	0.538			
% RV/TLC (IQ 25 - 75)	1.002	0.982-1.023	0.814			
Raw (IQ 25 - 75)	0.969	0.942-0.997	**0.032**	0.943	0.838 – 1.060	0.323
Eos cell/microL	0.989	0.979-1	**0.043**	0.954	0.884 – 1.029	0.222
FeNO 50 (IQ 25 - 75)	0.837	0.736-0.952	**0.007**	0.544	0.250 – 1.213	0.147

BE, bronchiectasis; COPD, chronic obstructive pulmonary disease; GERD, gastroesophageal reflux disease; OSAS, obstructive sleep apnea syndrome; LTOT, long-term oxygen therapy; NIV-CPAP, non-invasive ventilation - continuous positive airway pressure; ICS, inhaled corticosteroids; LABA, long-acting beta-agonists; LAMA, long-acting muscarinic antagonists; BSI, bronchiectasis severity index; FACED, FEV1, age, Pseudomonas aeruginosa colonization, extent of bronchiectasis, dyspnea; FEV1, forced expiratory volume in one second; FVC, forced vital capacity; TLC, total lung capacity; RV, residual volume; Raw, airway resistance; FeNO, fractional exhaled nitric oxide; Eos count, eosinophil count; NTM, nontuberculous Mycobacteria. P-values below 0.050 are considered statistically significant.

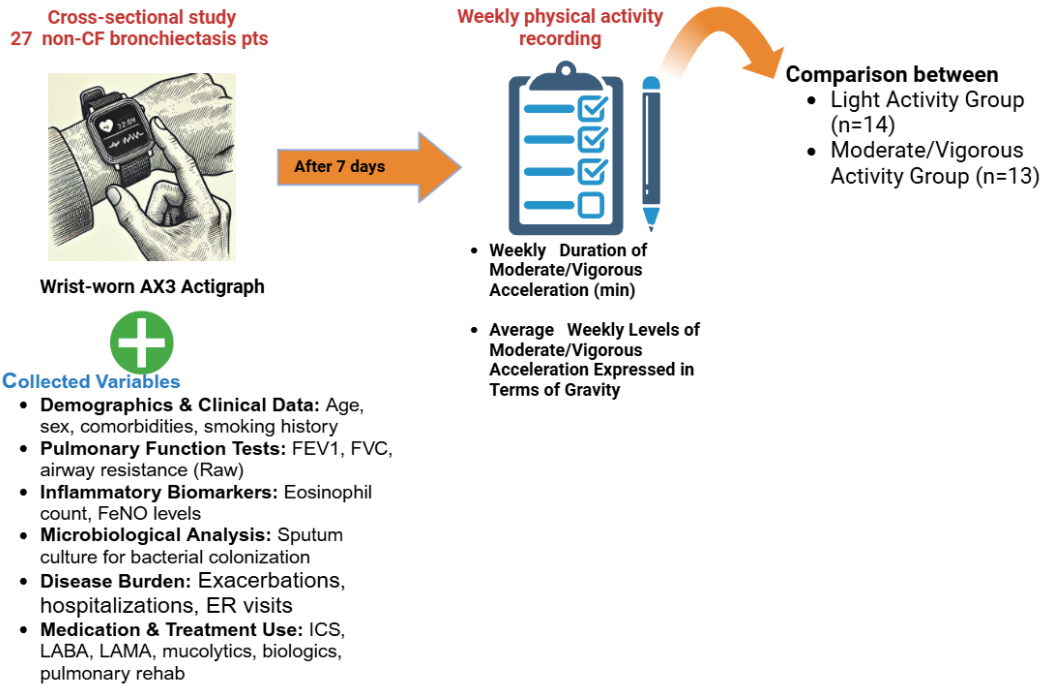

Figure 1. Graphical representation of the study design. CF, cystic fibrosis; pts, patients; FEV1, forced expiratory volume in 1 second; FVC, forced vital capacity; Raw, airway resistance; FeNO, fractional exhaled nitric oxide; ER, emergency room; ICS, inhaled corticosteroids; LABA, long-acting beta-agonists; LAMA, long-acting muscarinic antagonists.

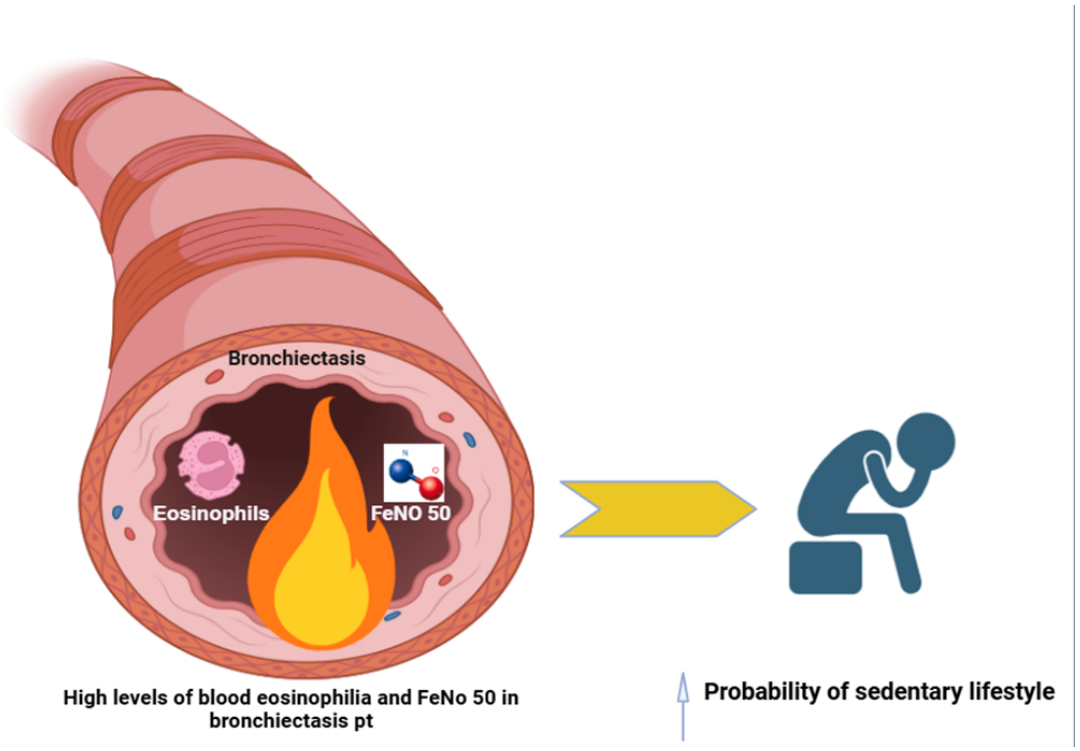

Figure 2. Graphical Representation of the study's main findings. FeNO 50, fractional exhaled nitric oxide at 50 mL/s; pt, patient; ↑, increased.