Thorac Res Pract. 2026;27(2):96-102 **DOI:** 10.4274/ThoracResPract.2026.2025-9-3

Original Article

The Relationship Between Peripheral Eosinophilia, Lower Respiratory Tract Pathogens, Age at First Pneumonia, and Malnutrition in Children with Non-cystic Fibrosis Bronchiectasis

Esin Gizem Olgun, Gizem Özcan, Fazılcan Zirek, Merve Nur Tekin, Secahattin Bayav, Mahmut Turğut, Mukaddes Ağırtıcı, Semra Küçük Öztürk, Seyhan Çelik Merteşe, Nazan Çobanoğlu

Department of Pediatric Pulmonology, Ankara University Faculty of Medicine, Ankara, Türkiye

Cite this article as: Olgun EG, Özcan G, Zirek F, et al. The relationship between peripheral eosinophilia, lower respiratory tract pathogens, age at first pneumonia, and malnutrition in children with non-cystic fibrosis bronchiectasis. *Thorac Res Pract.* 2026;27(2):96-102

ABSTRACT

OBJECTIVE: Non-cystic fibrosis (non-CF) bronchiectasis is a chronic lung disease, primarily characterised by neutrophilic inflammation, with *Haemophilus influenzae* (HI) frequently isolated from respiratory cultures. Recent adult studies have suggested a potential role for eosinophils in the frequency of pulmonary exacerbations and in lung function decline. This study aimed to evaluate the relationships among peripheral eosinophilia, lower respiratory tract pathogens, age at first pneumonia, and malnutrition in children with non-CF bronchiectasis.

MATERIAL AND METHODS: In this retrospective study, children who were diagnosed with non-CF bronchiectasis were grouped based on nutritional status, eosinophilia, age at first pneumonia, and the most frequently isolated microorganisms. Clinical outcomes were compared across groups.

RESULTS: Among 106 patients (61.3% male), malnutrition was present in 48.1% and eosinophilia in 39.6%. Primary immunodeficiency was the most common etiology (39.6%). HI and *Pseudomonas aeruginosa* (PA) were isolated in 61.3% and 24.5% of respiratory cultures, respectively. Patients with malnutrition had significantly lower forced expiratory volume in one second and forced vital capacity (FVC) values ($P = 0.023$ and $P = 0.005$, respectively). Eosinophilia was more prevalent in patients with PA isolation; was associated with younger ages at first pneumonia and bronchiectasis diagnoses ($P = 0.009$ and $P = 0.017$). PA isolation was associated with a higher frequency of aspiration syndromes ($P < 0.001$) and lower FVC values ($P = 0.040$). Patients who experienced their first episode of pneumonia before the age of two had more frequent exacerbations and were diagnosed with bronchiectasis at an earlier age.

CONCLUSION: Non-CF bronchiectasis in childhood may be preventable and/or non-progressive when diagnosed early. Clinical features such as malnutrition, eosinophilia, PA isolation, and early-onset pneumonia may help identify children who could benefit from closer clinical monitoring. Further pediatric studies are needed to validate these associations.

KEYWORDS: Bronchiectasis, eosinophilia, malnutrition, *Pseudomonas aeruginosa*

Received: 18.09.2025 ***Revision Requested:*** 11.01.2026 ***Last Revision Received:*** 02.02.2026

Accepted: 12.02.2026 ***Epub:*** 27.02.2026 ***Publication Date:*** 12.03.2026

Corresponding author: Esin Gizem Olgun, MD, e-mail: esingizemolgun@outlook.com

INTRODUCTION

Non-cystic fibrosis (non-CF) bronchiectasis is a chronic lung disease clinically characterized by recurrent pulmonary exacerbations accompanied by a wet or productive cough. Although bronchiectasis is typically regarded as irreversible bronchial dilation, early and effective treatment may lead to partial or complete reversal of airway damage.[1,2] Although chronic productive cough is the most common symptom of non-CF bronchiectasis, patients may also present with dyspnea, recurrent wheezing, persistent purulent sputum, hemoptysis, growth failure, and chest wall deformities.[3] Computed tomography (CT) of the chest is the gold standard for diagnosis.[4] Management strategies should be age-appropriate and individualized, including airway clearance techniques, mucoactive agents, pulmonary rehabilitation, and appropriate antibiotic therapy.[5-7] Given that the inflammation is typically neutrophilic, long-term macrolide therapy is often recommended.[8-12]

While the incidence of pediatric non-CF bronchiectasis has decreased due to improvements in antibiotic therapy and immunization programs, it still represents a significant cause of respiratory morbidity and mortality.[1,5] Global incidence rates in children are heterogeneous: reported rates range from 0.2 to 2.3 per 100,000 in Europe, 13.3 per 100,000 in the United Arab Emirates, and as high as 735 per 100,000 in Australia.[13,14] Though data from developing countries are scarce, poor living conditions and inadequate immunization in low-income settings have been associated with increased prevalence of non-CF bronchiectasis.[3,6,13,15]

The pathophysiology of non-CF bronchiectasis is explained by a vicious cycle of infection and inflammation, in which airway infections trigger inflammatory responses that impair mucociliary clearance, leading to further airway injury and increased susceptibility to infection.[16] Beyond persistent bacterial bronchitis and foreign body aspiration, other etiologies include bronchiolitis obliterans, gastroesophageal reflux disease, aspiration syndromes, primary immunodeficiencies (PID), airway hyperreactivity, primary ciliary dyskinesia (PCD), sleep-related disorders, heart failure, and rheumatologic diseases.[6,17] Although neutrophilic inflammation is typically predominant in bronchoalveolar lavage (BAL), some cohorts have reported eosinophilic predominance.[5,16,18] Adult studies suggest that patients with eosinophilia experience more frequent exacerbations and greater declines in forced expiratory volume in one second (FEV_1).[19] Among microbial pathogens, *Haemophilus influenzae* (HI) is the most frequently isolated organism in children with non-CF bronchiectasis.

Main Points

- This study evaluates the associations between peripheral eosinophilia, lower respiratory tract pathogens, nutritional status, and age at first pneumonia in children with non-cystic fibrosis (non-CF) bronchiectasis.
- To our knowledge, this is among the few studies focusing specifically on pediatric non-CF bronchiectasis and its clinical predictors.
- Peripheral eosinophilia and early-life respiratory infections may serve as markers to guide clinical management in this patient group.
- Our findings highlight the need for increased awareness and multicenter collaborations to improve outcomes in pediatric bronchiectasis.

This study examines the associations between peripheral eosinophilia, early respiratory infections, nutritional status, and airway pathogens in children with non-CF bronchiectasis, aiming to identify clinical features and potential markers relevant to disease management. Evidence regarding these associations in children is limited. Therefore, this study aims to characterise clinical features and potential markers that may help guide management in this population.

MATERIAL AND METHODS

This study was approved by the Ethics Committee of the Ankara University Faculty of Medicine in Ankara, Türkiye (approval no: 2025/235, date: 14.04.2025). Written consent was obtained from all participating children and their parents.

Medical records of patients under 18 years of age who were followed at our pediatric pulmonology outpatient clinic between 2015 and 2024 and who were diagnosed with bronchiectasis were retrospectively reviewed. One hundred and twenty patients under the age of 18 were diagnosed with bronchiectasis. Thirteen patients were excluded from the study because of a positive sweat test and detection of a *CFTR* gene mutation, resulting in a diagnosis of CF. One patient was also excluded following genetic testing that identified Hyperimmunoglobulin E syndrome (*STAT 3* gene defect). Data collected included age at first pneumonia, age at diagnosis of bronchiectasis, annual frequency of pulmonary exacerbations, malnutrition, peripheral eosinophilia, extent of bronchiectasis, spirometric parameters, lower airway microbiology, and underlying etiologies of bronchiectasis.

Malnutrition was assessed using body mass index (BMI) Z-scores adjusted for age; a Z-score below -1 was considered indicative of malnutrition.[20] Eosinophilia was defined as a total eosinophil count (TEC) >500 cells/μL on at least two separate complete blood counts, performed at intervals of at least 4 weeks.[21] Patients with PID associated with eosinophilia were excluded. The spirometry results included the percentages of FEV_1 and forced vital capacity (FVC) values in cooperative subjects. Respiratory pathogens identified from sputum, tracheal aspirate cultures, or BAL cultures were recorded, focusing on HI and PA. Etiological classifications of non-CF bronchiectasis were determined for all patients. Disease extent was evaluated using chest CT and categorized as localized (single lobe) or widespread (multiple lobes). Patients were grouped and compared based on nutritional status, eosinophilia presence, age at first pneumonia (<2 years vs. ≥2 years), and type of isolated microorganism. Outcomes were analyzed across groups.

To minimize potential sources of bias, we applied uniform diagnostic criteria for non-CF bronchiectasis and confirmed diagnoses by high-resolution CT. Peripheral eosinophil counts, microbiological cultures, and nutritional assessments were obtained using standardized laboratory and clinical protocols. Patients were included consecutively from our clinic to reduce

selection bias; only those with complete clinical and laboratory data were analyzed. These methodological approaches aimed to enhance the reliability of our findings despite the single-center setting.

Statistical Analysis

Statistical analyses were performed using SPSS version 20.0 (IBM Corp., Armonk, NY, USA). The distribution of quantitative variables was assessed using the Shapiro-Wilk test. Categorical variables were expressed as frequencies and percentages. Descriptive statistics were presented as mean and standard deviation for normally distributed variables. Student's t-test was used to compare continuous variables between groups, and the chi-square test was used for categorical variables. A *P* value of less than 0.05 was considered statistically significant.

RESULTS

A total of 106 patients diagnosed with non-CF bronchiectasis were included in the study. Demographic, clinical, and laboratory characteristics, as well as etiologies, are summarized in Table 1.

Of the patients, 61.3% were male. Chronic productive cough was reported in 89.6%, malnutrition in 48.1%, and eosinophilia in 39.6%. PID was the most frequent etiology (39.6%). HI and PA were isolated in 61.3% and 24.5% of respiratory cultures, respectively. The mean age at first pneumonia was 3.6±4.3 years, and the mean age at bronchiectasis diagnosis was 8.59±4.8 years. The average number of annual exacerbations was 5.8±2.0. Mean FEV_1 and FVC values were 73% and 75%, respectively.

When patients were compared by nutritional status, those with malnutrition had significantly lower FEV_1 and FVC values ($P = 0.023$ and $P = 0.005$, respectively) and a lower frequency of bronchial hyperreactivity ($P = 0.031$). No significant differences were observed in other clinical or etiological variables (Table 2).

Table 1. Demographic, clinical and laboratory characteristics and aetiologies of patients with non-CF bronchiectasis

	n (%)
Male	65 (61.3%)
Chronic productive cough	95 (89.6%)
Malnutrition	51 (48.1%)
Isolation of *Haemophilus influenzae*	65 (61.3%)
Isolation of *Pseudomonas aeruginosa*	26 (24.5%)
Eosinophilia	42 (39.6%)
PID	42 (39.6%)
Bronchial hyperreactivity	29 (27.3%)
Aspiration syndromes/GERD	28 (26.4%)
Bronchiolitis obliterans	23 (21.6%)
PCD	11 (10.3%)
Rheumatological diseases	5 (4.7%)
	Mean ± SD
Age at first pneumonia (year)	3.66±4.3
Age at diagnosis of bronchiectasis (year)	8.59±4.8
Number of pulmonary exacerbations per year	5.85±2.0
FEV_1 (%)	73±23
FVC (%)	75±19

non-CF: non-cystic fibrosis, PID: primary immunodeficiency, GERD: gastroesophageal reflux disease, PCD: primary ciliary dyskinesia, FEV_1: forced expiratory volume in one second, FVC: forced vital capacity

Table 2. Comparison of demographic, clinical, and laboratory characteristics and etiologies of non-CF bronchiectasis patients with and without malnutrition

	Malnutrition present (n = 51)	**Malnutrition absent (n = 55)**	***P* value**
Multiple lobes bronchiectasis	20	24	0.068*
Chronic productive cough	48	47	0.144*
Isolation of *Haemophilus influenzae*	33	32	0.491*
Isolation of *Pseudomonas aeruginosa*	13	13	0.825*
PID	19	23	0.631*
Bronchial hyperreactivity	9	20	**0.031***
Aspiration syndromes/GERD	14	14	0.816*
Bronchiolitis obliterans	14	9	0.166*
PCD	6	5	0.652*
Rheumatological diseases	2	3	0.710*
Age at first pneumonia mean ± SD (years)	3.85±4.4	3.92±4.0	0.554#
Age at bronchiectasis diagnosis mean ± SD (years)	8.72±5.3	8.91±4.2	0.864#
Annual exacerbation mean ± SD (attacks/year)	3.98±3.3	3.67±3.1	0.715#
FEV_1 mean ± SD (%)	65.5±18.8	77.7±23.2	**0.023#**
FVC mean ± SD (%)	67.8±16.6	79.7±17.6	**0.005#**

#Chi-square test was used

*Student-t test was used

non-CF: non-cystic fibrosis, PID: primary immunodeficiency, GERD: gastroesophageal reflux disease, PCD: Primary ciliary dyskinesia, SD: standard deviation, FEV_1: forced expiratory volume in one second, FVC: forced vital capacity

Eosinophilia was more commonly observed in patients with PA isolation ($P = 0.03$), while it was significantly less common among patients with chronic productive cough, bronchial hyperreactivity, and PCD ($P < 0.001$, 0.004, and 0.016, respectively). Patients with eosinophilia were significantly younger at first diagnosis of pneumonia and bronchiectasis ($P = 0.009$ and 0.017), though no significant differences were found in annual exacerbation frequency or spirometric values (Table 3).

When patients with isolation of HI were compared with those with isolation of PA, aspiration syndromes were more frequent in those with PA ($P < 0.001$), and FVC values were significantly lower in this group ($P = 0.040$) (Table 4).

Patients who experienced their first pneumonia before age 2 were diagnosed with bronchiectasis at a younger age ($P = 0.005$), experienced more frequent exacerbations ($P < 0.001$), had a higher prevalence of PCD ($P = 0.045$), and had lower rates of rheumatologic disease ($P = 0.041$) (Table 5).

Table 3. Comparison of demographic, clinical, and laboratory characteristics and etiologies of non-CF bronchiectasis patients with and without eosinophilia

	Eosinophilia present (n = 42)	Eosinophilia absent (n = 64)	*P* value
Multiple lobes bronchiectasis	15	29	0.327
Malnutrition	22	29	0.476
Chronic productive cough	39	56	**<0.001***
Isolation of *Haemophilus influenzae*	29	36	0.328*
Isolation of *Pseudomonas aeruginosa*	15	11	**0.03***
PID	16	26	0.860*
Bronchial hyperreactivity	5	24	**0.004***
Aspiration syndromes/GERD	13	15	0.679*
Bronchiolitis obliterans	8	15	0.599*
PCD	1	10	0.016*
Rheumatological diseases	2	3	0.491*
Age at first pneumonia mean ± SD (years)	2.67±3.3	4.73±4.5	**0.009#**
Age at bronchiectasis diagnosis mean ± SD (years)	7.48±4.9	9.69±4.4	**0.017#**
Annual exacerbation mean ± SD (attacks/year)	6±2.12	5.76±2.0	0.091#
FEV_1 mean ± SD (%)	68.9±18.4	73.4±22.5	0.154#
FVC mean ± SD (%)	73.0±15.7	75.4±19.0	0.456#

#Chi-square test was used
*Student-t test was used
non-CF: non-cystic fibrosis, PID: primary immunodeficiency, GERD: gastroesophageal reflux disease, PCD: Primary ciliary dyskinesia, SD: standard deviation, FEV_1: forced expiratory volume in one second, FVC: forced vital capacity

Table 4. Comparison of demographic, clinical, and etiological aspects of non-CF bronchiectasis patients based on isolation of HI or PA

	H. influenzae (n = 50)	*P. aeruginosa* (n = 11)	*P* value
Multiple lobes bronchiectasis	19	5	0.647*
Eosinophilia	19	5	0.647*
Malnutrition	26	6	0.878*
Chronic productive cough	48	10	0.480*
PID	21	3	0.365*
Bronchial hyperreactivity	18	3	0.581*
Aspiration syndromes/GERD	7	8	**<0.001***
Bronchiolitis obliterans	11	1	0.330*
PCD	8	0	0.155*
Rheumatological diseases	2	0	0.493*
Age at first pneumonia mean ± SD (years)	3.37±3.6	2.88±2.8	0.683#
Age at bronchiectasis diagnosis mean ± SD (years)	9.23±4.6	8.21±4.4	0.511#

Table 4. Continued

	H. influenzae (n = 50)	P. aeruginosa (n = 11)	*P* value
Annual exacerbation mean ± SD (attacks/year)	4.18±3.3	5.27±2.9	0.322#
FEV_1 mean ± SD (%)	72.1±18.4	48.0±47.6	0.064#
FVC mean ± SD (%)	74.6±14.2	53.3±40.4	**0.040#**

#Chi-square test was used
*Student-t test was used
non-CF: non-cystic fibrosis, HI: *Haemophilus influenzae*, PA: *Pseudomonas aeruginosa*, PID: primary immunodeficiency, GERD: gastroesophageal reflux disease, PCD: Primary ciliary dyskinesia, SD: standard deviation, FEV_1: forced expiratory volume in one second, FVC: forced vital capacity

Table 5. Comparison of demographic, clinical, and etiological aspects of non-CF bronchiectasis patients based on age at first pneumonia

	Age at first pneumonia <2 years (n = 47)	Age at first pneumonia ≥2 years (n = 59)	*P* value
Multiple lobes bronchiectasis	18	26/33	0.549*
Chronic productive cough	44	51	0.229*
Malnutrition	23	28	0.880*
Eosinophilia	22	20	0.177*
Isolation of *Haemophilus influenzae*	28	37	0.742*
Isolation of *Pseudomonas aeruginosa*	9	17	0.251*
PID	20	22	0.582*
Bronchial hyperreactivity	9	20	0.091*
Aspiration syndromes/GERD	14	14	0.482*
Bronchiolitis obliterans	10	13	0.925*
PCD	8	3	**0.045***
Rheumatological diseases	0	5	**0.041***
Age at bronchiectasis diagnosis mean ± SD (years)	7.39±4.6	9.95±4.5	**0.005#**
Annual exacerbation mean ± SD (attacks/year)	5.17±3.0	2.74±3.0	**<0.001#**
FEV_1 mean ± SD (%)	70.9±23.0	73.7±21.0	0.619#
FVC mean ± SD (%)	74.2±17.0	75.0±18.0	0.856#

#Chi-square test was used
*Student-t test was used
non-CF: non-cystic fibrosis, PID: primary immunodeficiency, GERD: gastroesophageal reflux disease, PCD: Primary ciliary dyskinesia, SD: standard deviation, FEV_1: forced expiratory volume in one second, FVC: forced vital capacity

DISCUSSION

In this study of children with non-CF bronchiectasis, we found that patients with malnutrition had lower FEV_1 and FVC values; those with isolation of PA had a higher incidence of aspiration syndromes and lower FVC values; and eosinophilic patients were diagnosed at a younger age and had more frequent isolation of PA and less frequent chronic cough, PCD, and bronchial hyperreactivity, reflecting an association rather than disease severity. Furthermore, patients who experienced pneumonia before the age of two had more frequent annual exacerbations, an earlier onset of bronchiectasis, a higher prevalence of PCD, and fewer rheumatologic diagnoses.

Study Limitations

There are also some limitations to our study. Since our centre is a tertiary care facility, our patients completed their treatment without being admitted to us during each pulmonary exacerbation. The number of pulmonary exacerbations per patient was reported as a mean value based on parents' reports obtained during routine follow-up visits. In addition, patients who had their first pneumonia before the age of 2 years were less cooperative during spirometry at follow-up because they were younger. This may be the reason why there was no significant difference in FEV_1 and FVC values. We are aware that the results of our study involving 106 children with non-CF bronchiectasis cannot be generalised because of the uneven distribution of participants among groups; however, we believe that the similarity of conditions such as eosinophilia, malnutrition, and PA isolation between our cohort and previous adult studies is a strength of the study.

In our cohort, the majority of patients (89.6%) presented with a chronic productive cough. The mean age at first pneumonia was 3.66 years, and the mean age at bronchiectasis diagnosis was 8.59 years. Nearly half of the patients (48.1%) were malnourished. Previous studies in low- to middle-income countries report similarly high rates of productive cough (53–96%).[22-25] A Thai study involving 35 children with non-CF bronchiectasis reported a mean age at diagnosis of 36

months.[26] An Italian study involving 105 children reported that the mean age at first pneumonia was 1.3 years, and the mean age at diagnosis of bronchiectasis was 7 years.[27] The longer interval between initial pneumonia and diagnosis, observed in developed countries, may be attributed to better healthcare access and lower rates of malnutrition.

While CF is the most common cause of bronchiectasis in high-income countries, epidemiological data for non-CF bronchiectasis remain unclear. Although reported causes are influenced by local diagnostic capabilities, PID, aspiration syndromes, post-infectious conditions, PCD, and congenital malformations are the most common causes worldwide.[6] Among pediatric populations in low- and middle-income countries, non-CF bronchiectasis is more common due to insufficient immunization coverage and higher rates of malnutrition. Although it is often classified as idiopathic due to limited diagnostic facilities, in our study the most common cause of non-CF bronchiectasis was PID (39.6%), a rate similar to that reported in studies from developed countries (10-34%).[13]

Consistent with the literature, HI (61.3%) was the most frequently isolated pathogen in our study, followed by PA (24.5%).[2,25] PA was more frequently identified in children with aspiration syndromes than in those with HI, and it was associated with significantly lower FVC. While this has been linked to higher morbidity in adults, pediatric data are lacking.[2,25,28]

Li et al.[29] reported a positive correlation of low BMI and low serum albumin/prealbumin levels with bronchiectasis severity on chest CT in adults. Similar pediatric studies are lacking. Similar to Li et al.[29], we also found that patients with malnutrition had lower FEV_1 and FVC values, indicating a greater reduction in lung capacity. Because children often have difficulty performing spirometry, further studies are needed to evaluate the relationship between lung capacity and malnutrition in patients with non-CF bronchiectasis.

Although neutrophilic inflammation predominates in non-CF bronchiectasis, some cohorts have shown eosinophilic involvement.[30,31] Previous studies suggest that PA may suppress Th1 responses via exotoxins and promote type 2 inflammation through elastase B and other virulence factors.[32] Guan et al.[33] defined eosinophilic bronchiectasis in adults as peripheral TEC >300 cells/μL (excluding eosinophilic syndromes), and found that eosinophilic patients more frequently had PA isolation and experienced higher morbidity and mortality. Consistent with previous studies in adults, eosinophilic children in our cohort showed a higher frequency of PA isolation; however, lung function parameters did not differ significantly between the groups. These findings may be associated with a different clinical profile, though conclusions regarding disease severity cannot be drawn from this study. Whether targeted anti-inflammatory approaches could be beneficial in selected pediatric patients requires validation in future controlled studies.

Among patients whose first episode of pneumonia occurred before age two, we observed higher exacerbation rates, earlier diagnosis of bronchiectasis, and higher frequency of PCD. These findings align with a study by Santamaria et al.[27] in Italy, which reported that early-onset pneumonia in children with non-CF bronchiectasis was often associated with underlying conditions, such as PCD, PID, and aspiration syndromes.

CONCLUSION

In our study of children with non-CF bronchiectasis, we demonstrated that malnutrition and PA isolation were associated with reduced lung capacity; eosinophilic patients had higher rates of poor-prognosis PA isolation; and age at first pneumonia was associated with earlier bronchiectasis diagnosis and higher annual exacerbation frequency. Non-CF bronchiectasis in childhood may be preventable or nonprogressive when diagnosed early, as suggested by previous studies. Greater attention to clinical features such as malnutrition, eosinophilia, PA isolation, and early-onset pneumonia may help identify children who could benefit from closer follow-up. Nevertheless, further research is needed in the pediatric population to better understand and manage this disease.

Ethics

Ethics Committee Approval: This study was approved by the Ethics Committee of the Ankara University Faculty of Medicine in Ankara, Türkiye (approval no: 2025/235, date: 14.04.2025).

Informed Consent: Written consent was obtained from all participating children and their parents.

Footnotes

Authorship Contributions

Surgical and Medical Practices: G.Ö., M.T., M.A., S.K.Ö., N.Ç., Concept: E.G.O., F.Z., N.Ç., Design: E.G.O., N.Ç., Data Collection or Processing: F.Z., M.N.T., S.B., Analysis or Interpretation: M.N.T., N.Ç., Literature Search: E.G.O., Writing: E.G.O.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

REFERENCES

1. Chang AB, Fortescue R, Grimwood K, et al. European Respiratory Society guidelines for the management of children and adolescents with bronchiectasis. *Eur Respir J.* 2021;58(2):2002990. [Crossref]
2. Al Subie H, Fitzgerald DA. Non-cystic fibrosis bronchiectasis. *J Paediatr Child Health.* 2012;48(5):382-388. [Crossref]
3. Gallucci M, Candela E, Di Palmo E, Miniaci A, Pession A. Non-cystic fibrosis bronchiectasis in pediatric age: a case series in a Metropolitan Area of Northern Italy. *Children (Basel).* 2022;9(9):1420. [Crossref]
4. Tiddens H, Meerburg JJ, van der Eerden MM, Ciet P. The radiological diagnosis of bronchiectasis: what's in a name? *Eur Respir Rev.* 2020;29(156):190120. [Crossref]
5. Chang AB, Bush A, Grimwood K. Bronchiectasis in children: diagnosis and treatment. *Lancet.* 2018;392(10150):866-879. [Crossref]
6. Poeta M, Maglione M, Borrelli M, Santamaria F. Non-cystic fibrosis bronchiectasis in children and adolescents: Neglected and emerging issues. *Pediatr Neonatol.* 2020;61(3):255-262. [Crossref]

7. Faverio P, Franco G, Landoni V, et al. Therapeutic management of bronchiectasis in children and adolescents: a concise narrative review. *J Clin Med.* 2024;13(16):4757. **[Crossref]**
8. El Boustany P, Gachelin E, Colomban C, et al. A review of non-cystic fibrosis bronchiectasis in children with a focus on the role of long-term treatment with macrolides. *Pediatr Pulmonol.* 2019;54(4):487-496. **[Crossref]**
9. Sun YW, Cen YH, Chen MH, Yan XK, Jin XF. Safety profiles and adverse reactions of azithromycin in the treatment of pediatric respiratory diseases: a systematic review and meta-analysis. *Medicine (Baltimore).* 2023;102(48):e36306. **[Crossref]**
10. Gallucci M, di Palmo E, Bertelli L, Camela F, Ricci G, Pession A. A pediatric disease to keep in mind: diagnostic tools and management of bronchiectasis in pediatric age. *Ital J Pediatr.* 2017;43(1):117. **[Crossref]**
11. Bush A. Azithromycin is the answer in paediatric respiratory medicine, but what was the question? *Paediatr Respir Rev.* 2020;34:67-74. **[Crossref]**
12. Song G, Zhang Y, Yu S, et al. Efficacy and safety of macrolides in the treatment of children with bronchiectasis: a meta-analysis. *Pediatr Res.* 2023;94(5):1600-1608. **[Crossref]**
13. McCallum GB, Binks MJ. The epidemiology of chronic suppurative lung disease and bronchiectasis in children and adolescents. *Front Pediatr.* 2017;5:27. **[Crossref]**
14. Mocelin HT, Fischer GB, Piccini JD, Baú R, Andrade CF, Lukrafka JL. Surgical treatment of non-cystic fibrosis bronchiectasis in children and adolescents: a review. *Paediatr Respir Rev.* 2023;46:57-62. **[Crossref]**
15. Gupta AK, Lodha R, Kabra SK. Non cystic fibrosis bronchiectasis. *Indian J Pediatr.* 2015;82(10):938-944. **[Crossref]**
16. Goyal V, Grimwood K, Marchant J, Masters IB, Chang AB. Pediatric bronchiectasis: no longer an orphan disease. *Pediatr Pulmonol.* 2016;51(5):450-469. **[Crossref]**
17. Wang H, Xu BP, Bao YM, et al. Etiology and clinical features of children with bronchiectasis in China: a 10-year multicenter retrospective study. *Clin Respir J.* 2023;17(9):841-850. **[Crossref]**
18. Benson VS, Hartl S, Barnes N, Galwey N, Van Dyke MK, Kwon N. Blood eosinophil counts in the general population and airways disease: a comprehensive review and meta-analysis. *Eur Respir J.* 2022;59(1):2004590. **[Crossref]**
19. Singh D, Agusti A, Martinez FJ, et al. Blood eosinophils and chronic obstructive pulmonary disease: a Global Initiative for Chronic Obstructive Lung Disease Science Committee 2022 review. *Am J Respir Crit Care Med.* 2022;206(1):17-24. **[Crossref]**
20. Becker P, Carney LN, Corkins MR, et al. Consensus statement of the Academy of Nutrition and Dietetics/American Society for Parenteral and Enteral Nutrition: indicators recommended for the identification and documentation of pediatric malnutrition (undernutrition). *Nutr Clin Pract.* 2015;30(1):147-161. **[Crossref]**
21. Costagliola G, Marco SD, Comberiati P, et al. Practical approach to children presenting with eosinophila and hypereosinophilia. *Curr Pediatr Rev.* 2020;16(2):81-88. **[Crossref]**
22. Singleton RJ, Valery PC, Morris P, et al. Indigenous children from three countries with non-cystic fibrosis chronic suppurative lung disease/bronchiectasis. *Pediatr Pulmonol.* 2014;49(2):189-200. **[Crossref]**
23. Kumar A, Lodha R, Kumar P, Kabra SK. Non-cystic fibrosis bronchiectasis in children: clinical profile, etiology and outcome. *Indian Pediatr.* 2015;52(1):35-37. **[Crossref]**
24. Lai SH, Wong KS, Liao SL. Clinical analysis of bronchiectasis in Taiwanese children. *Chang Gung Med J.* 2004;27(2):122-128. **[Crossref]**
25. Eralp EE, Gokdemir Y, Atag E, et al. Changing clinical characteristics of non-cystic fibrosis bronchiectasis in children. *BMC Pulm Med.* 2020;20(1):172. **[Crossref]**
26. Sitthikarnkha P, Anekvorakul A, Niamsanit S, Techasatian L, Saengnipanthkul S, Uppala R. Clinical characteristics and outcome of non-cystic fibrosis bronchiectasis in children: a tertiary care perspective. *SAGE Open Med.* 2025;13:20503121251320849. **[Crossref]**
27. Santamaria F, Montella S, Pifferi M, et al. A descriptive study of non-cystic fibrosis bronchiectasis in a pediatric population from central and southern Italy. *Respiration.* 2009;77(2):160-165. **[Crossref]**
28. Macfarlane L, Kumar K, Scoones T, Jones A, Loebinger MR, Lord R. Diagnosis and management of non-cystic fibrosis bronchiectasis. *Clin Med (Lond).* 2021;21(6):571-577. **[Crossref]**
29. Li L, Li Z, Bi J, et al. The association between serum albumin/prealbumin level and disease severity in non-CF bronchiectasis. *Clin Exp Pharmacol Physiol.* 2020;47(9):1537-1544. **[Crossref]**
30. Tsikrika S, Dimakou K, Papaioannou AI, et al. The role of non-invasive modalities for assessing inflammation in patients with non-cystic fibrosis bronchiectasis. *Cytokine.* 2017;99:281-286. **[Crossref]**
31. Pizzutto SJ, Grimwood K, Bauert P, et al. Bronchoscopy contributes to the clinical management of indigenous children newly diagnosed with bronchiectasis. *Pediatr Pulmonol.* 2013;48(1):67-73. **[Crossref]**
32. Agaronyan K, Sharma L, Vaidyanathan B, et al. Tissue remodeling by an opportunistic pathogen triggers allergic inflammation. *Immunity.* 2022;55(5):895-911.e10. **[Crossref]**
33. Guan WJ, Oscullo G, He MZ, Xu DY, Gómez-Olivas JD, Martinez-Garcia MA. Significance and potential role of eosinophils in non-cystic fibrosis bronchiectasis. *J Allergy Clin Immunol Pract.* 2023;11(4):1089-1099. **[Crossref]**