İSTANBUL UNIVERSITY PRESS

Çocuk Dergisi–Journal of Child,
JCHILD 2025, 25 (3): 125–131

https://doi.org/10.26650/jchild.2025.1670359

Çocuk Dergisi
Journal of Child

Submitted: 09.06.2025
Revision Requested: 31.07.2025
Last Revision Received: 04.08.2025
Accepted: 04.08.2025

Research Article

Open Access

Foreign body aspiration in children with allergic diseases: coincidence or association?

Sefika Ilknur Kokcu Karadağ [1,4], Elif Uğurlu [2], Hilal Güngör [4], Berat Dilek Demirel [3] & Recep Sancak [1]

[1] Ondokuz Mayıs University, Department of Pediatric Allergy and Immunology, Samsun,Türkiye
[2] Ondokuz Mayıs University, Department of Pediatrics, Samsun, Türkiye
[3] Ondokuz Mayıs University, Faculty of Medicine, Department of Pediatric Surgery, Samsun, Türkiye
[4] Prof.Dr.Cemil Tascıoglu City Hospital, Department of Pediatric Allergy and Immunology, Istanbul, Türkiye

Abstract

Objective: The aim of this study was to evaluate the reality of allergic disease risk in cases of foreign body aspiration and to assess the relationship between these two conditions.

Materials and Methods: The study included 63 patients who underwent bronchoscopy by the Pediatric Surgery Department with suspected foreign body aspiration. Demographic information of the patients was collected from hospital records, while data on allergic diseases were gathered through questionnaires.

Results: Out of 63 patients who underwent bronchoscopy due to suspected foreign body aspiration, a foreign body was detected in 48 (76.2%) cases, while 15 (23.8%) cases had no detection. Among those with detected foreign bodies, 93.3% were aged 3 years or younger, with a male-to-female ratio of 2.8:1. The most common foreign bodies found were hazelnuts (37.5%) and peanuts (20.8%). Among the patients presenting with suspected foreign body aspiration, 65.1% had wheezing and whistling sounds in their chest, 30.2% had previously been diagnosed with allergic bronchitis and asthma by doctors, 20.6% showed symptoms of allergic rhinitis, and 6.3% had allergic conjunctivitis. Additionally, a significant relationship was observed between smoking at home and foreign body aspiration (p = 0.04).

Conclusion: The findings of this study suggest a potential relationship between foreign body aspiration and allergic diseases. It is thought that allergic diseases may increase the susceptibility of the airways and mucosal edema, making it easier for foreign bodies to enter the respiratory tract. This situation could increase the risk of foreign body aspiration in an allergic individual.

Keywords Foreign body aspiration · allergic diseases · bronchoscopy · respiratory tract · risk factors

Citation: Kokcu Karadağ, S. I., Uğurlu, E., Güngör, H., Demirel, B. D. & Sancak, R. Foreign body aspiration in children with allergic diseases: coincidence or association? . Çocuk Dergisi–Journal of Child 2025; 25(3): 125-131. DOI: 10.26650/jchild.2025.1670359

Corresponding author: Sefika Ilknur Kokcu Karadağ drilknurkokcu @gmail.com

INTRODUCTION

Foreign body aspiration (FBA) in children is a serious condition requiring urgent evaluation and treatment, and it is the fourth most common cause of accidental death in children under three years of age (1). The diagnostic triad of sudden onset cough, wheezing, and unilateral decreased breath sounds, known as the classic triad, is significant in FBA diagnosis, with the frequency of these three signs occurring together ranging from 15% to 65% (2). The gold standard for diagnosis is bronchoscopy, and regardless of whether the diagnosis is made via imaging techniques or not, bronchoscopy is indicated in all suspected FBA cases (3). Because normal findings on physical examination and radiological assessment do not rule out FBA, bronchoscopy should be performed in all suspicious cases (4). This condition typically occurs in children and results from the inhalation of objects such as toy parts, food items, or small household objects (5). Children aged one to three years are at particularly high risk of FBA as they tend to explore the world orally (4). While most FBA cases are observed in children under three years of age, the highest incidence is reported in children aged one to two years (6).

Allergic reactions can lead to the narrowing and inflammation of the airways when exposed to allergens, especially those causing respiratory symptoms (7). This condition can facilitate the entry of foreign bodies into the airways due to the narrowing of the respiratory passages (8). Furthermore, some allergic reactions can increase edema and mucus production in the airways, which can cause foreign bodies to settle more easily in the airways (9). Particularly for children, symptoms such as itching of the mouth and nose during allergic reactions can lead to the introduction of foreign objects into their mouths or noses (10). Therefore, individuals with symptoms of allergic diseases may have an increased risk of foreign body aspiration (11).

There is currently no clear information on whether allergic diseases are more common in patients with foreign body aspiration (12). However, some studies suggest that there is a relationship between foreign body aspiration and allergic diseases (11). It is important for individuals with allergic diseases, especially those experiencing symptoms affecting the respiratory tract, to be cautious about the risk of foreign body aspiration (10). Particularly when experiencing symptoms affecting the respiratory tract, individuals should be vigilant about the risk of foreign body aspiration. Allergic reactions can cause itching and irritation in the airways, triggering cough and sneeze reflexes, which can facilitate the entry of foreign bodies into the airways. Conditions such as allergic asthma can make the airways more sensitive and narrow, making it more likely for foreign bodies to enter and cause obstruction in the airways. Additionally, during allergic reactions, increased mucus production in the airways can occur, leading to accumulation in the airways, which can facilitate the adherence of foreign bodies and cause obstruction. Furthermore, conditions such as allergic rhinitis and sinusitis can lead to the accumulation of foreign bodies in the nasal cavity and their progression into the airways (9-14).

Foreign body aspiration (FBA) is a significant pediatric emergency that presents diagnostic challenges, especially in children. Although age- and sex-related patterns of FBA are well established in the literature, the potential association between FBA and allergic diseases has not been adequately explored. This study is among the first to systematically examine allergic comorbidities in children undergoing bronchoscopy for suspected FBA, thereby uncovering a potential clinical overlap between two common pediatric conditions that are typically evaluated independently (15,16).

MATERIALS AND METHODS

Patient Selection and Data Collection: Our study was conducted at the Medical Faculty Hospital, involving 63 patients who underwent bronchoscopy by the Pediatric Surgery Department for suspected foreign body aspiration between 2019 and 2022. Important information such as allergic symptoms, environmental exposures, and family history of the patients were collected through questionnaires. These data provided fundamental insights to understand the relationship between allergic diseases and foreign body aspiration.

Data Analysis: The collected data were analyzed using a statistical software package. Age and gender differences between the groups were assessed using appropriate statistical methods such as t-tests and chi-square tests. The significance level was set at $p<0.05$.

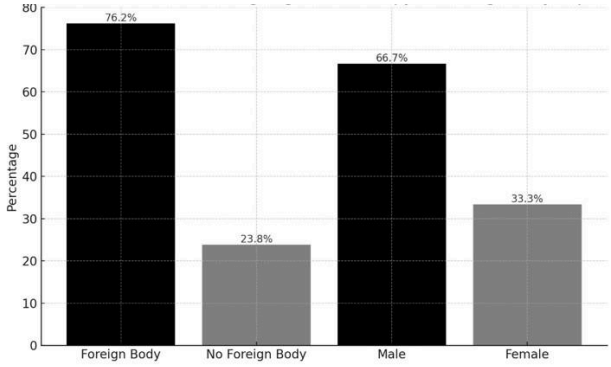
Ethics Committee: Ethical approval for this study was obtained from the Clinical Research Ethics Committee of Ondokuz Mayıs University. Our study was conducted in accordance with the principles of good clinical practice based on the Declaration of Helsinki. Ethical approval confirms that studies are conducted in compliance with ethical standards and human rights and that the rights of the participants were protected through informed consent. The study protocol was approved by the Ethics Committee of Ondokuz Mayıs University with the approval number 2020/42.

RESULT

In our study, rigid bronchoscopy was performed on 63 patients with suspected foreign body aspiration. Foreign bodies were detected in 48 patients (76.2%), while no foreign bodies were found in 15 patients (23.8%) (Figure 1). Among the 63 patients

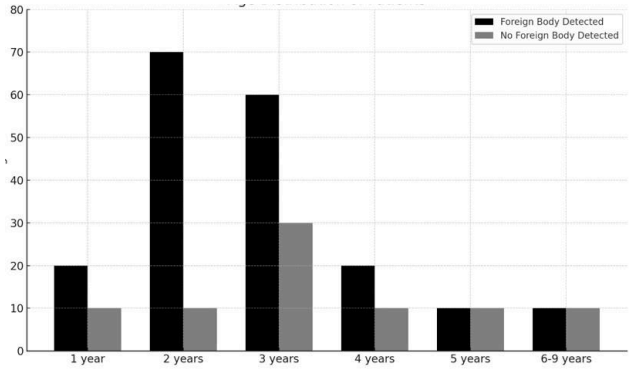
evaluated for suspected foreign body aspiration, 66.7% were male (n = 42) and 33.3% were female (n = 21) (Figure 1). The male-to-female ratio was determined to be 2:1. Additionally, when divided into two groups based on the presence or absence of a foreign body, 35.4% (n = 17) of the 48 patients with detected foreign bodies were female and 64.6% (n = 31) were male. In this case, the male-to-female ratio was 2.8:1.

Figure 1. Distribution of Patients Undergoing Bronchoscopy for Foreign Body Aspiration



The mean age ± standard deviation of the patients who underwent bronchoscopy for suspected foreign body aspiration was calculated as 3.0 ± 1.6 years (median: 3). The age range was between 1 and 9 years (median: 3). The mean age of patients with detected foreign bodies was 3.3 ± 1.67 years (minimum 1, maximum 9), whereas for patients without detected foreign bodies, it was 2.2 ± 0.9 years (minimum 1, maximum 4). The age difference between the two groups was found to be statistically significant (p<0,01). The age distributions of the patients are shown in Figure 2. In both age groups (under 3 years and over 3 years), foreign body aspiration was more common in males (Table 1).

Figure 2. Age distribution of patients



In terms of foreign body variety, the most frequently encountered foreign bodies were identified as hazelnuts (37.5%) and peanuts (20.8%). The other foreign bodies included walnuts (10.4%), almonds (2.1%), and pencil erasers (4.2%).

Table 1. Distribution of Foreign Body Presence by Age and Gender with Percentages

Category	Foreign Body Present n (%)	No Foreign Body n (%)	p-value
Group 1: ≤ 3 years			
Total	36 (72%)	14 (28%)	<0.01
Male	25 (71.4%)	10 (28.6%)	<0.01
Female	11 (73.3%)	4 (26.7%)	0.03
Group 2: > 3 years			
Total	12 (92.3%)	1 (7.7%)	<0.01
Male	6 (85.7%)	1 (14.3%)	0.03
Female	6 (100%)	0 (0%)	<0.01

In our study, children evaluated for suspected foreign body aspiration were assessed for allergic diseases. Because of this assessment, the frequency of having experienced at least one episode of chest wheezing or whistling in the past was found to be 65.1% (n = 41). Additionally, among these children, the diagnosis rates by doctors were 30.2% (n = 19) for allergic bronchitis or asthma, 20.6% (n = 13) for allergic rhinitis, 12.7% (n = 8) for eczema or itchy rashes, 6.3% (n = 4) for allergic conjunctivitis, and 3.2% (n = 2) for urticaria. These findings reveal a high prevalence of allergic symptoms in the patient group examined.

When the patients were divided into two groups based on the presence or absence of foreign bodies, 70.8% (n = 34) of the children in the group with detected foreign bodies reported having experienced at least one episode of chest wheezing or whistling in the past. In this group, the diagnosis rates by doctors were 31.3% (n = 15) for allergic bronchitis or asthma, 22.9% (n = 11) for allergic rhinitis, and 14.6% (n = 7) for eczema or itchy rashes. Although these findings are not statistically significant, they indicate a more pronounced presence of allergic conditions in this group (Table 2).

Because of examining environmental factors, it was found that factors such as smoking at home and having pets showed a similar distribution between the groups with and without detected foreign bodies. However, it was observed that smoking occurred more frequently in the homes of patients with detected foreign bodies (p = 0.04).

In conclusion, our study revealed the demographic characteristics and allergic conditions of pediatric patients who underwent bronchoscopy due to suspected foreign bodies, as well as the impact of environmental factors on these conditions. Our findings highlight the importance of considering these factors in pediatric bronchoscopy practices. This study paves the way for larger-scale research to better

Table 2. Comparison of Allergic Symptoms Between Groups (ISAAC-based Questionnaire)

Question	Total (n=%)	Foreign Body Not Detected (n=%)	Foreign Body Detected (n=%)	p-value
1. Has your child ever had wheezing or whistling sounds in their chest at any time in the past?	41 (65.1%)	7 (46.7%)	34 (70.8%)	0.09
2. Has a doctor ever diagnosed your child with allergic bronchitis or asthma?	19 (30.2%)	4 (26.7%)	15 (31.3%)	1.0
3. Has your child ever had eczema or itchy rash (atopic dermatitis)?	8 (12.7%)	1 (6.7%)	7 (14.6%)	0.67
4. At what age did this rash appear?				
Never	55 (87.3%)	14 (93.3%)	41 (85.4%)	
Before 2 years old	5 (7.9%)	1 (6.7%)	4 (8.3%)	1.0
Between 2-4 years old	3 (4.8%)	0 (0.0%)	3 (6.3%)	
Has your child ever had hives (urticaria)?	2 (3.2%)	1 (6.7%)	1 (2.1%)	0.42
5. Does your child have eye itching or watering (allergic conjunctivitis) complaints?	4 (6.3%)	2 (13.3%)	2 (4.2%)	0.24
6. Has your child had nasal discharge, itching, nasal congestion, or sneezing (allergic rhinitis/ hay fever)?	13 (20.6%)	2 (13.3%)	11 (22.9%)	0.72
7. Are these complaints seasonal?				
No	5 (38.5%)	2 (100.0%)	3 (27.3%)	0.12
Yes	8 (61.5%)	0 (0.0%)	8 (72.7%)	
8. Are these complaints year-round?				
No	10 (76.9%)	1 (50.0%)	9 (81.8%)	0.42
Yes	3 (23.1%)	1 (50.0%)	2 (18.2%)	

Note: Percentages represent the proportion of "Yes" responses to questions 1, 2, 3, 5, and 6. Statistical analysis was performed using Fisher's exact test or chi-square test as appropriate.

understand the relationship between foreign body aspiration and allergic diseases in children.

DISCUSSION

This study represents one of the first systematic investigations of allergic comorbidities in children undergoing bronchoscopy for suspected FBA, revealing important clinical findings that may inform future diagnostic and management approaches.

Our study demonstrated a notably high prevalence of allergic conditions among children with suspected FBA. In our cohort, allergic symptoms such as wheezing (65.1%), physician-diagnosed asthma or allergic bronchitis (30.2%), and allergic rhinitis (20.6%) were notably frequent among children undergoing bronchoscopy. Among those with confirmed FBA, these rates were even higher—70.8%, 31.3%, and 22.9%, respectively. Additionally, we identified a significant association between household smoking exposure and confirmed FBA ($p = 0.04$). In contrast, a regional school-based population study reported the prevalence of physician-diagnosed asthma and allergic bronchitis at 10.5%, allergic rhinitis at 4.6%, and atopic dermatitis at 3.1%, suggesting a striking difference in the allergic symptom burden between the general pediatric population and FBA-suspected cases (17). Although these differences did not reach statistical significance, likely due to sample size limitations, the trend observed in our study warrants further investigation.

Regarding the high prevalence of wheezing episodes (65.1%) observed in our cohort, this finding warrants detailed explanation as it represents a central observation of our study. Several factors may account for this elevated rate. The young age profile of our population (mean 3.0 ± 1.6 years) corresponds directly with the peak incidence period for viral bronchiolitis, which is the most common cause of wheezing in early childhood. This age group represents the most vulnerable period for bronchiolitis, and viral respiratory infections can both trigger wheezing episodes and potentially increase aspiration risk through enhanced coughing reflexes and increased nasal secretions. Additionally, the clinical overlap between FBA and allergic airway diseases contributes to the diagnostic complexity, as both conditions frequently present with similar respiratory symptoms. Furthermore, in children with known allergic conditions, acute FBA symptoms may be initially misattributed to asthma or allergic bronchitis

exacerbations, potentially contributing to the elevated wheezing prevalence in our cohort.

Our findings also corroborate the established demographic patterns in FBA. The mean age was 3.0 ± 1.6 years, with the highest frequency at 2 years, aligning with previous studies reporting peak incidence in children under the age of 3 years. A strong male predominance was noted (male-to-female ratio: 2.8:1), which may be attributed to the behavioral tendencies associated with male children (18,19). Hazelnuts and peanuts were the most frequently aspirated objects, consistent with regional dietary habits and previous local data (19,20).

One of the unique contributions of this study is its emphasis on the diagnostic overlap between allergic airway disease and FBA. Symptoms such as chronic cough, wheezing, or persistent respiratory distress may be misattributed to asthma, delaying the accurate diagnosis of FBA. Several case reports have described retained foreign bodies initially misdiagnosed as refractory asthma, further supporting the clinical relevance of this overlap (21,22). Our results highlight the importance of maintaining a broad differential diagnosis in children with allergic symptoms who do not respond to conventional therapies.

Several pathophysiological mechanisms may explain the observed association between allergic diseases and FBA. Allergic airway diseases are characterized by chronic inflammation, leading to bronchial hyperresponsiveness, increased mucus production, and mucosal edema (7-9). These changes may impair the normal protective mechanisms against foreign body aspiration, including effective cough reflexes and mucociliary clearance.

The "unified airway" concept suggests that upper and lower respiratory tract inflammations are interconnected (23,24). Allergic rhinitis-induced nasal congestion and post-nasal drip may increase the risk of aspiration, particularly during sleep or while eating. Additionally, mouth breathing due to nasal obstruction may bypass the natural filtering function of the nose. Children with allergic rhinitis frequently exhibit repetitive behaviors such as nose rubbing, sniffing, and throat clearing. These actions, combined with increased oral exploration in children, may create opportunities for foreign body aspiration.

Furthermore, chronic airway inflammation may desensitize protective reflexes, reducing the effectiveness of cough and gag responses that normally prevent foreign body aspiration. Symptoms such as nasal itching and sneezing, which are frequently observed in allergic rhinitis, can lead to repetitive hand-to-face contact and manipulation of the nasal area. This behavior may facilitate the aspiration of nasal secretions into the lower airways, particularly in young children, as previously described in studies highlighting nasobronchial interactions and upper-lower airway continuity (23,24).

Our study identified household smoking exposure as significantly associated with confirmed FBA ($p = 0.04$). This finding aligns with the existing literature demonstrating that environmental tobacco smoke exposure increases airway inflammation, mucus production, and bronchial hyperresponsiveness (25). The inflammatory cascade induced by passive smoking may create a predisposing environment for foreign body retention by promoting mucosal edema and impaired mucociliary clearance mechanisms.

These findings suggest that allergic symptoms are more common in patients with suspected foreign body aspiration. This underscores the importance of considering allergic symptoms during the evaluation of foreign body aspiration cases. Our study's findings demonstrate that allergic symptoms are more frequently observed in patients with suspected foreign body aspiration. Therefore, it is crucial to evaluate and treat allergic symptoms in these patients, as allergic diseases can pose a risk of foreign body aspiration.

Patients can present with various symptoms. In the literature, a case was reported where a patient with chronic cough for an extended period and no improvement despite asthma treatment was diagnosed with foreign body aspiration after a wire was seen in the mediastinum on radiographs, leading to surgery (21). This case underscores the importance of accurate diagnosis and the fact that chronic cough in asthma patients can be due to other causes. Especially in children, some foreign bodies (e.g., needles, pins, or wires) may remain undetected in the bronchi for an extended period. While cough is the most common symptom, symptoms can mimic other pediatric conditions such as asthma, croup, pneumonia, or hemoptysis, potentially delaying accurate diagnosis (22). In such cases, if the child had not previously been diagnosed with asthma, the current diagnosis might have been made earlier. These findings highlight the importance of considering common-allergic symptoms in patients with suspected foreign body aspiration during the diagnosis and treatment processes.

This underscores the necessity for a detailed examination of the allergic symptoms during patient evaluation. Note that allergic diseases can increase the risk of foreign body aspiration and complicate the clinical picture. Therefore, accurately identifying and effectively managing allergic symptoms is crucial in cases of foreign body aspiration. Proper evaluation of patients' symptoms and necessary medical interventions can significantly impact the disease's course. However, more comprehensive and in-depth research

is needed on the frequent occurrence of allergic symptoms in patients with suspected foreign body aspiration. The importance of this situation in the diagnosis and treatment processes is increasingly emphasized, and new studies may contribute to the development of more effective interventions in clinical practice.

Study Limitations

This study has several important limitations. Our cross-sectional design only allows observation of the prevalence of allergic diseases among children with suspected FBA but cannot establish whether allergic diseases increase the aspiration risk. This would require prospective cohort or case-control studies comparing the FBA rates between allergic and non-allergic children.

Selection bias exists because our cohort includes only children undergoing bronchoscopy, potentially representing more severe cases. Those with mild symptoms or spontaneous foreign body expulsion would be missed. The absence of a control group limits comparison with the general pediatric population, although we referenced population-based studies.

The small sample size (n = 63) may have limited the statistical power to detect differences between groups, particularly for uncommon allergic conditions. Allergic history obtained through caregiver questionnaires may involve recall bias or symptom over-reporting during respiratory emergencies. Finally, we could not determine whether allergic diseases preceded or followed FBA, limiting our understanding of causality.

Clinical implications and future directions

This study presents preliminary evidence that allergic airway conditions may predispose children to FBA. The frequent co-occurrence of allergic symptoms among children undergoing bronchoscopy emphasizes the need to integrate a thorough allergic history into the diagnostic evaluation of suspected FBA. Clinicians should maintain heightened awareness of FBA in children with known allergic diseases who present with persistent or worsening respiratory symptoms, particularly when symptoms fail to respond to conventional allergy management. Conversely, in children presenting with suspected FBA, a comprehensive allergic history should be obtained to guide perioperative management and long-term care.

Large-scale prospective cohort studies are needed to establish whether allergic diseases truly predispose children to FBA. Additionally, case-control studies comparing FBA rates between allergic and non-allergic children would provide stronger evidence for this association. The investigation of specific allergic phenotypes (e.g., severe asthma, allergic rhinitis) to FBA risk would further refine our understanding. The integration of allergic disease assessment into FBA diagnostic protocols may improve both the immediate management and long-term outcomes for affected children.

Acknowledgement	We would like to sincerely thank the Department of*** Pediatric Surgery for their valuable contributions to the execution of this study.
Ethics Committee Approval	The study protocol was approved by the Ethics Committee of Ondokuz Mayıs University with the approval number 2020/42.
Informed Consent	Written consent was obtained from the participants.
Peer Review	Externally peer-reviewed.
Author Contributions	Conception/Design of Study- Ş.İ.K.K., B.D.D., R.S.; Data Acquisition- Ş.İ.K.K., B.D.D.,E.U.; Data Analysis/Interpretation- E.U., H.G.; Drafting Manuscript- Ş.İ.K.K.; Critical Revision of Manuscript- Ş.İ.K.K., E.U., H.G, B.D.D., R.S.; Final Approval and Accountability- Ş.İ.K.K., E.U., H.G, B.D.D., R.S.
Conflict of Interest	Authors declared no conflict of interest.
Financial Disclosure	Authors declared no financial support.

Author Details

Sefika Ilknur Kokcu Karadağ
[1] Ondokuz Mayıs University, Department of Pediatric Allergy and Immunology, Samsun,Türkiye
[4] Prof.Dr.Cemil Tascıoglu City Hospital, Department of Pediatric Allergy and Immunology, Istanbul, Türkiye
0000-0001-9234-633X drilknurkokcu @gmail.com

Elif Uğurlu
[2] Ondokuz Mayıs University, Department of Pediatrics, Samsun, Türkiye
0000-0001-8289-2783

Hilal Güngör
[4] Prof.Dr.Cemil Tascıoglu City Hospital, Department of Pediatric Allergy and Immunology, Istanbul, Türkiye
0000-0002-6886-2358

Berat Dilek Demirel
[3] Ondokuz Mayıs University, Faculty of Medicine, Department of Pediatric Surgery, Samsun, Türkiye
0000-0002-9358-0045

Recep Sancak
[1] Ondokuz Mayıs University, Department of Pediatric Allergy and Immunology, Samsun,Türkiye
0000-0003-0711-5620

REFERENCES

1 Tan HK, Brown K, McGill T et al. Airway foreign bodies (FB): a 10-year review Int J Pediatr Otorhinolaryngol. 2000;56(2):91-9. doi: 10.1016/s0165-5876(00)00391-8. PMID: 11115682.

2 Black RE, Choi KJ, Syme WC, et al. Bronchoscopic removal of aspirated foreign bodies in children. Am J Surg. 1984 Nov;148(5):778-81.

3 Foltran F, Ballali S, Passali FM,et al. Foreign bodies in the airways: a meta-analysis of published papers Int J Pediatr Otorhinolaryngol. 2012 May 14;76 Suppl 1:S12-9. doi: 10.1016/j.ijporl.2012.02.004. Epub 2012 Feb 12. PMID: 22333317.

4 Rodríguez H, Passali GC, Gregori D et al.Management of foreign bodies in the airway and esophagus. Int J Pediatr Otorhinolaryngol. 2012 May 14;76 Suppl 1:S84-91. doi: 10.1016/j.ijporl.2012.02.010. Epub 2012 Feb 24. PMID: 22365376.

5 Sultan TA, Van AB. Review of tracheobronchial foreign body aspiration in the South African pediatric age group. Thorac Dis. 2016;8:3787-3796.

6 Wallis C, Alexopoulou E, Antón-Pacheco JL, et al. ERS statement on tracheomalacia and bronchomalacia in children. *Eur Respir J*. 2019;54:1900382. Published 2019 Sep 28. doi:10.1183/13993003.00382-2019

7 Lin RY, Williams KD. Hypersensitivity to molds in New York City in adults who have asthma. *Allergy Asthma Proc*. 2003;24:13-18.

8 Kamran A, Jennings RW. Tracheomalacia and Tracheobronchomalacia in Pediatrics: An Overview of Evaluation, Medical Management, and Surgical Treatment. *Front Pediatr*. 2019;7:512. Published 2019 Dec 12. doi:10.3389/fped.2019.00512

9 Rosenstreich DL, Eggleston P, Kattan M et al. Role of cockroach allergy and exposure to cockroach allergen in causing morbidity among inner-city children with asthma N Engl J Med. 1997;336(19):1356-1363.

10 Feng CH, Miller MD, Simon RA. The united allergic airway: connections between allergic rhinitis, asthma, and chronic sinusitis Am J Rhinol Allergy. 2012 May-Jun;26(3):187-90. doi: 10.2500/ajra.2012.26.3762. PMID: 22643942; PMCID: PMC3906509.

11 Cingi C, Muluk NB, Cobanoglu B, Çatli T, Dikici O. Nasobronchial interaction. World J Clin Cases. 2015;3(6):499-503. doi: 10.12998/wjcc.v3.i6.499. PMID: 26090369; PMCID: PMC4468895.

12 Bajaj D, Sachdeva A, Deepak D. Foreign body aspiration. *J Thorac Dis*. 2021;13(8):5159-5175. doi:10.21037/jtd.2020.03.94

13 Bousquet J, Khaltaev N, Cruz AA, et al. Allergic Rhinitis and its Impact on Asthma (ARIA) 2008 update (in collaboration with the World Health Organization, GA(2)LEN and AllerGen). Allergy. 2008 Apr;63 Suppl 86:8-160.

14 Greiner AN, Hellings PW, Rotiroti G, Scadding GK. Allergic rhinitis. Lancet. 2011;378(9809):2112-2122.

15 Fidkowski CW, Zheng H, Firth PG. The anesthetic considerations of tracheobronchial foreign bodies in children: a literature review of 12,979 cases Anesth Analg. 2010;111(4):1016-1025.

16 Safari M, Manesh MR. Demographic and Clinical Findings in Children Undergoing Bronchoscopy for Foreign Body Aspiration Ochsner J. 2016 Summer;16(2):120-4. PMID: 27303219; PMCID: PMC4896653.

17 Karadag SIK, Sariaydin B, Sariaydin A, Sancak R. Evolving Trends in Pediatric Allergic Diseases: A Cross-Sectional Study Over 20 Years in the Central Black Sea Region of Turkey. *Pediatr Allergy Immunol Pulmonol*. 2024;37(3):74-80. doi:10.1089/ped.2024.0021

18 Fidkowski CW, Zheng H, Firth PG. The anesthetic considerations of tracheobronchial foreign bodies in children: a literature review of 12,979 cases Anesth Analg. 2010 Oct;111(4):1016-25. doi: 10.1213/ANE.0b013e3181ef3e9c. Epub 2010 Aug 27. PMID: 20802055.

19 Ding G, Wu B, Vinturache A, Cai C, Lu M, Gu H. Tracheobronchial foreign body aspiration in children: A retrospective single-center cross-sectional study Medicine (Baltimore). 2020;99(22):e20480. doi: 10.1097/MD.0000000000020480. PMID: 32481458.

20 Paksu S, Paksu MS, Kilic M, Guner SN, Baysal K, Sancak R, Ozturk F. Foreign body aspiration in childhood: evaluation of diagnostic parameters Pediatr Emerg Care. 2012 Mar;28(3):259-64. doi: 10.1097/PEC.0b013e3182494eb6. PMID: 22344214.

21 Ewa Łoś-Rycharska, Zuzanna Wasielewska, Katarzyna Nadolska & Aneta Krogulska (2021) A foreign body in the mediastinum as a cause of chronic cough in a 10-year-old child with asthma, Journal of Asthma, 58:2, 276-280, DOI: 10.1080/02770903.2019.1684515

22 Torsello M, Sicuranza L, Meucci D, Salvati A, Tropiano ML, Santarsiero S, Calabrese C, D'Onghia A, Trozzi M. Foreign body aspiration in children: our pediatric tertiary care experience Pediatr Surg Int. 2024 Mar 29;40(1):93. doi: 10.1007/s00383-024-05679-z. PMID: 38551664.

23 Scadding GK, Kariyawasam HH, Scadding G et al. BSACI guideline for the diagnosis and management of allergic and non-allergic rhinitis (Revised Edition 2017; First edition 2007). Clin Exp Allergy 2017;47:856-889. doi:10.1111/cea.12953

24 Licari A, Castagnoli R, Denicolò CF, et al. The nose and the lung: united airway disease? Front Pediatr. 2017;5:44. doi:10.3389/fped.2017.00044

25 Burke H, Leonardi-Bee J, Hashim A et al. Prenatal and passive smoke exposure and incidence of asthma and wheezing: systematic review and meta-analysis Pediatrics. 2012;129(4):735-744. doi:10.1542/peds.2011-2196

26 Platts-Mills TA, Vervloet D, Thomas WR, et al. Indoor allergens and asthma: report of the Third International Workshop. J Allergy Clin Immunol. 1997;100(6 Pt 1):S2-24. doi:10.1016/s0091-6749(97)70292-6