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Research Article

ASSOCIATION BETWEEN ALLERGIC RHINITIS AND ASTHMA IN CHILDREN: AN ORIGINAL RESEARCH

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Abstract: ***Introduction****:* Allergic rhinitis (AR) and bronchial asthma are among the most prevalent chronic allergic disorders affecting children worldwide. Both conditions share common immunopathological mechanisms involving IgE-mediated hypersensitivity and airway inflammation. Increasing evidence supports the "united airway disease" concept, suggesting that inflammation involving the upper airway significantly influences lower airway disease progression. Early identification of allergic rhinitis in children may therefore facilitate timely diagnosis and better control of asthma.**Aim**:To evaluate the association between allergic rhinitis and asthma among pediatric patients and determine clinical factors associated with asthma occurrence in children diagnosed with allergic rhinitis.**Materials and Methods**A hospital-based cross-sectional observational study was conducted among 180 children aged 5–15 years attending the pediatric outpatient department over a period of 18 months. Diagnosis of allergic rhinitis was based on Allergic Rhinitis and its Impact on Asthma (ARIA) criteria, while asthma was diagnosed according to Global Initiative for Asthma (GINA) guidelines. Demographic characteristics, family history of allergy, environmental exposures, clinical symptoms, eosinophil count, serum IgE, and spirometry findings were recorded. Statistical analysis was performed using SPSS version 27. Chi-square test, Student's t-test, and logistic regression were applied. A p-value <0.05 was considered statistically significant.**Results**:Among 180 children, 108 (60.0%) had allergic rhinitis. Asthma was diagnosed in 72 (40.0%) children. The prevalence of asthma among children with allergic rhinitis was significantly higher than among those without allergic rhinitis (56.5% vs. 15.3%, p<0.001). Persistent rhinitis, elevated serum IgE, eosinophilia, and positive family history independently predicted asthma occurrence.**Conclusion**:Allergic rhinitis demonstrated a strong association with childhood asthma. Early diagnosis and comprehensive management of allergic rhinitis may reduce asthma morbidity and improve long-term respiratory outcomes.

Keywords: Allergic rhinitis; Asthma; Children; Pediatric allergy; United airway disease

INTRODUCTION

Allergic diseases constitute one of the fastest-growing chronic health problems worldwide, particularly among children. Allergic rhinitis (AR) and bronchial asthma are the two most common manifestations of atopic disease, sharing similar immunological mechanisms characterized by immunoglobulin E (IgE)-mediated inflammation and eosinophilic airway infiltration [1]. Their increasing prevalence has created a considerable public health burden due to recurrent healthcare visits, reduced quality of life, school absenteeism, and healthcare expenditure.

The concept of "United Airway Disease" proposes that the upper and lower respiratory tracts represent a single functional unit. Consequently, inflammation affecting the nasal mucosa frequently extends to the bronchial tree, explaining the close coexistence of allergic rhinitis and asthma [2]. Epidemiological studies have consistently demonstrated that approximately 60–80% of children with asthma have concomitant allergic rhinitis, whereas nearly one-third of children with allergic rhinitis eventually develop asthma [3].

The pathophysiology involves exposure to inhaled allergens triggering activation of mast cells, eosinophils, T-helper type 2 lymphocytes, and release of inflammatory mediators including histamine, leukotrienes, and various cytokines. This inflammatory cascade contributes to airway hyperresponsiveness, mucosal edema, mucus hypersecretion, and chronic airway remodeling [4]. Genetic susceptibility, environmental pollution, passive smoking, urbanization, indoor allergens, and climatic factors further increase disease susceptibility [5].

Several longitudinal studies have shown that untreated allergic rhinitis significantly increases the risk of subsequent asthma development. Persistent nasal inflammation contributes to impaired lower airway

function even in asymptomatic individuals, emphasizing the importance of early diagnosis and management [6]. Furthermore, effective treatment of allergic rhinitis has been associated with improved asthma control, reduced exacerbation frequency, decreased emergency department visits, and enhanced quality of life [7].

Current international recommendations from the Allergic Rhinitis and its Impact on Asthma (ARIA) initiative and the Global Initiative for Asthma (GINA) advocate simultaneous evaluation of upper and lower airway diseases in all pediatric patients presenting with allergic symptoms [8,9]. Despite these recommendations, allergic rhinitis often remains underdiagnosed in routine pediatric practice, resulting in delayed recognition of associated asthma.

Data regarding the prevalence and association between allergic rhinitis and asthma among Indian pediatric populations remain limited, particularly in tertiary healthcare settings. Identification of predictive clinical factors could facilitate early intervention strategies and integrated disease management.
Therefore, the present study was undertaken to evaluate the association between allergic rhinitis and asthma among children attending a tertiary care hospital and identify factors associated with asthma development in children diagnosed with allergic rhinitis [10].

Aim
To evaluate the association between allergic rhinitis and asthma among pediatric patients attending a tertiary care hospital.

Objectives
1. To determine the prevalence of allergic rhinitis among children.
2. To determine the prevalence of asthma among children with allergic rhinitis.
3. To evaluate demographic and clinical characteristics associated with asthma.
4. To identify risk factors independently associated with asthma occurrence.

MATERIALS AND METHODS

Study Design
Hospital-based cross-sectional observational study.

Study Setting
Department of Pediatrics of a tertiary care teaching hospital.

Study Duration
18 months.

Study Population
Children aged 5–15 years attending pediatric outpatient services with symptoms suggestive of allergic disorders.

Sample Size
A total of 180 consecutive eligible children were enrolled after obtaining written informed consent from parents or legal guardians.

Inclusion Criteria
- Children aged 5–15 years.
- Clinical diagnosis of allergic rhinitis according to ARIA guidelines.
- Children evaluated for asthma symptoms.
- Parents willing to provide informed consent.

Exclusion Criteria
- Congenital respiratory disorders.
- Chronic lung diseases other than asthma.
- Immunodeficiency disorders.
- Recent respiratory tract infection (<4 weeks).
- Incomplete clinical records.

Data Collection
The following information was collected using a structured proforma:
- Age
- Gender
- Residence
- Family history of allergy
- Exposure to passive smoking
- Household pets
- Seasonal variation
- Nasal symptoms
- Wheezing episodes
- Serum total IgE
- Absolute eosinophil count
- Spirometry findings
- Skin prick testing where indicated

Diagnosis of allergic rhinitis was established according to ARIA guidelines, while asthma diagnosis followed GINA recommendations.

Statistical Analysis
Data were entered into Microsoft Excel and analyzed using SPSS version 27. Continuous variables were expressed as mean ± standard deviation, while categorical variables were summarized as frequencies and percentages. Student's t-test compared continuous variables, whereas Chi-square or Fisher's exact test analyzed categorical variables. Multivariate logistic regression identified independent predictors of asthma. Statistical significance was considered at $p < 0.05$.

RESULTS

A total of 180 children aged 5–15 years were enrolled in the present study. The mean age of the participants was 9.8 ± 2.7 years, with males constituting 55.6% (n=100) and females 44.4% (n=80). Allergic rhinitis was diagnosed in 108 (60.0%)

children, while 72 (40.0%) were diagnosed with bronchial asthma. Among children with allergic rhinitis, 61 (56.5%) had concomitant asthma, whereas only 11 (15.3%) children without allergic rhinitis were diagnosed with asthma. This association was statistically highly significant (p<0.001).

Table 1. Demographic and Clinical Characteristics of the Study Population (n = 180)

Variable	Total (n=180)	Percentage (%)
Age Group (years)		
5–7	48	26.7
8–10	62	34.4
11–13	46	25.6
14–15	24	13.3
Gender		
Male	100	55.6
Female	80	44.4
Residence		
Urban	112	62.2
Rural	68	37.8
Family history of allergy	76	42.2
Passive smoking exposure	58	32.2
Household pets	41	22.8
Allergic rhinitis present	108	60.0
Asthma present	72	40.0

Narrative Findings

As shown in Table 1, the largest proportion of children belonged to the 8–10-year age group (34.4%), followed by the 5–7-year age group (26.7%). Boys were slightly more affected than girls (55.6% vs. 44.4%). Urban residence accounted for nearly two-thirds of participants (62.2%). A positive family history of allergic disease was present in 42.2%, while passive smoking exposure was reported in 32.2%. Allergic rhinitis was identified in 60.0% of children, whereas bronchial asthma was diagnosed in 40.0% of the study population.

Table 2. Association Between Allergic Rhinitis and Asthma

Variable	Asthma Present n (%)	Asthma Absent n (%)	Total	p-value
Allergic rhinitis present	61 (56.5)	47 (43.5)	108	<0.001
Allergic rhinitis absent	11 (15.3)	61 (84.7)	72	
Total	72	108	180	

Chi-square = 30.72

Narrative Findings

Table 2 demonstrates a strong association between allergic rhinitis and asthma. Among children diagnosed with allergic rhinitis, 56.5% had bronchial asthma compared with only 15.3% among children without allergic rhinitis. Statistical analysis showed this relationship to be highly significant (Chi-square = 30.72, p<0.001), indicating that allergic rhinitis was strongly associated with asthma occurrence in the pediatric population.

Table 3. Clinical Characteristics Among Children with Allergic Rhinitis (n = 108)

Clinical Variable	Asthma (n=61)	No Asthma (n=47)	p-value
Persistent rhinitis	42 (68.9%)	18 (38.3%)	<0.001
Seasonal rhinitis	19 (31.1%)	29 (61.7%)	0.002
Elevated serum IgE	49 (80.3%)	23 (48.9%)	<0.001
Eosinophilia (>500/µL)	38 (62.3%)	16 (34.0%)	0.004
Positive family history	36 (59.0%)	17 (36.2%)	0.019
Passive smoking	28 (45.9%)	12 (25.5%)	0.031

Narrative Findings

Among children with allergic rhinitis, persistent rhinitis was significantly more common in those with asthma (68.9%) than those without asthma (38.3%) (p<0.001). Elevated serum IgE levels were observed in 80.3% of asthmatic children compared with 48.9% of non-asthmatic children. Similarly, eosinophilia, family history of allergy, and passive smoking exposure were all significantly associated with the coexistence of asthma (Table 3).

Table 4. Multivariate Logistic Regression Analysis for Predictors of Asthma

Variable	Adjusted Odds Ratio (AOR)	95% CI	p-value
Allergic rhinitis	4.82	2.31–10.04	<0.001
Persistent rhinitis	2.74	1.36–5.54	0.005

Elevated serum IgE	3.48	1.61–7.53	0.002
Eosinophilia	2.31	1.14–4.69	0.021
Family history of allergy	2.08	1.01–4.29	0.046
Passive smoking	1.87	0.91–3.83	0.084

Narrative Findings

Multivariate logistic regression (Table 4) demonstrated that allergic rhinitis remained the strongest independent predictor of childhood asthma (AOR 4.82; 95% CI: 2.31–10.04; $p<0.001$). Persistent rhinitis increased the likelihood of asthma nearly threefold (AOR 2.74), while elevated serum IgE and eosinophilia were also significant independent predictors. Although passive smoking showed an increased odds ratio, it did not retain independent statistical significance after adjustment ($p=0.084$).

Summary of Key Findings

- 60.0% of enrolled children had allergic rhinitis.
- 40.0% had bronchial asthma.
- Children with allergic rhinitis had nearly fourfold higher prevalence of asthma than children without allergic rhinitis.
- Persistent allergic rhinitis, elevated serum IgE, eosinophilia, and family history were significantly associated with asthma.
- Logistic regression confirmed allergic rhinitis as the strongest independent predictor of pediatric asthma.

DISCUSSION

The present hospital-based cross-sectional study evaluated the association between allergic rhinitis (AR) and bronchial asthma among children aged 5–15 years. The findings demonstrated a strong and statistically significant relationship between allergic rhinitis and asthma, supporting the concept that these disorders represent different manifestations of a common inflammatory airway disease. More than half (56.5%) of children with allergic rhinitis had coexisting asthma, compared with only 15.3% of children without allergic rhinitis. This difference remained highly significant after multivariate adjustment, with allergic rhinitis emerging as the strongest independent predictor of asthma.

The coexistence of allergic rhinitis and asthma is biologically plausible because both conditions share similar immunopathological mechanisms involving IgE-mediated hypersensitivity, eosinophilic inflammation, mast-cell activation, and T-helper type 2 cytokine responses. The "United Airway Disease" hypothesis proposes that inflammation in the upper airway directly influences the lower respiratory tract through systemic inflammatory mediators, neural reflexes, and aspiration of inflammatory secretions. Consequently, chronic untreated nasal inflammation may contribute to bronchial hyperresponsiveness and asthma development in susceptible children [11].

In the present study, allergic rhinitis was diagnosed in 60% of children evaluated for allergic respiratory symptoms. This prevalence is comparable with previous pediatric studies conducted in tertiary care settings. A systematic review by Bousquet et al. reported that allergic rhinitis affects approximately 10–30% of children globally, with prevalence varying according to geographical region, environmental allergen exposure, and diagnostic criteria [12]. Indian epidemiological studies have also demonstrated increasing prevalence over the past two decades, attributed to urbanization, environmental pollution, climate change, and changing lifestyle patterns.

One of the principal observations of this study was the markedly increased prevalence of asthma among children with allergic rhinitis. The odds of asthma were nearly five times higher among children with allergic rhinitis after adjusting for other risk factors. These findings are consistent with the recommendations of the Allergic Rhinitis and its Impact on Asthma (ARIA) initiative, which emphasizes that evaluation for asthma should be routine in every child diagnosed with allergic rhinitis [13]. The close relationship between these diseases highlights the need for integrated management strategies rather than treating them as independent clinical entities.

Persistent allergic rhinitis was significantly associated with asthma compared with seasonal allergic rhinitis. Nearly 69% of children with persistent symptoms had asthma, whereas seasonal symptoms predominated among children without asthma. Persistent exposure to perennial allergens such as house dust mites, molds, cockroach allergens, and animal dander may produce sustained airway inflammation that extends beyond the nasal cavity into the bronchial tree. Similar observations have been reported in longitudinal cohort studies where persistent rhinitis significantly increased future asthma risk [14].

Serum total IgE levels were significantly higher among children with asthma in the present study. Elevated IgE reflects enhanced atopic sensitization and increased allergen-specific immune responses. Previous investigations have consistently demonstrated that elevated serum IgE serves as an important biomarker for both allergic rhinitis and asthma severity. Licari et al. similarly reported that children with concomitant allergic rhinitis and asthma exhibit significantly higher IgE

concentrations and eosinophilic airway inflammation compared with children having isolated rhinitis [15].

Peripheral blood eosinophilia also showed a significant association with asthma. Eosinophils contribute directly to airway epithelial injury, mucus hypersecretion, airway remodeling, and bronchial hyperresponsiveness through release of cytotoxic granule proteins and inflammatory mediators. The present findings support previous pediatric studies indicating that eosinophilia remains an easily accessible biomarker reflecting active allergic airway inflammation [16].

A positive family history of allergic disorders was another independent predictor of asthma. Nearly 60% of children with both allergic rhinitis and asthma reported a first-degree relative with allergic disease. Genetic susceptibility has long been recognized as an important determinant of atopy. Numerous genome-wide association studies have identified polymorphisms affecting cytokine production, epithelial barrier function, and IgE regulation that contribute to familial clustering of allergic disorders [17].

Passive exposure to tobacco smoke showed a higher frequency among asthmatic children, although statistical significance was lost after multivariate adjustment. Environmental tobacco smoke remains an established risk factor for recurrent wheezing, impaired lung growth, and increased asthma exacerbations in children. The lack of independent significance in this study may reflect the relatively modest sample size or confounding by other allergic risk factors [18].

The findings of the present study have important clinical implications. Since allergic rhinitis frequently precedes asthma, early recognition and effective management of rhinitis may improve asthma control and potentially reduce disease progression. International ARIA and GINA guidelines recommend routine screening for lower airway symptoms in all patients with allergic rhinitis and careful assessment of nasal symptoms in children presenting with asthma [13,19]. Such integrated evaluation facilitates early intervention, reduces healthcare utilization, improves symptom control, and enhances quality of life.

The strengths of the present study include standardized diagnostic criteria based on ARIA and GINA recommendations, comprehensive evaluation of clinical and laboratory parameters, and multivariate analysis to identify independent predictors. However, certain limitations should be acknowledged. The cross-sectional design precludes establishment of temporal causality between allergic rhinitis and asthma. The study was conducted at a single tertiary care center, limiting generalizability to the broader population. Skin prick testing and allergen-specific IgE estimation were not uniformly available for all participants, and environmental allergen exposure was based primarily on parental reporting. Future multicenter prospective cohort studies incorporating objective allergen assessment and long-term follow-up would further clarify the progression from allergic rhinitis to asthma in children [20].

Overall, the findings reinforce current evidence that allergic rhinitis should not be considered a localized nasal disorder but rather an important marker of lower airway disease. Early diagnosis, integrated management, environmental control measures, and regular follow-up are likely to improve respiratory outcomes in pediatric patients [21-25].

CONCLUSION

The present study demonstrated a significant association between allergic rhinitis and bronchial asthma among children. More than half of the children with allergic rhinitis had coexisting asthma, and allergic rhinitis independently increased the likelihood of asthma by nearly fivefold. Persistent rhinitis, elevated serum IgE levels, eosinophilia, and positive family history were significant predictors of asthma. These findings support the concept of united airway disease and emphasize the importance of routine asthma screening in children diagnosed with allergic rhinitis. Early recognition and comprehensive management of allergic airway disease may improve long-term respiratory health and reduce childhood asthma morbidity.

Strengths of the Study

- Standardized diagnostic criteria (ARIA and GINA).
- Comprehensive clinical and laboratory assessment.
- Multivariate regression analysis to identify independent predictors.
- Clinically relevant pediatric population.

Limitations

- Cross-sectional study design.
- Single-center study.
- Moderate sample size.
- Limited objective allergen testing.
- Lack of long-term follow-up.

Declarations

Ethics Approval

The study protocol was approved by the Institutional Ethics Committee before commencement of the study.

Informed Consent

Written informed consent was obtained from parents or legal guardians prior to enrollment.

Funding

No external funding was received for this study.

Conflict of Interest

The authors declare no conflict of interest.

Authors' Contributions

All authors contributed to the conception, study design, data acquisition, analysis, manuscript preparation, and final approval of the manuscript.

Data Availability

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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