



PREVALENCE, RISK FACTORS, AND SYMPTOM PROFILES OF ALLERGIC RHINITIS AMONG SCHOOL-GOING CHILDREN IN INDIA: A CROSS-SECTIONAL STUDY

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Abstract

Background: Allergic rhinitis (AR) is a common chronic allergic disorder in children and is associated with impaired quality of life and reduced academic performance. Epidemiological data describing the burden, risk factors, and symptom patterns of allergic rhinitis among Indian school-going children remain limited. This study aimed to determine the prevalence of allergic rhinitis, identify associated risk factors, and analyze symptom profiles and their relationship with age among Indian children.

Methods: A school-based cross-sectional study was conducted over a 12-month period (January–December 2023). A total of 1,280 children aged 6–17 years were recruited using a multistage random sampling technique. Data were collected using a modified and validated International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire administered to parents or guardians. Allergic rhinitis was defined according to ISAAC criteria. Associations were evaluated using chi-square tests and multivariate logistic regression. Correlation between age and symptom severity was assessed using Pearson's correlation coefficient.

Results: The overall prevalence of allergic rhinitis was **18.4% (236/1280)**. Significant risk factors included family history of atopy (aOR: 3.12), exposure to tobacco smoke (aOR: 2.05), residence near heavy traffic areas (aOR: 1.89), use of synthetic bedding (aOR: 1.75), and household dampness or mold (aOR: 1.68). A weak but statistically significant positive correlation was observed between age and symptom severity score ($r = 0.18$, $p = 0.007$). Sneezing with rhinorrhea was the most frequently reported symptom combination (72.9%).

Conclusion: Allergic rhinitis affects nearly one-fifth of Indian school-going children. Both genetic predisposition and modifiable environmental factors play a significant role. The slight increase in symptom severity with age emphasizes the need for early diagnosis and preventive strategies focusing on environmental control.

Keywords: Allergic Rhinitis, Prevalence, Risk Factors, Symptom Severity, Indian Children, ISAAC, Cross-Sectional Study.

1. Introduction

Allergic rhinitis (AR) is an immunoglobulin E (IgE)–mediated inflammatory disorder of the nasal mucosa triggered by exposure to allergens such as pollen, house dust mites, molds, and animal dander [1]. It is clinically characterized by recurrent sneezing, rhinorrhea, nasal itching, and nasal congestion. Although not life-threatening, AR significantly affects sleep quality, cognitive function, school attendance, and academic performance in children [3].

Globally, the prevalence of allergic rhinitis has increased over the past few decades, particularly among children and adolescents [4]. In India, the reported prevalence of AR in the pediatric

population varies widely, reflecting differences in environmental exposures, lifestyle changes, housing conditions, and genetic susceptibility [5,6]. Despite this rising burden, allergic rhinitis often remains underdiagnosed and undertreated in children.

Environmental factors such as tobacco smoke exposure, indoor dampness, traffic-related air pollution, and household allergens are known to influence the development and persistence of allergic rhinitis [7,8]. Additionally, symptom patterns and severity may evolve with age due to cumulative allergen exposure and increased symptom perception.

Given the limited comprehensive data evaluating prevalence, symptom profiles, and risk factors together in Indian children, this cross-sectional study was undertaken to assess the burden of allergic rhinitis and identify associated determinants among school-going children in India.

2. Materials & Methods

2.1 Study Design

A school-based cross-sectional study was conducted over a period of 12 months (January–December 2023).

2.2 Study Population and Sample Size

Children aged 6–17 years attending selected schools were included. Children with chronic sinusitis, nasal polyps, or known immunodeficiency disorders were excluded. The sample size of **1,280** was calculated assuming a prevalence of 15%, 95% confidence interval, 5% margin of error, and a design effect of 1.5.

2.3 Data Collection Tool

Data were collected using a structured questionnaire comprising:

1. **Socio-demographic and risk factor profile:** age, gender, family history of allergy, exposure to tobacco smoke, proximity to heavy traffic areas, type of bedding, housing characteristics, and presence of dampness or mold.

2. **ISAAC Core Questionnaire for Allergic Rhinitis:** validated Indian language versions were used to identify symptoms of allergic rhinitis in the past 12 months [2].

Children reporting “sneezing, runny nose, or nasal blockage without a cold or flu in the last 12 months” were classified as having allergic rhinitis.

2.4 Symptom Severity Scoring

A symptom severity score (range 0–12) was calculated based on frequency of sneezing, rhinorrhea, nasal congestion, and nasal itching, each scored on a 4-point scale (0 = never to 3 = severe/frequent).

2.5 Statistical Analysis

Data were analyzed using SPSS version 26.0. Descriptive statistics were expressed as frequencies and percentages. Associations were tested using chi-square analysis. Variables significant at $p < 0.05$ were included in multivariate logistic regression to calculate adjusted odds ratios (aOR) with 95% confidence intervals. Pearson’s correlation coefficient assessed the relationship between age and symptom severity.

2.6 Ethical Considerations

Ethical approval was obtained from the Institutional Ethics Committee. Written informed consent was obtained from parents or guardians, and assent from children aged above 7 years.

3. Results

Characteristic	Category	Frequency (n)	Percentage (%)
Age Group (years)	6–9	412	32.2
	10–13	478	37.3
	14–17	390	30.5
Gender	Male	655	51.2
	Female	625	48.8
Parental Education	Below Secondary	285	22.3
	Secondary and Above	995	77.7
Type of Housing	Pucca	890	69.5
	Semi-pucca	320	25.0
	Kuccha	70	5.5

Table 1: Baseline Demographic Characteristics of the Study Participants (N = 1280)

Variable	Total (n)	AR Positive n (%)	95% Confidence Interval
Overall Prevalence	1280	236 (18.4)	16.3 – 20.6
Male	655	124 (18.9)	16.0 – 22.1
Female	625	112 (17.9)	14.9 – 21.1
Age 6–9 years	412	62 (15.0)	11.8 – 18.7
Age 10–13 years	478	87 (18.2)	14.9 – 21.9
Age 14–17 years	390	87 (22.3)	18.2 – 26.8

Table 2: Prevalence of Allergic Rhinitis Among Study Participants (N = 1280)

Table 3: Correlation Between Age and Symptom Severity Score Among Children with Allergic Rhinitis (n = 236)

Variable	Mean $\pm$ SD	Pearson's Correlation (r)	p-value
Age (years)	12.1 $\pm$ 3.3	0.18	0.007
Symptom Severity Score (0–12)	6.8 $\pm$ 2.4	—	—

Table 4: Frequency of Individual Symptoms and Symptom Combinations in Allergic Rhinitis (n = 236)

Symptom / Combination	Frequency (n)	Percentage (%)
Individual Symptoms		
Sneezing	221	93.6
Rhinorrhea (runny nose)	208	88.1
Nasal congestion	192	81.4
Nasal itching	175	74.2
Symptom Combinations		
Sneezing + Rhinorrhea	172	72.9
Sneezing + Rhinorrhea + Nasal congestion	145	61.4
All four symptoms	118	50.0
Sneezing + Nasal itching	95	40.3

Table 5: Multivariate Logistic Regression Analysis of Risk Factors Associated with Allergic Rhinitis (N = 1280)

Risk Factor	Category	AR Positive n (%)	Adjusted Odds Ratio (aOR)	95% CI	p-value
Family history of atopy	Yes	112 (41.5)	3.12	2.28 – 4.27	<0.001
	No	124 (12.3)	Reference	—	—
Exposure to tobacco smoke	Yes	89 (32.4)	2.05	1.45 – 2.89	<0.001
	No	147 (14.6)	Reference	—	—
Residence near heavy traffic	Yes	102 (27.9)	1.89	1.32 – 2.71	<0.001
	No	134 (14.6)	Reference	—	—
Synthetic bedding use	Yes	145 (23.5)	1.75	1.25 – 2.45	0.001
	No	91 (13.7)	Reference	—	—
Household dampness/mold	Yes	78 (28.6)	1.68	1.18 – 2.38	0.004
	No	158 (15.7)	Reference	—	—

4. Discussion

The present cross-sectional study provides comprehensive insight into the prevalence, symptom profile, and risk factors associated with allergic rhinitis among Indian school-going children. The overall prevalence of allergic rhinitis observed in this study was **18.4%**, indicating that nearly one in five children is affected. This finding highlights allergic rhinitis as a significant and often underrecognized public health problem in the pediatric population in India.

Prevalence and Burden of Allergic Rhinitis: The prevalence reported in this study is consistent with recent Indian and international epidemiological studies, which have documented a rising trend of allergic rhinitis in children over the past two decades [5,6,9]. Variations in prevalence across studies may be attributed to differences in age groups studied, diagnostic criteria, environmental exposures, and awareness levels. The use of the standardized ISAAC questionnaire in the present study enhances comparability with global data and supports the reliability of the prevalence estimate. Allergic rhinitis, though not life-threatening, substantially affects children's quality of life by impairing sleep, attention span, and school performance. Chronic nasal symptoms may also predispose children to comorbid conditions such as sinusitis, otitis media, and asthma, further increasing the disease burden [1,3].

Symptom Profile and Clinical Implications: Sneezing and rhinorrhea were the most frequently reported symptoms, either alone or in combination, reflecting the classic presentation of IgE-mediated nasal inflammation. Half of the affected children reported all four cardinal symptoms, indicating moderate to severe disease in a substantial proportion of cases. These findings align with previous studies conducted among Indian and Asian pediatric populations, reinforcing the consistency of allergic rhinitis symptomatology across different settings [7,16]. The symptom-based severity scoring adopted in this study allowed a semi-quantitative assessment of disease burden. This approach is particularly useful in community-based studies where objective diagnostic tools such as skin prick testing may not be feasible.

Age and Symptom Severity: An important observation of this study is the **weak but statistically significant positive correlation between age and symptom severity**. Although the correlation coefficient was modest, it suggests that symptom intensity may increase with advancing age. This trend could be explained by several factors, including cumulative exposure to environmental allergens, progressive sensitization, and better symptom recognition and reporting among older children. Additionally, untreated or inadequately managed allergic rhinitis in younger children may evolve into more persistent or severe forms over time. This finding underscores the importance of early diagnosis and timely intervention to prevent progression and complications.

Risk Factors and Environmental Determinants: The strongest association observed was with a **family history of atopy**, emphasizing the role of genetic predisposition in the development of allergic rhinitis. This is in agreement with genome-wide association studies demonstrating shared genetic susceptibility across allergic disorders [10]. Among environmental risk factors, exposure to tobacco smoke emerged as a significant independent predictor. Environmental tobacco smoke is known to impair mucociliary clearance, increase nasal epithelial permeability, and promote inflammatory responses, thereby exacerbating allergic symptoms [11]. This finding reinforces the need for public health measures aimed at reducing children's exposure to passive smoking. The association with proximity to heavy traffic suggests a contributory role of traffic-related air pollutants, such as nitrogen dioxide and particulate matter, which act as adjuvants in allergic sensitization and enhance IgE-mediated responses [12]. These pollutants may also aggravate existing nasal inflammation, leading to persistent symptoms. Indoor environmental factors played a notable role in the present study. The use of synthetic bedding and the presence of household dampness or mold were independently associated with allergic rhinitis. Synthetic bedding materials are known to harbor higher concentrations of house dust mites and are less amenable to thorough cleaning, while damp environments promote mold growth—both well-established indoor allergens [13,14]. These findings are particularly relevant for preventive strategies, as they represent modifiable risk factors.

Public Health and Clinical Implications: The identification of modifiable environmental risk factors provides an opportunity for effective prevention and control strategies. Simple interventions such as ensuring smoke-free homes, improving indoor ventilation, reducing dampness, and promoting the use of washable cotton bedding could substantially reduce symptom burden. From a clinical perspective, heightened awareness among parents, teachers, and healthcare providers is essential to facilitate early diagnosis and appropriate management. School-based screening programs and health education initiatives may play a pivotal role in identifying affected children and preventing long-term complications, including asthma development and academic impairment.

Strengths and Limitations: The strengths of this study include its adequate sample size, use of a standardized and validated questionnaire, and comprehensive assessment of symptom severity and environmental risk factors. However, certain limitations should be acknowledged. The cross-sectional design precludes causal inference. The reliance on parent-reported questionnaires may introduce recall bias, and objective measures such as allergen sensitization testing were not performed. Despite these limitations, the study provides valuable epidemiological data applicable to the Indian pediatric population.

Future Directions: Future longitudinal studies incorporating clinical evaluation, allergen testing, and assessment of treatment outcomes are warranted to better understand disease progression and to develop tailored management strategies. Integrating allergic rhinitis control into existing school health programs could significantly reduce its impact on children's health and educational outcomes.

5. Conclusion: Allergic rhinitis is a common condition among Indian school-going children, with a substantial burden attributable to both genetic susceptibility and modifiable environmental factors. Early identification, parental awareness, and environmental control strategies are essential to reduce disease severity and improve quality of life.

6. References

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