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Co-morbid Allergic Rhinosinusitis in Pediatric Asthma: Prevalence, Severity, and Impact on Control

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Abstract

Background: Asthma and allergic rhinosinusitis (ARS) are interrelated inflammatory airway diseases that often co-exist in children, reflecting the unified airway concept(1). Co-morbid ARS may exacerbate lower airway obstruction, increase symptom burden, and impair asthma control, yet its prevalence and impact in Indian pediatric populations remain under-characterized. **Objective**: To determine the prevalence of ARS in children aged 5–12 years with physician-diagnosed asthma and to evaluate its association with asthma control status. **Methods**: In this cross-sectional study, 123 consecutive children (5–12 years) attending a tertiary pediatric respiratory clinic were enrolled over six months. Asthma was confirmed per GINA 2024 criteria. ARS was diagnosed using ARIA 2020 standards. Asthma control was assessed via the GINA four-item tool. Demographics, socioeconomic status, family history, and clinical data were collected. Data were analyzed in SPSS v25; ARS prevalence was reported with 95% confidence intervals (CI). Chi-square tests compared control status by ARS presence and family history, with $p < 0.05$ indicating significance. Multivariate logistic regression adjusted for age, sex, socioeconomic status, and medication adherence. **Results**: ARS prevalence was 48.8% [60/123; 95% CI 39.8–57.8%]. Poor asthma control occurred in 66.7% of ARS-positive versus 31.7% of ARS-negative children [p=0.0002; OR 2.4, 95% CI 1.5–3.9]. A positive family history of asthma was associated with poor control (5) in 70.0% versus 34.2% without [p<0.0001; OR 2.5, 95% CI 1.4–4.6]. **Conclusion:** Nearly half of pediatric asthma patients exhibit co-morbid ARS, which is strongly linked to suboptimal asthma control. Routine screening and

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integrated management of upper and lower airway inflammation are recommended to enhance pediatric asthma outcomes.

Introduction

Asthma is one of the most common chronic diseases in childhood, affecting an estimated 7–10% of children worldwide(1) and placing a significant burden on healthcare systems and families alike. Allergic rhinosinusitis (ARS), encompassing allergic rhinitis and associated sinus inflammation, frequently coexists with asthma, embodying the unified airway concept(1) that recognizes the interdependence of upper and lower respiratory tracts. This concept is grounded in several key observations: anatomically, the respiratory epithelium extends continuously from the nasal vestibule to the bronchioles; immunologically, Th2-mediated inflammation propagates across airway compartments; and neurologically, nasobronchial reflexes can trigger bronchoconstriction in response to nasal mucosal irritation. In ARS, allergen exposure in the nasal mucosa leads to activation of mast cells and basophils, with release of histamine, leukotrienes, and cytokines such as interleukin-4, -5, and -13. These mediators recruit eosinophils and perpetuate mucosal edema, increased vascular permeability, and mucus hypersecretion. Systemic dissemination of these inflammatory mediators can extend to the lower airways, aggravating bronchial hyperresponsiveness and airway obstruction characteristic of asthma. Conversely, bronchial inflammation may influence sinonasal mucosa through reflex mechanisms and hematogenous spread of inflammatory cells and mediators. Epidemiological studies demonstrate that ARS affects up to 60% of children with asthma(6), with variation influenced by geographic, environmental, and genetic factors. In India, urban community surveys report pediatric asthma prevalence of 5–12%, with ARS present in nearly half of these patients. Tertiary care hospital cohorts further document adenoid hypertrophy associated with chronic ARS in over 70% of asthmatic children(6), underscoring severe upper airway involvement. Clinically, co-morbid ARS and asthma are associated with increased symptom frequency, including daytime wheeze and cough, nocturnal awakenings, and greater reliance on short-acting β2-agonists(4). Health-related quality of life is adversely impacted, reflected in higher rates of school absenteeism and

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activity limitation. Healthcare utilization increases significantly in this population: children with both conditions have more frequent outpatient visits, emergency department presentations, and hospital admissions, translating into elevated direct costs for medications and procedures and indirect costs from parental work absenteeism. Guidelines from the Global Initiative for Asthma (GINA) 2024 and the Allergic Rhinitis and its Impact on Asthma (ARIA) 2020(8) update emphasize the importance of integrated management, recommending simultaneous assessment and treatment of sinonasal and bronchial inflammation. Integrated management strategies include the use of intranasal corticosteroids(2) and second-generation antihistamines(2) for ARS, along with optimized inhaled corticosteroid and long-acting β2-agonist regimens for asthma. When ARS is uncontrolled, adenoidectomy may be considered in cases of significant adenoid hypertrophy contributing to nasal obstruction. Despite clear evidence supporting these approaches, real-world practice reveals gaps: under recognition of ARS during asthma consultations, variable referral to otolaryngology, and inconsistent use of intranasal therapies. These shortcomings may reflect limited clinician awareness, resource constraints, and concerns regarding corticosteroid side effects. Better understanding of ARS prevalence, severity, and its impact on asthma control in specific clinical settings is vital to tailor management pathways, allocate resources effectively, and improve patient outcomes. The current study aims to quantify the burden of ARS in children aged 5–12 years with asthma attending a tertiary pediatric respiratory clinic in India and to evaluate its association with asthma control status, thereby informing best practices for integrated airway management.

Methodology

A cross-sectional observational study design was employed to assess the prevalence and impact of co-morbid ARS in pediatric asthma in the population attending a tertiary care hospital. The study was conducted over a six-month period (January–June 2024) at the pediatric respiratory clinic of a tertiary care hospital with comprehensive asthma and allergy services. Eligible participants included children aged 5 to 12 years with a physician-confirmed asthma diagnosis based on GINA 2024 criteria, which require a documented

history of variable respiratory symptoms—including wheezing, dyspnea, chest tightness, and cough—combined with objective evidence of variable expiratory airflow limitation (≥12% improvement in FEV_1 post-bronchodilator or ≥20% peak flow variability). Exclusion criteria were chronic respiratory comorbidities (e.g., cystic fibrosis), recent sinonasal or airway surgeries within the past six months, known immunodeficiency, and inability to complete clinical assessments or provide informed consent. Ethical approval was obtained from the Institutional Ethics Committee, and written informed consent was secured from parents or legal guardians, with assent from children aged ≥7 years, in accordance with the Declaration of Helsinki. Data collection employed a structured questionnaire and clinical examination protocol, capturing: demographic variables (age, sex, socioeconomic status via the modified Kuppuswamy scale 2024), detailed asthma history (duration of disease, maintenance therapy, adherence assessed via Morisky Medication Adherence Scale, and exacerbation frequency in the past year), and family history of asthma in first-degree relatives. ARS assessment followed ARIA 2020 guidelines: participants reporting at least two nasal symptoms (nasal obstruction, rhinorrhea, sneezing, or itching) persisting for ≥1 hour/day on ≥4 days/week underwent anterior rhinoscopy to confirm mucosal edema. ARS severity was graded as mild (symptoms present but not troublesome), moderate (troublesome symptoms affecting sleep or activities), or severe (symptoms significantly impairing quality of life). Asthma control was evaluated using the validated GINA 2024 four-item questionnaire, with questions regarding daytime symptoms, night-time awakenings, short-acting β2-agonist use, and activity limitation over the preceding four weeks. Affirmative responses were summed to categorize control status as: controlled (0), partly controlled (1–2), or uncontrolled (3–4). Clinical assessments—including spirometry (per ATS/ERS guidelines) to measure FEV_1 and peak expiratory flow rates—and rhinoscopic examinations were performed by experienced pediatric pulmonologists and otolaryngologists to ensure inter-rater reliability. Data entry and management utilized a secure electronic database with double-entry verification and periodic audits to ensure data integrity. Statistical analyses were conducted using IBM SPSS Statistics v.25. Descriptive statistics summarized continuous variables as means with standard deviations or medians with interquartile ranges, and categorical

variables as frequencies with percentages. The prevalence of ARS was estimated with 95% confidence intervals using the Wilson score method. Comparisons of asthma control between ARS-positive and ARS-negative groups, and between children with and without a positive family history of asthma, were performed using chi-square tests. Odds ratios with 95% confidence intervals quantified the strength of associations. A multivariate logistic regression model adjusted for potential confounders—such as age, sex, socioeconomic status, and medication adherence—was constructed to identify independent predictors of poor asthma control. Statistical significance was defined as a two-tailed p-value <0.05, and model fit was assessed using the Hosmer-Lemeshow test and Nagelkerke R(2).

Results

Table 1. Demographic & Clinical Characteristics

Characteristic	n = 123
Age, mean ± SD (years)	8.5 ± 2.1
Male	73 (59.3%)
Female	50 (40.7%)
SES (middle/high)	98 (79.7%)
Family history positive	50 (40.7%)

Table 2. Clinical Characteristics

Feature		n (%)
ARS present		60 (48.8%)
ARS severity	Mild	20 (16.3%)
	Moderate	28 (22.8%)
	Severe	12 (9.8%)
Control of asthma	Well controlled	63 (51.2%)
	Partly controlled	40 (32.5%)

	Uncontrolled	20 (16.3%)

Table 3. Asthma Control by ARS Status

ARS Status	Poor control[a] n (%)	Good control[b] n (%)	Total
Present	40 (66.7%)	20 (33.3%)	60
Absent	20 (31.7%)	43 (68.3%)	63

a- Partly + uncontrolled; b- Well controlled

Table 4. Associations

Comparison	$\chi(2)$ (df=1)	p-value	Interpretation
ARS vs poor control	13.63	0.0002	Strong association
Family history vs poor control	16.01	<0.0001	Strong association

Discussion

This study demonstrates a high prevalence of co-morbid allergic rhinosinusitis (ARS) in pediatric asthma, with 48.8% of 123 enrolled children meeting ARIA 2020 criteria for ARS. Our findings are concordant with previous studies from tertiary care centers in India reporting ARS prevalence in the range of 45–60%. The integrated airway model provides a mechanistic basis for these observations: sinonasal and bronchial mucosa share common inflammatory pathways characterized by Th2-skewed immune responses, eosinophil infiltration, and elevated IgE levels. The significant association between ARS and poor asthma control—illustrated by a chi-square statistic of 13.63 (p=0.0002) and an adjusted odds ratio of 2.4 (95% CI 1.5–3.9)—underscores the impact of upper airway inflammation on bronchial disease manifestations. Children with ARS experienced higher rates of daytime symptoms, night-time awakenings, and reliever use, reflecting a twofold increase in the likelihood of uncontrolled or partly controlled asthma. Several pathophysiological mechanisms may explain this relationship. Persistent nasal obstruction and rhinorrhea can

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promote oral breathing, bypassing the nasal mucosa's role in humidifying and filtering inhaled air, thus exposing lower airways to particulate matter and pathogens. Additionally, systemic spread of inflammatory mediators, such as eosinophil-derived neurotoxin and IL-5, may sustain bronchial eosinophilia and airway hyperresponsiveness. Genetic predisposition also appears influential: a positive family history of asthma was independently associated with poor control (adjusted OR 2.5, 95% CI 1.4–4.6; $p<0.0001$), suggesting that inherited factors modulate both upper and lower airway inflammatory responses. These insights highlight a high-risk subgroup warranting tailored monitoring and early intervention. Despite evidence-based recommendations from GINA and ARIA favoring combined treatment strategies—including intranasal corticosteroids(2), second-generation antihistamines, and optimized inhaled corticosteroid regimens—our data reveal suboptimal integration of sinonasal therapies in routine asthma management. Less than half of ARS-positive children received prescription of intranasal corticosteroids(2) or referral to otolaryngology, indicating gaps in clinician awareness and resource availability. Health systems and clinician factors contribute to these practice gaps. Primary care and general pediatric providers may not routinely screen for ARS symptoms during asthma visits, and access to ENT specialists is limited in many regions. Furthermore, parental concerns regarding steroid side effects may hinder adherence to intranasal corticosteroid regimens. Addressing these barriers requires targeted education, streamlined referral pathways, and provision of cost-effective treatment options. From a public health perspective, integrated care models—such as combined asthma-ARS clinics—have shown promise in improving symptom control, reducing exacerbations, and decreasing healthcare utilization. Pilot programs incorporating nurse-led screening protocols and telemedicine follow-ups for ARS management have demonstrated feasibility and acceptance among families. In terms of research implications, longitudinal cohort studies are needed to evaluate the long-term benefits of early ARS intervention on lung function trajectories, exacerbation rates, and health-related quality of life. Incorporation of objective biomarkers—such as fractional exhaled nitric oxide (FeNO) and nasal nitric oxide measurements—could stratify patients by inflammatory phenotype and guide personalized therapy. Environmental and socio-demographic determinants—such as household air pollution, allergen exposure, and

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socioeconomic status—should be examined to identify modifiable risk factors for ARS and asthma comorbidity in diverse pediatric populations. In conclusion, our findings reinforce the critical role of ARS as a modifiable determinant of asthma control and highlight the need for integrated management strategies, clinician education, and health system interventions to optimize care for children affected by both conditions.

Conclusion

Co-morbid allergic rhinosinusitis is highly prevalent in pediatric asthma and significantly impairs asthma control. Integrated management—including routine screening, intranasal corticosteroids(2), and optimized inhaled therapy—can improve symptom control and reduce healthcare utilization. Tailored interventions for high-risk subgroups, such as children with positive family history, and the development of combined asthma-ARS care pathways are essential for enhancing pediatric respiratory health outcomes.

Limitations and Recommendations

Limitations of this study include its single-center, cross-sectional design, which prevents causal inferences and may limit generalizability, as well as reliance on clinical rhinoscopy without imaging or endoscopic confirmation of sinus pathology. Future research should encompass multicenter, longitudinal studies with objective diagnostic modalities—including nasal endoscopy, imaging, and biomarker assessments—to validate findings and elucidate the temporal dynamics of ARS and asthma comorbidity. Implementation studies evaluating integrated care models and cost-effectiveness analyses of combined therapy protocols are also recommended.

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