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Childhood Bronchial Asthma and Associated Risk Factors among Children Attending a Tertiary Care Hospital in Northen India

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ABSTRACT

Background: Bronchial asthma is among the most prevalent chronic respiratory diseases of childhood globally and contributes substantially to recurrent morbidity, school absenteeism, emergency healthcare visits, and impaired quality of life. India contributes approximately 12.9% of global asthma cases, and data from coastal southern India on clinical phenotyping and associated factors remain limited.

Objectives: To describe the clinical profile and severity pattern of bronchial asthma among children aged 5–15 years and to identify associated allergic, familial, environmental, and perinatal risk factors.

Methods: A hospital-based study was conducted enrolling 290 children aged 5–15 years with bronchial asthma diagnosed by standard clinical criteria. Data on demographics, age at onset, family history, allergic manifestations, birth weight, feeding practices, and triggering factors were collected using a structured proforma. Asthma severity was classified per NAEPP-EPR-3 criteria.

Results: Intermittent asthma was the most common severity category (132/290, 45.5%), followed by mild persistent (84/290, 28.9%), moderate persistent (64/290, 22.1%), and severe persistent asthma (10/290, 3.4%). Severe persistent asthma was confined to children aged 10–15 years. Early-onset asthma (≤3 years) was present in 130 (44.8%) children. Family history of asthma was reported in 154 (53.1%) participants. Allergic rhinitis was the commonest associated allergic condition. Seasonal variation (81.4%), upper respiratory tract infection (80.0%), and dust exposure (74.5%) were the leading triggering factors.

Conclusion: Childhood bronchial asthma in this hospital-based cohort was predominantly intermittent or mild persistent and was strongly associated with atopic manifestations, positive family history, and environmental triggers. Early identification, caregiver education, and reduction of preventable exposures are essential for reducing asthma-related morbidity among children.

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1. INTRODUCTION

Bronchial asthma is a chronic inflammatory disorder of the airways characterized by variable and recurring symptoms of wheeze, cough, shortness of breath, and chest tightness, associated with fluctuating expiratory airflow limitation. It is one of the most

common non-communicable diseases affecting children worldwide and represents a substantial public health burden.[1] According to the World Health Organization, asthma affected an estimated 280 million people globally in 2022 and caused approximately half a million deaths, with India contributing nearly 12.9% of global asthma cases and 42.4% of global asthma mortality.[2]

The burden of pediatric asthma in India is compounded by under-diagnosis, delayed treatment initiation, inadequate long-term controller therapy, and limited access to preventive services, particularly in semi-urban and coastal settings.[3] The Global Asthma Network Phase I study, which included over 45,000 Indian school children, found that nearly 82% of current wheezers had not received a clinical diagnosis of asthma, underscoring a major diagnostic gap in the country.[4] Regional heterogeneity in climate, urbanization, housing conditions, socioeconomic profile, and healthcare-seeking behavior means that the risk factor profile of childhood asthma may differ considerably between geographic locations in India.[5]

Several risk factors have been implicated in the development and exacerbation of childhood asthma, including family history of atopy, coexisting allergic disorders, recurrent respiratory infections, exposure to indoor tobacco smoke, household air pollution, low birth weight, and early dietary patterns.[6,7] The association between allergic rhinitis and asthma in children has been conceptualized as a manifestation of united airway disease, wherein shared pathophysiological mechanisms including post-nasal drip, naso-bronchial reflex, and systemic immunological responses drive concurrent upper and lower airway inflammation.[8]

Understanding the contextual determinants of childhood asthma is essential for developing locally relevant preventive strategies and improving clinical management. However, published data characterizing the clinical profile and risk factor distribution in coastal Karnataka remain limited. The present study was therefore undertaken to assess the clinical profile, severity pattern, and associated risk factors among children with bronchial asthma attending a tertiary care teaching hospital in this region.

2. MATERIALS AND METHODS

2.1 Study Design and Setting

This hospital-based study was conducted in the Department of Pediatrics of a tertiary care health center in northern India in collaboration with Department of Community Medicine from August 2024 to July 2025.

2.2 Study Participants

Children aged 5–15 years presenting to the pediatric outpatient department with a diagnosis of bronchial asthma were included. The diagnosis was established clinically on the basis of recurrent episodes of wheeze, cough, and breathlessness, particularly nocturnal or early morning in pattern, with documented spontaneous or treatment-related reversibility. Children with congenital heart disease, structural pulmonary abnormalities, chest wall deformities, immunocompromised status, or other major systemic conditions that could confound respiratory symptom assessment were excluded. Children who had received bronchodilator therapy within a window period prior to assessment were also excluded as per the original study protocol.

2.3 Severity Classification and Data Collection

Asthma severity was categorized into intermittent, mild persistent, moderate persistent, and severe persistent disease according to the National Asthma Education and Prevention Program Expert Panel Report 3 (NAEPP-EPR-3) guidelines.[9] Data were collected using a predesigned semi-structured proforma recording demographic profile, age at onset of wheeze, family history of asthma, coexisting allergic conditions (allergic rhinitis, allergic conjunctivitis, atopic dermatitis), birth weight, breastfeeding history, and triggering factors. Participants were categorized into early-onset asthma (onset ≤3 years) and late-onset asthma (onset >3 years).

2.4 Sample Size and Statistical Analysis

A total of 290 children satisfying eligibility criteria were enrolled consecutively during the study period. Data were entered and analyzed using SPSS version 25.0 (IBM Corporation, Armonk, New York, USA). Categorical variables were summarized as frequencies and percentages. Because the primary objective was descriptive, formal hypothesis testing was not the focus; findings are presented as distributional patterns.

2.5 Ethical Considerations

Institutional Ethics Committee approval was obtained before commencing the study. Written informed consent was taken from parents or legal guardians of all participants. Confidentiality of participant data was maintained throughout.

3. RESULTS

3.1 Severity Distribution and Age-wise Pattern

A total of 290 children with bronchial asthma were included. Among these, intermittent asthma was the most common severity category, observed in 132 children (45.5%). Mild persistent asthma was present in 84 children (28.9%), moderate persistent asthma in 64 children (22.1%), and severe persistent asthma in 10 children (3.4%). Age-stratified analysis revealed that among younger children aged 5.01–10 years (n=160), 80 (50.0%) had intermittent asthma, 42 (26.3%) mild persistent asthma, and 38 (23.7%) moderate persistent asthma, with no case of severe persistent asthma in this age group. (Table 1).

Table 1. Age-wise distribution of severity of bronchial asthma among study participants (n=290)

Age Group	Intermittent n (%)	Mild Persistent n (%)	Moderate Persistent n (%)	Severe Persistent n (%)
5.01–10 years (n=160)	80 (50.0%)	42 (26.3%)	38 (23.7%)	0
10.01–15 years (n=130)	52 (40.0%)	42 (32.3%)	26 (20.0%)	10 (7.7%)
Total (n=290)	132 (45.5%)	84 (28.9%)	64 (22.1%)	10 (3.4%)

3.2 Clinical Profile and Onset Characteristics

Early-onset asthma (≤3 years) was observed in 130 children (44.8%), while the majority — 160 children (55.2%) — had late-onset disease. A positive family history of asthma was reported in 74 of 130 early-onset children (56.9%) compared with 80 of 160 late-onset children (50.0%), suggesting a marginally greater familial clustering among those with early-onset disease. Birth weight below 2.5 kg was noted in 14 of 112 children (12.5%) in the early-onset group and in 32 of 130 children (24.6%) in the late-onset group. Breastfeeding for more than 12 months was observed in 94 of 120 children (78.3%) with early-onset asthma and in 92 of 134 children (68.7%) with late-onset asthma (Table 2).

Table 2. Clinical and demographic profile of study participants by age at onset of asthma

Variable	Early Onset ≤3 yrs (n=130) n (%)	Late Onset >3 yrs (n=160) n (%)
Onset of wheeze	130 (44.8%)	160 (55.2%)
Family history of asthma	74 (56.9%)	80 (50.0%)
Allergic rhinitis	96 (73.8%)	108 (67.5%)
Allergic conjunctivitis	40 (30.8%)	42 (26.3%)
Atopic dermatitis	4 (3.1%)	8 (5.0%)
Birth weight <2.5 kg	14/112 (12.5%)	32/130 (24.6%)
Breastfeeding >12 months	94/120 (78.3%)	92/134 (68.7%)

3.3 Triggering Factors

Seasonal variation was the most frequently reported precipitating factor overall, affecting 236 children (81.4%), followed closely by upper respiratory tract infection (232 children, 80.0%) and dust exposure (216 children, 74.5%). Smoke exposure was reported in 182 of 290 children (62.8%), while play or exercise-induced symptoms were present in 172 children (59.3%). Food allergy was identified as a trigger in 116 children (40.0%), and pet exposure in 88 children (30.3%). Across all trigger categories, the early-onset group consistently showed slightly higher proportions than the late-onset group, most notably for upper respiratory tract infection (early onset: 84.6%; late onset: 76.2%), dust exposure (78.5% vs. 71.2%), and pet exposure (35.4% vs. 26.2%) (Table 3).

Table 3. Distribution of triggering factors among study participants by age at onset (n=290)

Triggering Factor	Early Onset (n=130) n (%)	Late Onset (n=160) n (%)	Total (n=290) n (%)
Seasonal variation	108 (83.1%)	128 (80.0%)	236 (81.4%)
Upper respiratory infection	110 (84.6%)	122 (76.2%)	232 (80.0%)
Dust exposure	102 (78.5%)	114 (71.2%)	216 (74.5%)
Smoke exposure	84/128 (65.6%)	98/154 (63.6%)	182 (62.8%)
Play / exercise-induced	80 (61.5%)	92 (57.5%)	172 (59.3%)
Food allergy	58 (44.6%)	58 (36.2%)	116 (40.0%)
Pet exposure	46 (35.4%)	42 (26.2%)	88 (30.3%)

4. DISCUSSION

The present hospital-based study provides a detailed description of the clinical profile, severity distribution, and associated risk factors of childhood bronchial asthma in coastal Karnataka. The finding that intermittent asthma constituted nearly half of all cases is consistent with data from comparable Indian hospital-based studies.[10,11] The predominance of milder severity forms, however, should not obscure the significant cumulative morbidity these children experience through recurrent exacerbations, missed school days, and impaired physical activity. It also reflects the important healthcare burden created by frequent outpatient consultations for a condition that is, in large measure, preventable.

An important and clinically significant finding was that all 10 cases of severe persistent asthma occurred exclusively in older children aged 10–15 years. While this study was not designed to identify longitudinal progression, this pattern may reflect cumulative allergen sensitization, continued and uncontrolled environmental exposure, inadequate long-term controller therapy, poor adherence to preventive measures over time, or delayed specialist referral. Previous Indian studies have similarly noted that older children and adolescents with unmanaged or under-diagnosed asthma may present with more severe disease.[12] This finding has practical implications for pediatric care protocols that should include systematic severity reassessment at each clinical encounter.

Early-onset asthma was observed in nearly half the cohort and was associated with a slightly higher frequency of positive family history compared with late-onset disease (56.9% vs. 50.0%). This is consistent with prior evidence suggesting that genetically predisposed children exposed to early environmental triggers develop respiratory symptoms at a younger age.[13] A meta-analysis and systematic review of childhood asthma phenotypes has highlighted that early-onset atopic asthma carries distinct pathophysiological characteristics and a different trajectory from late-onset disease, reinforcing the value of early-onset as a clinically relevant categorization.[14]

Allergic rhinitis was the most prevalent associated condition in both onset groups, affecting approximately 70% of the overall cohort. This prevalence is in keeping with the well-established concept of united airway disease, which postulates that the upper and lower airways function as a single functional unit sharing epithelial continuity, immunological responses, and inflammatory mediators.[8,15] In children with asthma, allergic rhinitis is estimated to be present in 60–70% of cases, and its effective treatment has been shown to have beneficial effects on lower airway symptoms, further supporting the importance of combined upper and lower airway management strategies.[15] Smoke exposure was identified as a trigger in nearly two-thirds of children, reflecting the ongoing burden of tobacco smoke and household air pollution in this setting, consistent with observations from community-based studies across India.[16]

Low birth weight was reported in a higher proportion of the late-onset group compared with the early-onset group (24.6% vs. 12.5%), an observation that merits careful interpretation. A meta-analysis by Xu et al. found that low birth weight was significantly associated with an increased risk of childhood asthma.[17] However, the mechanisms underlying this association - which may include impaired fetal lung development, altered immune programming, or compounding social determinants - could vary by onset phenotype and require prospective study.

4.1 Limitations

This study carries several limitations that must be acknowledged. First, as a hospital-based study at a single tertiary referral centre, findings may not be representative of the general pediatric population, and selection bias toward more symptomatic or medically complex children cannot be excluded. Second, the cross-sectional and descriptive nature of the study precludes causal inference, and the absence of a control group limits assessment of relative risk. Third, exposure data including family history, feeding history, birth weight, and triggering factors were derived from caregiver recall, introducing potential recall and social desirability biases.

5. CONCLUSION

Childhood bronchial asthma among children attending this study site was predominantly intermittent or mild persistent in severity. Allergic rhinitis was the most common associated condition, and the high prevalence of atopic co-morbidity across both onset subgroups underscores the importance of comprehensive allergic assessment in pediatric asthma care. Family history, seasonal triggers, respiratory infections, dust, and smoke exposure were consistently implicated as major risk factors. Systematic early identification of at-risk children, structured caregiver education, environmental trigger reduction, comprehensive management of coexisting allergic conditions, and improved access to long-term controller therapy are essential steps toward reducing asthma-related morbidity among children in this region.

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