

Clinical Spectrum of Childhood Asthma in Children Aged 6–14 Years: A Hospital-Based Study

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ABSTRACT

Background: Asthma is one of the most common chronic respiratory diseases in children and contributes significantly to pediatric morbidity. The disease spectrum varies depending on genetic, environmental, and perinatal risk factors.

Methods: This prospective observational study was conducted at the Department of Pediatrics, MKCG Medical College & Hospital, Berhampur. A total of 70 children aged 6–14 years diagnosed with asthma according to the GINA 2022 guidelines were enrolled. Demographic details, BMI, family history, allergic history, triggering factors, and perinatal risk factors were recorded. Clinical assessment included symptom profile and signs of severity. Pulmonary function tests (PFT), including FEV1 and PEFr were performed, and bronchodilator reversibility testing was conducted. Data were analyzed using descriptive statistics, chi-square test, and independent t-test.

Results: The majority of children (57.1%) were in the 6–9 years age group, with an equal male-to-female ratio (1:1). Most had a normal BMI (75.7%). However, 20% were overweight or obese and exhibited greater symptom severity. Common triggers included junk food intake (70%), sedentary lifestyle (58.6%), and allergen exposure (51.4%). Significant perinatal associations included NICU stay (65.7%) and preterm birth (48.6%). FEV1 variability >12% was observed in 58.6% of cases, while 48.6% had baseline PEFr <70% predicted. Asthma was well controlled in 40%, partially controlled in 37.1% & uncontrolled in 25.7% of total cases.

Conclusion: Childhood asthma is more prevalent in younger school-aged children and is strongly associated with modifiable environmental and perinatal risk factors. Early diagnosis using spirometry and targeted management strategies are crucial to improving asthma control and reducing future exacerbations.

Key-words: Childhood asthma, Pulmonary function test, FEV1 variability, PEFr, Risk factors, Asthma control

INTRODUCTION

Asthma is a chronic respiratory disease that affects people of all ages, but its impact on children is particularly significant. It is a leading cause of morbidity and mortality in pediatric populations, resulting in missed school days, hospitalizations, and even fatalities.

[1]

Asthma's clinical spectrum in children is diverse, ranging from mild to severe, and its presentation can vary depending on age, genetic predisposition, environmental factors, and comorbidities.^[2]

According to the International Study of Asthma and Allergies in Childhood (ISAAC), global prevalence of severe asthma among adolescents is 6.9%, ranging from 3.8% in Asia-Pacific and Northern and Eastern Europe to 11.3% in North America.^[3] Limited data are available on the prevalence of asthma among schoolchildren in India. Amidst wide interregional variation, few Indian studies have reported the prevalence of childhood asthma in the range of 3.5% to 29.5%.^[4]

Asthma in children aged 6-14 years is a complex condition that requires a comprehensive understanding

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of its pathophysiology, clinical presentation, and management strategies.^[5] The developing lungs and immune systems of children in this age group make them more susceptible to environmental triggers and respiratory infections, which can exacerbate asthma symptoms and increase the risk of complications.^[6]

The Immune system of children is still maturing, and their lungs are still developing, making them more prone to inflammation and airway constriction.^[7] Additionally, children in this age group are more likely to be exposed to environmental triggers such as allergens, air pollution and tobacco smoke, which can trigger asthma symptoms. Respiratory infections, such as the common cold and flu, are also more common in children and can trigger asthma exacerbations.^[8]

The clinical presentation of asthma in children aged 6-14 years can vary widely, ranging from mild symptoms such as occasional coughing and wheezing to severe exacerbations requiring hospitalization.^[9] Children with asthma may experience symptoms such as shortness of breath, chest tightness, and coughing, which can be mistaken for other respiratory conditions. Accurate diagnosis and assessment of asthma severity are crucial for guiding treatment decisions and preventing complications.^[10]

Asthma management in children aged 6-14 years requires a multifaceted approach that includes pharmacological and non-pharmacological interventions. Pharmacological interventions, such as inhaled corticosteroids and bronchodilators, are commonly used to control asthma symptoms. In contrast, non-pharmacological interventions, such as avoidance of environmental triggers and respiratory therapy, may also be necessary.^[11] Developing a personalized treatment plan that considers the child's specific needs and circumstances is essential to achieving optimal asthma control.^[12]

MATERIALS AND METHODS

This clinical study was meticulously designed as a prospective, observational study to investigate the demographic and clinical characteristics of children with asthma aged 6-14 years, as well as their clinical spectrum and outcomes, at MKCG Medical College & Hospital, Berhampur.

Inclusion criteria- All the cases of asthma in children between the age group 6-14 years with signs and symptoms of asthma as per GINA guidelines who are admitted to the Department of Pediatrics M.K.C.G. Medical College & Hospital will be enrolled.

Exclusion criteria

- Children with other respiratory diseases like pneumonia, empyema and hydropneumothorax, etc. will be excluded.
- Children below 6 years will be excluded due to limitation of the study for lung function test in younger children.

Study Parameters- The primary clinical parameters included assessments of asthma severity, symptoms, pulmonary function, and treatment outcomes. Biochemical parameters involved the measurement of blood levels of inflammatory markers, such as eosinophil count and IgE levels, from blood samples collected at the time of diagnosis and at follow-up visits. These parameters were chosen for their relevance to diagnosing, monitoring, and predicting asthma outcomes in children. Additionally, the study evaluated the frequency and duration of asthma exacerbations, the need for hospitalization, and the quality-of-life scores for patients with asthma.

Methodology - A case record sheet was prepared, in which patient demographic details, anthropometric measurements (height, weight, BMI, & the family history of asthma and allergies, including triggering factors & responses were recorded in question format. If a child had a previously diagnosed case of asthma, the number of episodes in the hospital and at home was noted, and the types of reliever and controller used were mentioned in the format. Then a symptom-free interval was noted. Finally, in both cases (new and previous cases), symptoms at the time of presentation, different clinical findings, lab parameters, and chest X-ray were obtained, followed by PFT during hospital admission & results were noted. The breath-o-meter was used to measure PEFR according to standard procedures. The highest of three readings was taken as the correct value, and 50% of predicted PEFR was used as the cut-off for categorising the child's asthma severity.

On spirometry, FEV1 values and results of bronchodilator reversibility testing were recorded and compared according to the diagnostic criteria for childhood asthma in the GINA 2022 guidelines, and the final diagnosis was made. In cases of acute exacerbation, the first patient was stabilized. Details were recorded according to the case record format; PFT was performed, and follow-up was arranged to assess symptom control and prevent risk factors for future severe episodes.

Detailed comparisons of age, sex, child's locality, and prevalence of asthma based on family history and allergic history were calculated, and outcomes were assessed from PEFr and FEV1 values.

Statistical Analysis- Data analysis for the study was conducted using Microsoft Excel and statistical software.

Descriptive statistical analysis was performed, and percentages, frequencies, means, standard deviations (SD), confidence intervals (CI), and Chi-square tests were calculated. Independent T-tests were also conducted to compare the means of continuous variables between different severity groups. The statistical analysis enabled the identification of meaningful patterns and conclusions from the collected data, providing insights into the clinical spectrum and management of asthma in children aged 6-14 years.

RESULTS

Out of 70 asthmatic cases, 40(57.1%) children belonged to the 6-9 years age group & 10-14 years age group constituted 42.9% of the study population (Table 1).

Table 1: Age-specific distribution of childhood asthma cases

| Age Group | Frequency | Percentage | Cumulative (%) |
|-----------|-----------|------------|----------------|
| 10-14 | 30 | 42.9 | 42.9 |
| 6-9 | 40 | 57.1 | 100 |
| Total | 70 | 100 | |

The majority of Asthmatic cases had normal BMI (75.7%). Obesity and overweight accounted for 7.1% & 12.9% of

total cases, respectively, and underweight accounted for 4.3% of total asthmatic cases (Table 2).

Table 2: Distribution of cases according to BMI

| BMI Group | Frequency | Percentage | Cumulative (%) |
|------------|-----------|------------|----------------|
| Normal | 53 | 75.7 | 75.7 |
| Obese | 5 | 7.1 | 82.9 |
| Overweight | 9 | 12.9 | 95.7 |

The highest association of asthma was with intake of junk food (70%), followed by sedentary lifestyles (58.6%). Exposure to allergens & after exercise both constituted 51.4% of total cases. Exposure to smoke was associated

with 47.1% of cases. The association of Lower socio-economic status with asthma symptoms was 41.4%; middle & upper socio-economic status each accounted for 30% & 28.6% of cases, respectively (Table 3).

Table 3: Association of triggering factors with cases of Asthma

| Triggering Factor | Count | Percentage (%) | |
|---|--------|----------------|------|
| Triggering Factor - Exposure to Allergens | 36 | 51.4 | |
| Triggering Factor - Exposure to Smoke | 33 | 47.1 | |
| Triggering Factor - Intake of Junk Food | 49 | 70.0 | |
| Triggering Factor- Sedentary Lifestyle | 41 | 58.6 | |
| Triggering Factor - After Exercise | 36 | 51.4 | |
| Triggering Factor - Socioeconomic Status | Lower | 29 | 41.4 |
| | Middle | 21 | 30 |
| | Upper | 20 | 28.6 |

NICU stays during early infancy and the need for ventilation was associated with 65.7% & 44.3% of total cases, respectively. Preterm delivery & Low birth weight

were associated with 48.6% & 45.7% of total cases, respectively, and formula feeding (i.e., early weaning) was associated with 44.3% of cases (Table 4).

Table 4: Association of perinatal risk factors with cases of asthma

| Perinatal Risk Factor | Count | Percentage (%) |
|--|-------|----------------|
| Perinatal Risk Factor - Preterm | 34 | 48.6 |
| Perinatal Risk Factor - LBW | 32 | 45.7 |
| Perinatal Risk Factor - NICU Stay | 46 | 65.7 |
| Perinatal Risk Factor - Need for Ventilation | 31 | 44.3 |
| Perinatal Risk Factor - Formula Feeding | 31 | 44.3 |

The characteristic triad of asthma symptoms, i.e. dry cough, wheeze, and difficulty in breathing, was found in all cases of asthma. Chest Tightness was found in 24.3%

of total cases and was a common symptom in 51.4% of total asthma cases (Table 5).

Table 5: Distribution of asthma cases according to presenting symptoms

| Presenting Symptoms | Count | Percentage (%) |
|---|-------|----------------|
| Presenting Symptoms - Dry Cough | 70 | 100 |
| Presenting Symptoms - Wheeze | 70 | 100 |
| Presenting Symptoms - Difficulty in Breathing | 70 | 100 |
| Presenting Symptoms - Chest Tightness | 17 | 24.3% |
| Presenting Symptoms - Fever | 36 | 51.4% |

Of the 70 enrolled cases, 10 (14.2%) had Cyanosis as a clinical sign. Tachypnoea (RR >30 breaths/min) was observed in 70% of cases. Use of the accessory muscle was found in 21.4% of cases. An audible wheeze was

present as a clinical sign in 20% of the children. O₂ saturation <92% was observed in 45% of cases & Pulsus Paradoxus was found in 27.5% of the total cases under study (Table 6).

Table 6: Distribution of cases according to signs of asthma

| Clinical Sign of Asthma | | Count | Percentage (%) |
|----------------------------|-----------------|-------|----------------|
| Cyanosis | Yes | 10 | 14.20 |
| | No | 60 | 85.80 |
| Respiratory Rate (>30/min) | >30 breaths/min | 49 | 70 |
| | <30 breaths/min | 21 | 30 |
| Accessory Muscle Use | Yes | 15 | 21.40 |
| | No | 55 | 78.60 |
| Audible Wheeze | Yes | 14 | 20 |
| | No | 56 | 80 |
| Oxygen Saturation | <=92% | 32 | 45 |
| | >=93% | 38 | 55 |
| Pulsus Paradoxus | Yes | 19 | 27.50 |
| | No | 51 | 72.50 |

After Bronchodilator treatment, FEV₁ was measured; 58.6% of children had more than 12% variability from

Baseline, and 41.4% of Children with asthma had FEV₁ variability less than 12% (Table 7).

Table 7: Distribution of asthma cases according to post-bronchodilator FEV1 value (variability)

| Variability | Count | Percentage (%) |
|-----------------------|-------|----------------|
| FEV1 Variability >12% | 41 | 58.6 |
| FEV1 Variability <12% | 29 | 41.4 |

In the present study on baseline PEFR estimation, 52.8% of cases had PEFR values greater than 70% of the predicted value, and 48.6% had PEFR values less than 70% of the predicted value (Table 8).

Table 8: Distribution of cases according to baseline PEFR values

| Predicted | Count | Percentage (%) |
|-------------------------|-------|----------------|
| PEFR (Prediction%) >70% | 37 | 52.9 |
| PEFR (Prediction%) <70% | 34 | 48.6 |

Among previously diagnosed asthmatic children, 22.9% used a nebulizer as an inhaler device, 11.4% used oral medication, 25.7% used an MDI with a spacer as an inhaler device, and 7.1% used a DPI as an inhaler device.

Among newly diagnosed asthma cases, 41.4% used MDI with a spacer, 11.4% used MDI with a spacer and mask, and 12.9% used DPI (Table 9).

Table 9: Distribution of asthma cases according to time of diagnosis and inhaler device use.

| | Outcome- Previously Diagnosed | | | | Outcome - Newly Diagnosed | | | |
|---|-------------------------------|------|-------|------|---------------------------|------|-------|------|
| | No | | Yes | | No | | Yes | |
| | Count | % | Count | % | Count | % | Count | % |
| Previously Advised - Nebulization | 21 | 30 | 16 | 22.9 | 16 | 22.9 | 21 | 30 |
| Previously Advised – Oral Medication | 19 | 27.1 | 8 | 11.4 | 8 | 11.4 | 19 | 27.1 |
| Previously Advised - MDI with Spacer | 24 | 34.3 | 18 | 25.7 | 18 | 25.7 | 24 | 34.3 |
| Use of Inhaler Device - MDI with Spacer | 29 | 41.4 | 19 | 27.1 | 19 | 27.1 | 29 | 41.4 |
| Use of Inhaler Device - MDI with Spacer with Mask | 8 | 11.4 | 8 | 11.4 | 8 | 11.4 | 8 | 11.4 |
| Use of Inhaler Device - DPI | 9 | 12.9 | 5 | 7.1 | 5 | 7.1 | 9 | 12.9 |

In the present study, 40% were well controlled, 37.1% were partially controlled, and 25.7% were uncontrolled (Table 10).

Table 10: distribution of cases according to control of asthma.

| Asthma Control | Count | Percentage (%) |
|---------------------------------------|-------|----------------|
| Asthma Control - Well Controlled | 28 | 40 |
| Asthma Control - Partially Controlled | 26 | 37.1 |
| Asthma Control - Uncontrolled | 18 | 25.7 |

DISCUSSION

In the present study, among 70 asthmatic children enrolled, the male: female ratio was 1:1 (35 males and 35 females). Nearly 57.1% of the study population were in the 6-9 years age group, and 42.9% were in the 10-14 years age group. A similar study by Bacharier *et al.* [13] showed that 61.7% of 175 children were in the 10-14-year age group.

A study by Kabra *et al.* [14] found that most asthmatic children had normal BMI. However, 19.3% of the asthmatic children were overweight or obese. Breathlessness and chest tightness were more often seen in asthmatic children who were overweight or obese than in children with normal BMI ($p < 0.05$). In our study, similar results were found: the majority of asthmatic cases had a normal BMI (75.7%). But 20% of the study population were overweight or obese. Chest tightness and fever were more often seen in asthmatic children who were overweight or obese than those with normal BMI ($p < 0.05$).

According to a systematic review and meta-analysis by Brini *et al.* [15], it was shown that Preterm babies have, on average, 36% higher risk of asthma than term babies. In our study, 48.6% of asthmatic children were preterm at the time of delivery. Similarly, Khan *et al.* [16] showed that low birth weight babies had low lung function, leading to increased prevalence of asthma in the adolescent age group. The Longitudinal study by Piotrowska *et al.* [17] on the association between breastfeeding and respiratory allergies and type in American children found that the lowest asthma prevalence was among those who were exclusively breastfed (5%) and the highest among those who were formula-fed (24.1%). Similar results were found in our study, in which the prevalence of asthma among formula-fed infants in early infancy was 44.3%.

A Prospective observational study was conducted by Al-Moamary *et al.* [18] on the clinical Profile of asthma among Pediatric patients attending a tertiary care hospital. In 100 cases of Bronchial asthma, Cough was the predominant symptom in 95% of cases, followed by Wheeze in 90% and difficulty in breathing in 83%. In the present study, Dry cough, wheeze, and difficulty in breathing were found in all cases of Bronchial asthma; fever was found in 51.4% of cases, & Chest tightness was found in 24.3% of total cases of asthma. Then, we extrapolated the association between asthma symptoms in children with normal or higher BMI. In our study, the

characteristic triad of asthma symptoms, such as dry cough, wheeze and difficulty in breathing were found in all cases, whether normal BMI, overweight, or obese children. Similar results were found in Roel *et al.* [19], where Breathlessness & Chest tightness were more often seen in those asthmatic children who were overweight & obese than those with normal BMI ($p < 0.05$).

The urgent issue of asthma management strategies is early diagnosis. Though asthma can be diagnosed on clinical grounds, poor compliance and difficulty in monitoring are impediments to successful management. So, all older children should undergo spirometry as part of the initial evaluation of disease. In our spirometry-based study, 44.3% had FEV1 > 80% and 31.4% had FEV1 between 60-80%. However, 24.3% of children had FEV1 less than 60%, and 58.6% had FEV1 variability greater than 12%, which is characteristic of asthma. Similar results were found in the study conducted by Reyna *et al.* [20]

In our study peak expiratory flow rate was measured at the time of diagnosis, which was called baseline PEFR and baseline value found out to be 52.9% of children were more than 70% of predicted & 48.6% of children were found to have baseline PEFR less than 70% of predicted and after Bronchodilator treatment, PEFR was measured, variability from baseline was more than 13% in 74.3% which was in consistent with asthma. Evidence suggests that the association of a positive family history of asthma, along with a decreased PEFR, could provide a basis for targeted preventive efforts. A study conducted by Shiyas *et al.* also showed similar results. [21]

CONCLUSIONS

Prevalence of childhood asthma is more common in 6-9 years age group with 57.1%. More prevalence of childhood asthma in urban population (54.3%) is due to high intake of junk food, exposure to dust and sedentary lifestyles. Positive family history of asthma was associated with high incidence of childhood asthma. The incidence of asthma was high among the high-risk group. Obese and Overweight children were associated with more severity of Asthma symptoms than the children with normal BMI. Early identification of signs and symptoms of asthma in accordance with positive family history and risk factors vital in postulate the initial treatment of asthma and their monitoring to reduce risk future exacerbation.

CONTRIBUTION OF AUTHORS

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