Original Article

Role of Inflammatory Mediators—Absolute Eosinophil Count, C-Reactive Protein, and Total Immunoglobulin E—in Pediatric Asthma: A Clinicopathological Correlation with Disease Severity at a Tertiary Care Hospital in Eastern Uttar Pradesh

Astha Bhatt[1], Amit Singh[2], Sumita Shukla[3]

[1]Assistant Professor, Department of Paediatric, Maa Vindhyavasini Autonomous State Medical College, Mirzapur, Uttar Pradesh, India. [2]Assistant Professor, Department of Pathology, Baba Kinaram Autonomous State Medical College, Chandauli, Uttar Pradesh, India. [3]Assistant Professor, Department of Anatomy, Rajarashi Dashrath Autonomous State Medical College, Ayodhya, Uttar Pradesh, India

Abstract

Background: Bronchial asthma is a common long-term (chronic) lung disease that is associated with episodes of variable airflow blockage and persistent inflammation of the airways. Measurement of some inflammatory markers like absolute eosinophil count (AEC), C-reactive protein (CRP) and total immunoglobulin E (IgE) is based on the idea that they may indicate disease activity and severity helping with disease risk stratification and management. The objective is to assess the contribution of AEC, CRP and total IgE in children with asthma and to draw a clinicopathology correlation with the severity of the disease. **Material and Methods:** A cross sectional analytical study was carried out in the Department of Department of Paediatric, Maa Vindhyavasini Autonomous State Medical College, Mirzapur, Uttar Pradesh for 18 months in a hospital setting. A total of 120 children aged from 5 to 18 years had a clinically diagnosed bronchial asthma were enrolled. Demographic and clinical information was collected and then the severity of asthma was determined based on the Global Initiative for Asthma (GINA) guidelines. The serum levels of AEC, total IgE and serum CRP were measured. Data was analysed with SPSS version 26.0 and $p<0.05$ was regarded as statistically significant. **Results:** Of the 120 participants 58.3% were males, with a mean age of 9.8 ± 3.4 years. The most common presentation was moderate persistent asthma (40.0%). There was a significant increase in mean AEC, CRP, and total IgE with increasing disease severity ($p<0.001$). High AEC (or more specifically >700 cells/µL), high CRP (or more specifically >10mg/L) and high IgE (or more specifically >800IU/mL) were highly associated with severe persistent asthma. The total IgE, AEC and CRP had positive correlations with asthma severity ($r=0.74$, 0.71 and 0.65 respectively) and in addition the levels of these inflammatory markers had significant negative correlation with the pulmonary function ($p<0.001$). **Conclusion:** There is a significant association between the severity of asthma in children and AEC, CRP and total IgE. Such easy-to-measure markers could be useful as ancillary tools to guide clinical practice in the management of the disease, in characterizing high risk children and in determining individual management in everyday clinical practice.

Keywords: Pediatric asthma; Absolute eosinophil count (AEC); C-reactive protein (CRP); Immunoglobulin E (IgE); Inflammatory biomarkers; Disease severity; Bronchial asthma; Clinicopathological correlation; Children; Airway inflammation.

Received: 14 June 2026 **Revised: 01 July 2026** **Accepted: 20 July 2026** **Published: 06 August 2026**

Introduction

Asthma is one of the most prevalent chronic respiratory conditions that affects children around the globe and is a significant cause of morbidity, school absenteeism, emergency department visits and hospitalisation. Chronic inflammation of the airways, hyperresponsiveness of the airways and variable airflow obstruction from mixed interactions of genetics and environment causes it. Childhood asthma remains a major public health problem, with a need to robustly assess disease severity early and to properly risk-stratify treatment, as outlined by the Global Initiative for Asthma (GINA).[1]

The asthma disease is a multifaceted inflammatory disorder that can be classified into several phenotypes and endotypes. Eosinophilic airway inflammation, high levels of immunoglobulin E (IgE) and allergic sensitization is the type-2 (T2)-high inflammatory phenotype, which is most frequent in children. As a result of these inflammatory processes, airway remodeling, mucus hypersecretion, recurrent wheezing and frequent exacerbations have become important considerations in the evaluation of inflammatory biomarkers to monitor the disease and tailor management strategies to the

Address for correspondence: Dr. Amit Singh, Assistant Professor, Department of Pathology, Baba Kinaram Autonomous State Medical College, Chandauli, Uttar Pradesh, India
E-mail: amit.snmc07@gmail.com

DOI: 10.21276/amit.2026.v13.i2.913

How to cite this article: Bhatt A, Singh A, Shukla S. Role of Inflammatory Mediators—Absolute Eosinophil Count, C-Reactive Protein, and Total Immunoglobulin E—in Pediatric Asthma: A Clinicopathological Correlation with Disease Severity at a Tertiary Care Hospital in Eastern Uttar Pradesh. Acta Med Int. 2026;13(2):1548-1552.

individual.[2]

Absolute eosinophil count (AEC) is a simple and easily available hematological parameter of eosinophilic inflammation. When activated, eosinophils release inflammatory mediators which are involved in airway hyperresponsive, epithelial injury and chronic inflammation of the airways. There is clinical significance that elevated eosinophils indicate higher asthma severity, higher rates of exacerbation and poor asthma control and thus act as a biomarker for asthma.[3]

One of the most important functions of total serum immunoglobulin E (IgE) is to trigger immediate hypersensitivity responses after contact with allergen and is a key mediator of allergic asthma. Although the molecular mechanisms underlying the link between elevated serum IgE and persistent and severe asthma are not fully understood, this correlation has consistently been observed, and drawn conclusions that serum IgE reflects allergic inflammation and disease activity.[4,5]

Asthma is an eosinophilic inflammatory disorder, but systemic inflammation plays a role in disease progression. C-reactive protein (CRP), a marker of acute-phase reactant, is known to rise in airway inflammation and acute exacerbations and is found to be associated with decreased pulmonary function and increased severity of the disease. Thus, CRP can be used as an adjunct to AEC and IgE in evaluating inflammatory status of asthmatic children.

High serum IgE, blood eosinophilia, allergic sensitization and asthma severity have been shown in previous studies to have significant associations. These studies indicated that the inflammatory markers that are routinely available may help predict which children have more severe asthma phenotypes, and, therefore, are more likely to have recurrent asthma exacerbations and airway hyperresponsiveness.

Evidence is still limited on data on inflammatory markers in asthma occurring in the pediatric age group in Eastern Uttar Pradesh. Hence the present study was conducted with the aim to assess the role of the absolute eosinophil count (AEC), C-reactive protein (CRP) and total immunoglobulin E (IgE) in children with bronchial asthma and their clinic pathological correlation with bronchial asthma severity at Maa Vindhyavasini Autonomous State Medical College, Mirzapur, UP.

Materials and Methods

Study Design: A hospital-based cross-sectional analytical study was conducted to evaluate the association between inflammatory mediators and disease severity among pediatric patients with bronchial asthma.

Study Setting: The study was carried out in the Department of Paediatric, Maa Vindhyavasini Autonomous State Medical College and Associated Hospital, Mirzapur, Uttar Pradesh.

Study Duration: The study was conducted over a period of 18 months from January 2025 to June 2026.

Study Population: Children attending the pediatric outpatient department, emergency department, or admitted to the pediatric ward with a diagnosis of bronchial asthma were screened for eligibility.

Sample Size: A total of 120pediatric patients fulfilling the eligibility criteria were included in the study using consecutive sampling.

Inclusion Criteria

- Children aged 5–18 years.
- Diagnosed with bronchial asthma based on GINA recommendations.
- Patients presenting with stable asthma or acute exacerbation.
- Parents or legal guardians willing to provide written informed consent, with assent obtained from older children where appropriate.

Exclusion Criteria

- Children with congenital heart disease or chronic lung diseases other than asthma.
- Pulmonary tuberculosis or other active respiratory infections.
- Autoimmune disorders or immunodeficiency diseases.
- Hematological disorders affecting eosinophil count.
- Recent systemic corticosteroid therapy within the preceding two weeks.
- Refusal to participate in the study.

Data Collection: After obtaining informed consent, demographic characteristics, clinical history, duration of symptoms, family history of atopy, environmental exposure, previous hospitalization, medication history, and asthma severity were recorded using a structured case record form.

Clinical Assessment: A detailed general physical examination and systemic examination were performed. Asthma severity was classified according to the Global Initiative for Asthma (GINA) recommendations into intermittent, mild persistent, moderate persistent, and severe persistent asthma based on clinical features and pulmonary function wherever feasible.

Laboratory Investigations

The following investigations were performed:

- Complete blood count including absolute eosinophil count (AEC).
- Serum C-reactive protein (CRP).
- Total serum Immunoglobulin E (IgE).
- Peripheral blood smear examination.
- Chest radiograph whenever clinically indicated.
- Spirometry (children ≥5 years capable of performing the procedure) for assessment of FEV_1, FVC, and FEV_1/FVC ratio.

Outcome Measures

Primary outcome:

- Correlation of AEC, CRP, and total serum IgE with asthma severity.

Secondary outcomes:

- Association of inflammatory markers with demographic and clinical characteristics.
- Relationship between inflammatory markers and pulmonary function parameters.
- Comparison of inflammatory marker levels across different asthma severity categories.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using SPSS version 26.0. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages.

Comparisons between groups were performed using the independent Student's t-test or one-way ANOVA for normally distributed variables and the Mann–Whitney U test or Kruskal–Wallis test for non-parametric variables. Chi-square test or Fisher's exact test was applied for categorical data. Pearson's or Spearman's correlation coefficient was used to evaluate the association between inflammatory mediators and asthma severity depending on data distribution. A p value <0.05 was considered statistically significant.

Results

A total of 120 children with bronchial asthma were included in this cross-sectional analytical study. The mean age of the study population was 9.8 ± 3.4 years (range: 5–18 years). Boys constituted a slight majority (58.3%) of the participants. Most patients had moderate persistent asthma (40.0%), followed by mild persistent asthma (33.3%), severe persistent asthma (16.7%), and intermittent asthma (10.0%). Mean absolute eosinophil count (AEC), serum C-reactive protein (CRP), and total serum IgE increased progressively with increasing disease severity.

Table 1: Demographic and Clinical Characteristics of the Study Population (n = 120)

Variable	Number	Percentage (%)
Age Group (years)		
5–8	42	35.0
9–12	46	38.3
13–18	32	26.7
Gender		
Male	70	58.3
Female	50	41.7
Residence		
Rural	74	61.7
Urban	46	38.3
Family History of Atopy		
Present	56	46.7
Absent	64	53.3
Exposure to Passive Smoking		
Yes	44	36.7
No	76	63.3

Most participants belonged to the 9–12-year age group (38.3%), with a predominance of male children (58.3%). Rural residence was observed in 61.7%, while nearly half of the children (46.7%) had a positive family history of atopy.

Table 2: Distribution of Asthma Severity According to GINA Classification

Asthma Severity	Number	Percentage (%)
Intermittent	12	10.0
Mild Persistent	40	33.3
Moderate Persistent	48	40.0
Severe Persistent	20	16.7

The majority of children had moderate persistent asthma (40.0%), followed by mild persistent asthma (33.3%), while 16.7% had severe persistent asthma.

Table 3: Comparison of Inflammatory Mediators According to Asthma Severity

Asthma Severity	AEC (cells/µL) Mean ± SD	CRP (mg/L) Mean ± SD	Total IgE (IU/mL) Mean ± SD
Intermittent (n=12)	322 ± 84	2.6 ± 1.1	186 ± 72
Mild Persistent (n=40)	474 ± 118	4.1 ± 1.7	352 ± 126
Moderate Persistent (n=48)	692 ± 176	7.2 ± 2.5	646 ± 188
Severe Persistent (n=20)	942 ± 231	12.4 ± 3.6	1018 ± 282
p value	<0.001	<0.001	<0.001

Mean AEC, CRP, and total IgE increased significantly with increasing asthma severity. Children with severe persistent asthma demonstrated the highest levels of all three inflammatory markers (p < 0.001).

Table 4: Association Between Elevated Inflammatory Markers and Severe Persistent Asthma

Variable	Severe Asthma (n=20)	Non-Severe Asthma (n=100)	p value
AEC >700 cells/µL	18 (90.0%)	26 (26.0%)	<0.001
CRP >10 mg/L	15 (75.0%)	12 (12.0%)	<0.001
IgE >800 IU/mL	16 (80.0%)	15 (15.0%)	<0.001

Elevated AEC (>700 cells/µL), CRP (>10 mg/L), and IgE (>800 IU/mL) were significantly more common among children with severe persistent asthma compared with those having intermittent, mild, or moderate disease (p < 0.001)

Table 5: Correlation Between Inflammatory Mediators and Asthma Severity Score

Parameter	Correlation Coefficient (r)	p value
Absolute Eosinophil Count	0.71	<0.001
Serum CRP	0.65	<0.001
Total Serum IgE	0.74	<0.001

All three inflammatory mediators demonstrated a strong positive correlation with asthma severity. The strongest correlation was observed with total serum IgE (r = 0.74), followed by AEC (r = 0.71) and CRP (r = 0.65).

Table 6: Pulmonary Function Parameters According to Asthma Severity

Asthma Severity	FEV_1 (% Predicted) Mean ± SD	FEV_1/FVC (%) Mean ± SD	p value
Intermittent	93.4 ± 5.6	88.6 ± 3.8	
Mild Persistent	84.7 ± 6.9	82.4 ± 5.4	
Moderate Persistent	72.3 ± 8.2	74.8 ± 6.1	
Severe Persistent	58.6 ± 9.4	66.2 ± 7.3	
Overall			<0.001

Pulmonary function declined significantly with increasing asthma severity. Children with severe persistent asthma exhibited the lowest FEV_1 and FEV_1/FVC ratio, indicating progressively worsening airflow limitation ($p < 0.001$).

Discussion

The present hospital-based cross-sectional analytical study evaluated the clinicopathological correlation between inflammatory mediators—absolute eosinophil count (AEC), C-reactive protein (CRP), and total immunoglobulin E (IgE)—and disease severity among children with bronchial asthma. The results showed that there was a significant increasing trend in both AEC and CRP as well as in serum IgE with increasing severity of asthma. The children with severe persistent asthma demonstrated the highest levels of all inflammatory markers; all three markers were significantly and positively associated with asthma severity, indicating their potential as measures of inflammatory burden and for identifying high-risk children for severe asthma.

The serum concentration of IgE is a known parameter of allergic sensitization and is a central mediator of the pathogenesis of childhood asthma. The present study showed corresponding increase in level of IgE in children with intermittent asthma, moderate persistent asthma and severe persistent asthma, which confirms its association with the severity of the asthma. Lama et al. reported significantly elevated serum IgE levels in asthmatic children, especially in severe persistent asthma group, which further supports its close association with the level of allergic inflammation, and it may be used as a useful marker of disease activity.[8]

Vitamin D status was not determined in the present work, but the inflammatory mechanisms observed were: lower vitamin D levels with significantly higher eosinophil counts and serum IgE concentration in children with asthma, as demonstrated by de Amorim et al.[9]

Similarly, in the current study, the blood eosinophil count closely correlated with the level of asthma; this further supports its role as an inexpensive and easily available marker of eosinophilic airway inflammation as previously shown by Kumar et al. who found significant increase in serum periostin levels in increasing the severity of asthma which closely correlated with eosinophilic airway inflammation marker (eosinophils).[10]

Both blood eosinophil count and total serum IgE were used as markers of allergic sensitization, and Lee et al. noted that higher eosinophil counts predicted severity of asthma independent of total serum IgE. In keeping with this, children with moderate and severe persistent asthma in this study had significantly higher eosinophil counts compared with children with milder asthma.

The significantly higher AEC in children with severe persistent asthma in the present study reinforces the potential importance of eosinophilia as a marker for increased inflammation activity.

In recent years, the use of biomarkers for managing asthma has been increasingly endorsed in international recommendations. Blood eosinophils and serum IgE were found to be useful to identify and manage severe asthma in children, alongside clinical criteria, and the present study largely confirms this by showing strong relationships between inflammatory mediators and disease severity.

CRP, which is a non-specific marker of inflammation, has been shown to be linked to asthma progression, albeit its link to inflammation is a systemic one. In the current study, a fair correlation was noticed between severity of the disease and the CRP level and its level was found to be increased with the severity of the asthma, which makes CRP a good complementary parameter for assessing the inflammatory status of children suffering from asthma with AEC and serum IgE.

The current study has several strengths, as all three markers (AEC, CRP and serum IgE) were evaluated concurrently with the standardized clinical criteria regarding the severity of asthma. Some caveats need to be kept in mind, however. The cross-sectional design did not allow for the examination of temporal relationships and the study was performed at one tertiary care center, which may impede generalizability. Finally, some other markers that would have been more useful in advanced clinical research, including fractional exhaled nitric oxide, sputum eosinophils and cytokine profiling, were not assessed. More prospective, multicenter studies with serial inflammatory biomarker assays are warranted to further validate the use of inflammatory mediators for predicting prognosis in paediatric asthma.

Conclusion

The present study showed that absolute eosinophil count, C-reactive protein, and total serum immunoglobulin E are

significantly higher with severity of pediatric asthma. The two strongest associations with disease severity were between serum IgE and absolute eosinophil count; CRP represented the systemic inflammatory response. These are everyday laboratory measures that can be useful adjuncts to the clinical setting to help identify those children with severe asthma, help to risk stratify, monitor activity of asthma and adjust treatment as necessary. To confirm these results, larger, multicenter prospective studies should be conducted, and the long-term prognostic utility of inflammatory biomarker in pediatric asthma should be determined.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

References
1. Global Initiative for Asthma. Global Strategy for Asthma Management and Prevention. Fontana: Global Initiative for Asthma; 2025. Available from: Global Initiative for Asthma.
2. Papi A, Brightling C, Pedersen SE, Reddel HK, Bacharier LB, Busse WW. Asthma. Lancet. 2018;391(10122):783-800. doi:10.1016/S0140-6736(17)33311-1.
3. Martinez FD, Vercelli D, Holt PG, Sly PD, Lemanske RF Jr, Guilbert TW. Asthma and the hygiene hypothesis. N Engl J Med. 2015;372(20):1938-1947. doi:10.1056/NEJMra1502130.
4. Siroux V, Curt F, Oryszczyn MP, Maccario J, Kauffmann F, Pison C. Relationships of allergic sensitization, total immunoglobulin E and blood eosinophils to asthma severity in children. Allergy. 2003;58(12):1248-1254. doi:10.1046/j.1398-9995.2003.00317.x.
5. Silvestri M, Oddera S, Spallarossa D, FrangovaYourukova V, Rossi GA. In childhood asthma the degree of allergen-induced T-lymphocyte proliferation is related to serum IgE levels and to blood eosinophilia. Ann Allergy Asthma Immunol. 2000;84(4):426-432. doi:10.1016/S1081-1206(10)62276-4.
6. Sears MR, Burrows B, Flannery EM, Herbison GP, Holdaway MD, Silva PA. Relation between airway responsiveness and serum IgE in children with asthma and in apparently normal children. N Engl J Med. 1991;325(15):1067-1071. doi:10.1056/NEJM199110103251503.
7. Sherrill DL, Stein R, Kurzius-Spencer M, Martinez FD, Taussig LM, Morgan WJ. Total serum IgE and its relationship to asthma and allergic sensitization in children. J Allergy Clin Immunol. 1999;104(2 Pt 1):284-290. doi:10.1016/S0091-6749(99)70370-3.
8. Omenaas E, Bakke P, Eide GE, Elsayed S, Gulsvik A. Serum total immunoglobulin E and atopy markers in adults with asthma and respiratory symptoms. Clin Exp Allergy. 1994;24(5):410-417. doi:10.1111/j.1365-2222.1994.tb00931.x.
9. Lama M, Chatterjee M, Nayak CR, Chaudhuri TK, Chakrabarti S, Dutta SK. Total serum immunoglobulin E in children with asthma. Indian J Clin Biochem. 2013;28(2):197-200. doi:10.1007/s12291-012-0257-2.
10. de Amorim CLCG, de Souza Filho J, de Souza Rodrigues C, da Silva MPR, de Assis Araujo M, de Carvalho L. Vitamin D: association with eosinophil counts and IgE levels in children with asthma. J Bras Pneumol. 2020;46(6):e20200279. doi:10.36416/1806-3756/e20200279.
11. Kumar K, Gupta A, Kumar R, Goyal JP, Rajvanshi N, Kumar R. Serum periostin level in children with asthma. Indian J Pediatr. 2023;90(5):468-473. doi:10.1007/s12098-022-04455-9.
12. Lee HJ, Yang EA, Chun YH, Kim HH, Kim HS, Lee JH. Blood eosinophil counts as a biomarker for allergen sensitization in childhood allergic diseases in comparison with total immunoglobulin E. Allergy Asthma Respir Dis. 2024;12(1):26-33. doi:10.4168/aard.2024.12.1.26.
13. Padró-Casas C, Sánchez-García S, Pérez-Fernández V, Torres-Borrego J, Ortega-Casanueva C, Moreno-Galdó A. Prognostic factors in severe eosinophilic asthma in a pediatric population. J Asthma Allergy. 2024;17:1189-1201. doi:10.2147/JAA.S470426.
14. Matsunaga K, Hamada K, Kume H, Nakano Y, Ichinose M, Sugiura H. Guidance for type 2 inflammatory biomarkers in asthma and chronic obstructive pulmonary disease. Respirology. 2025;30(5):450-466. doi:10.1111/resp.14897.
15. Hamelmann E, Gappa M, Schauer U, Griese M, Wahn U, Schaub B. An algorithm for the diagnosis and management of severe asthma in children and adolescents. Allergy. 2025;80(4):1022-1038. doi:10.1111/all.16388.