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Correlation of Nasal Smear Eosinophils, Serum IgE Levels, and Absolute Eosinophil Counts with Clinical Severity in Allergic Rhinitis: A Tertiary Care Study

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KEYWORDS
Allergic rhinitis, nasal smear eosinophils, serum IgE, absolute eosinophil count, TNSS, biomarker, inflammation

ABSTRACT:
Allergic rhinitis (AR) is a widespread chronic inflammatory disorder of the upper airway that has a steady increase in global prevalence. The markers such as nasal smear eosinophils (NSE), serum immunoglobulin E (IgE), and absolute eosinophil count (AEC) are associated with allergic conditions but their specific applicability in determining the severity of AR symptoms remains inadequately described.
Objective:
To investigate the association between NSE, serum IgE, and AEC with nasal symptom severity in allergic rhinitis patients, evaluated by the Total Nasal Symptom Score (TNSS).
Materials and Methods:
This is a prospective observational study conducted at a tertiary healthcare centre from April 2023 to October 2024. Seventy patients were selected with the diagnosis of Allergic rhinitis based on ARIA guidelines. Nasal smears were collected with the help of nasal swabs and stained using May-Grunwald-Giemsa method. Serum IgE levels were measured via ELISA, and AEC was calculated by manual differential white blood cell counts. TNSS was used to evaluate the severity of clinical symptoms. Data analysis involved descriptive statistics, Pearson's correlation, and chi-square tests, with statistical significance set at $p < 0.05$.
Results:
NSE, AEC, and serum IgE levels exhibited a significant positive correlation with TNSS ($p < 0.0001$). Average NSE percentages were found to be 9.62% in patients with mild symptoms, 18.32% in moderate, and 30.60% in severe cases. Both AEC and serum IgE levels increased consistently with increased severity of symptoms. Spearman's correlation depicted the strongest association between TNSS and serum IgE ($r = 1.0$), followed by NSE ($r = 0.832$) and AEC ($r = 0.574$).
Conclusion:
Serum IgE, NSE, and AEC are effective biomarkers for evaluating symptom severity in patients with allergic rhinitis. Incorporating these parameters into standard clinical assessment protocols could enhance disease tracking and aid in tailoring personalized treatment approaches.

Introduction

Allergic rhinitis (AR) is a widespread condition, with studies estimating its prevalence in 20–30% of adults and as many as 40% of children, although figures can differ across populations. It is the most commonly diagnosed form of chronic rhinitis, affecting roughly 10–20% of individuals globally, and its incidence appears to be increasing over time. Severe forms of AR are known to significantly impair quality of life, disrupting sleep patterns and daily productivity.

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Serum IgE testing plays a vital role in diagnosing suspected allergic disorders, including AR, asthma, atopic dermatitis, urticaria, eczema, and some parasitic diseases[1, 2]. In parallel, elevated eosinophil counts are frequently associated with allergic responses, asthma, parasitic infestations, granulomatous diseases, fibrotic disorders, and certain malignancies.

The current study adds to the growing evidence base by highlighting the relevance of nasal smear eosinophils in allergic rhinitis. These eosinophils, which reflect local allergic inflammation in the nasal mucosa, were found to correlate with disease severity. This supports previous findings suggesting that eosinophils are key mediators of nasal mucosal inflammation (Rondon et al., 2007), reinforcing their potential as a useful marker for assessing disease activity and progression[3].

Materials and Methods

This prospective observational study was conducted in department of Pathology at Integral Institute of Medical Science and Research (IIMS&R), Lucknow from April 2023– October 2024. The final sample size was calculated to be 70. Nasal smears were collected with the help of a swab from inferior turbinate of each nostril for evaluating Nasal Smear Eosinophils and blood samples were taken for Absolute eosinophil count and Serum IgE levels.

Results

Table 1 shows that Total Nasal Symptom Score (TNSS) increases with disease severity. Mild cases (n=23) had a mean TNSS of **3.30±1.29,** moderate cases (n=34) had **7.22±1.17,** and severe cases (n=13) had the highest score at **11.08±0.86**. This clear upward trend suggests that TNSS is positively correlated with the severity of the condition.

Table 1: Level of TNSS among different categories of the cases

	No of Patients	Mean ± SD	p value
Mild	23	3.30± 1.29	<0.0001
Moderate	34	7.22±1.17	
Severe	13	11.08±0.86	

The mean age shows moderate TNSS patients being younger (28.35 ± 14.74 years) compared to mild (34.26 ± 13.18) and severe (37.08 ± 9.77) categories, suggesting symptom severity may increase with age. Serum IgE levels remain relatively similar across groups and do not follow a consistent trend, although the differences are statistically significant ($p < 0.042$), implying variability that may be clinically relevant. AEC levels, however, increase markedly with TNSS severity—from 396.57 ± 181.29 in the mild group to 2994.92 ± 2955.12 in the severe group—showing a highly significant association ($p < 0.0001$), indicating a strong correlation between eosinophil levels and symptom burden.

Similarly, NSE scores rise consistently from 6.91 ± 3.82 in mild cases to 23.69 ± 6.43 in severe cases, again with a statistically significant difference ($p < 0.0001$), further supporting the link between clinical severity and nasal symptom scoring. The distribution of patients includes 23 in the mild, 34 in the moderate, and 13 in the severe TNSS categories.

Table 2: Kruskal-Wallis Test (Comparison Across TNSS Groups), (Mild, Moderate, Severe) with IgE, AEC and NSE in cases with Allergic Rhinitis-

TNSS Category	Age (Mean ± SD)	Serum IgE (Mean ± SD)	AEC (Mean ± SD)	NSE (Mean ± SD)	Count
Mild	34.26± 13.18	343.78± 150.20	396.57± 181.29	6.91± 3.82	23
Moderate	28.35± 14.74	356.87± 145.54	1045.91± 405.26	11.35± 3.65	34

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Severe	37.08± 9.77	318.23± 161.74	2994.92± 2955.12	23.69± 6.43	13
		p= 0.042	p=< 0.0001	p=< 0.0001	

The correlation between Total Nasal Symptom Score (TNSS) and Absolute Eosinophil Count (AEC) is moderate but the weakest among the three comparisons. This suggests that while AEC shows some positive relationship with symptom severity, it is not a strong predictor of TNSS. The correlation between TNSS and Serum IgE levels is perfectly positive (r = 1.00), meaning that as TNSS increases, IgE levels also increase in a directly proportional manner. This suggests that Serum IgE is a very strong biomarker for predicting symptom severity in allergic rhinitis. In clinical practice, monitoring IgE levels could be highly useful for assessing and managing allergic rhinitis severity. The correlation between TNSS and Nasal Smear Eosinophils (NSE) is moderately strong (r = 0.832). This indicates that higher NSE percentages are associated with more severe TNSS scores, but the relationship is not as strong as with IgE.

Table 3:Spearman Correlation Coefficient for comparison of TNSS vs AEC, TNSS vs IgE and TNSS vs NSE.

Comparison	Spearman Correlation Coefficient
TNSS vs AEC	0.574 (weakestcorrelation)
TNSS vs IgE	1.00 (Strong positive correlation)
TNSS vs NSE	0.832 (Moderate correlation)

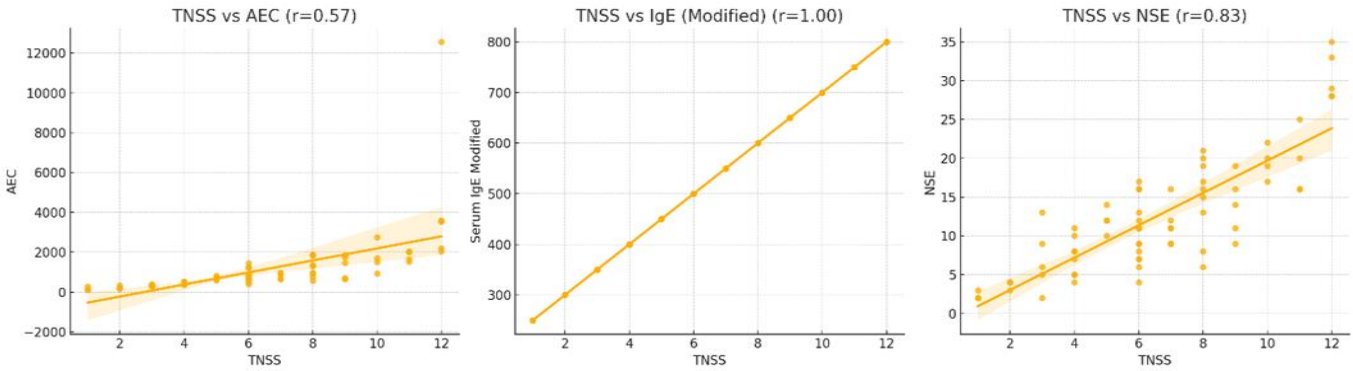

Figure 4: Spearman Correlation Coefficient for comparison of TNSS vs AEC, TNSS vs IgE and TNSS vs NSE.

Discussion

In this study, a significant variation in the Total Nasal Symptom Score (TNSS) was observed across different serum IgE level groups (p = 0.041), with a progressive rise in TNSS values from 6.55 ± 2.98 in patients with mild symptoms to 6.63 ± 2.99 in those with severe manifestations. This trend indicates a direct association between elevated serum IgE levels and increased nasal symptom burden. These findings are consistent with the findings reported by Bousquet J. et al. (2021), who found that individuals with higher serum IgE levels experienced more severe allergic symptoms and a decline in quality of life [4]. This strenthens the importance of IgE in allergic rhinitis pathophysiology and emphasise the potential of IgE-specific therapies like omalizumab, particularly in severe cases.

Shruthi Gowthami et al. reported a similar demographic distribution, with the highest proportion of participants aged 31–40 years and a predominance of males (81.7%). Based on TNSS severity, 35% were classified

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as mild, 28.3% as moderate, and 36.7% as severe. The study showed a mean AEC of 753.95 cells/cu.mm and an average serum IgE of 586 IU/ml. A significant correlation was found between nasal eosinophil scores and TNSS ($r = 0.652$; $p < 0.05$), consistent across both intermittent and persistent allergic rhinitis cases [5].

According to findings by Agarwal A. et al., 46.6% of allergic rhinitis patients had AEC values above 450 cells/cu.mm, with levels ranging between 300 and 2000 cells/cu.mm, and a mean of 553 cells/cu.mm. Elevated serum IgE (>120 IU/ml) was found in 69.5% of patients, with a mean level of 603.7 IU/ml. However, simultaneous elevation of both AEC and IgE was observed in only 37.1% of cases, and the association between the two markers was not statistically significant ($p > 0.05$) [6].

In the investigation led by Dechu Muddaiah, rhinorrhea was the most frequently reported symptom (90%), followed by nasal blockage (85%) and sneezing or itching (76%). Wheezing was observed in 14% of participants. Regarding severity, 66.3% had mild symptoms, 6.9% had moderate, and 26.9% had severe symptoms. Serum IgE levels showed a significant association with allergic rhinitis ($p = 0.00010766$), while AEC levels did not demonstrate a significant correlation ($p = 0.176665$) [7].

Dr. Jayagar Prabakaran's study noted that 43% of allergic rhinitis patients were aged between 15 and 30 years, and 56% were male. The predominant symptom was rhinorrhea (97%), followed by sneezing (82%) and nasal congestion (41%). Although two-thirds of patients had AEC values below 500 cells/cu.mm, 52% exhibited moderate to severe nasal eosinophilia. A strong and significant relationship was found between nasal eosinophil counts and symptom severity ($p = 0.001$). In contrast, the correlation between AEC and TNSS was weaker and not statistically significant ($p = 0.062$), suggesting that NSE may serve as a more reliable indicator of disease intensity than AEC [8].

Overall Analysis:

The current findings suggest that TNSS is positively correlated with serum IgE, NSE, and AEC to varying degrees. Serum IgE demonstrated the strongest and most consistent association with clinical severity, underscoring its role as the most dependable biomarker. NSE also correlated well, making it a useful supplementary marker. In comparison, AEC, while informative, may be better suited as a secondary parameter during clinical evaluation.

Conclusion:

This study establishes a meaningful association between TNSS and immunological markers—serum IgE, NSE, and AEC—in patients with allergic rhinitis. Among these, serum IgE emerged as the most robust indicator of disease severity. Given the IgE-mediated mechanism underlying allergic rhinitis, elevated total IgE was a crucial inclusion criterion and was present in over 90% of patients with predominant symptoms such as sneezing, nasal congestion, rhinorrhea, and itching.

NSE exhibited a moderate but notable correlation with TNSS, surpassing that of AEC. Its affordability, simplicity, and reproducibility make it a practical test, particularly in the initial diagnostic workup of suspected AR. Though not effective for determining symptom onset, type, or duration, NSE may serve as a helpful indicator of therapeutic response over time.

AEC was markedly elevated in individuals with moderate-to-severe symptoms and in select cases of mild persistent rhinitis. Despite its limitations, it remains a valuable adjunctive marker. Collectively, this study supports the integration of IgE, NSE, and AEC into a personalized, biomarker-driven approach to diagnosing and managing allergic rhinitis.

Declarations

Ethical Approval: Approved by Institutional Ethics Committee...

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Conflict of Interest: None declared.

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