

ASSOCIATION OF MODIFIED TOTAL NASAL SYMPTOM SCORE WITH INFLAMMATORY MARKERS IN ALLERGIC RHINITIS: A CROSS-SECTIONAL STUDY

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ABSTRACT

Allergic rhinitis (AR) is a type 2-mediated inflammatory disorder characterized by systemic allergic sensitization and localized airway inflammation. The modified Total Nasal Symptom Score (mTNSS) which assesses sneezing, rhinorrhea, nasal congestion, nasal pruritus and Postnasal drip is a simple clinical tool for evaluating symptom severity. A hospital-based cross-sectional analytical study was conducted among 90 participants comprising 30 patients each with allergic rhinitis, non-allergic rhinitis and healthy controls. Allergic rhinitis was diagnosed based on clinical symptoms and serum IgE >100 IU/mL. This study evaluated the diagnostic accuracy of mTNSS in allergic rhinitis and its association with serum total IgE and fractional exhaled nitric oxide (FeNO). The mean mTNSS was higher in allergic rhinitis (9.93 ± 1.59) than in non-allergic rhinitis (2.8 ± 1.37) and controls (0.53 ± 0.57) ($p < 0.001$). Serum IgE levels increased with higher mTNSS categories, with most individuals scoring 10–15 exhibiting IgE concentrations >500 IU/mL. The optimal mTNSS cut-off for diagnosing allergic rhinitis was ≥ 7 , providing 100% sensitivity and 96.7% specificity. The positive association between mTNSS and inflammatory markers supports its clinical relevance. Owing to its simplicity, low cost and high diagnostic accuracy, mTNSS serve as an effective screening tool for the early identification of allergic rhinitis.

Keywords: Allergic Rhinitis, IgE, Inflammatory markers, FeNO

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INTRODUCTION:

Rhinitis is an inflammatory disorder of the nasal mucosa characterized by rhinorrhea, sneezing, nasal obstruction, and nasal pruritus occurring in various combinations.¹ Allergic rhinitis (AR) is a type 2 (Th2-mediated) inflammatory disease involving both systemic allergic sensitization and localized airway inflammation.² In India, the prevalence of Allergic rhinitis ranges from 10% to 40%, with a rising incidence of both Allergic rhinitis and asthma.³

A simple, reliable and standardized tool for assessing symptom severity is therefore essential in routine clinical practice. The Total Nasal Symptom Score (TNSS) is a validated questionnaire that evaluates the four cardinal symptoms of AR—sneezing, rhinorrhea, nasal congestion, and nasal pruritus. Each symptom is graded on a four-point scale ranging from 0 (no symptoms) to 3 (severe symptoms).^{4,5,6}

The modified Total Nasal Symptom Score (mTNSS) expands the TNSS by incorporating Postnasal drip (PND), recognizing its clinical relevance in allergic rhinitis. The mTNSS evaluates five symptoms—sneezing, rhinorrhea, nasal obstruction, nasal itching, and Post nasal drip each scored from 0 to 3, yielding a total score ranging from 0 to 15.^{7,8} Post nasal drip reflects posterior nasal discharge secondary to mucosal inflammation and is a common symptom in patients with Allergic rhinitis and other sinonasal disorders. It is thought to result from impaired mucociliary clearance.⁹

By incorporating Post nasal discharge, the mTNSS provides a more comprehensive assessment of disease burden and symptom severity. So in this study, correlations between mTNSS scores and biomarkers such as serum total immunoglobulin E (IgE) and fractional exhaled nitric oxide (FeNO) is assessed as it may offer additional insight into the

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relationship between clinical symptoms and underlying type 2 inflammation, thereby improving the overall evaluation of disease activity.

OBJECTIVES:

- To compare mTNSS across Allergic rhinitis, Non allergic rhinitis and the control groups.
- To compare serum total IgE levels and fractional exhaled nitric oxide (FeNO) between allergic and non-allergic rhinitis.
- To evaluate the diagnostic performance of mTNSS in relation to IgE and FeNO.

METHODOLOGY:

It's a hospital-based cross-sectional analytical study. Participants exhibiting rhinitis symptoms and healthy volunteers visiting the hospital during the study period were recruited. The participants were classified into three groups: the allergic rhinitis group, the non-allergic rhinitis group and the healthy controls.

The sample size was chosen based on the difference in FeNO levels between individuals with Allergic rhinitis (AR) and Non allergic rhinitis (NAR) reported by Rolla et al.,¹⁰ who revealed considerably higher FeNO levels in Allergic rhinitis than in Non allergic rhinitis groups. (44.3 ppb vs. 22.0 ppb). The sample size for comparison of two independent means was obtained using the formula: $n = 2(Z\alpha + Z\beta)^2 \sigma^2 / d^2$

Based on the data, the minimum sample size necessary was 28 participants per group, with 95% confidence level ($Z\alpha = 1.96$); 80% power ($Z\beta = 0.84$). The sample size was rounded up to 30 participants per group to adjust for any exclusions and to preserve equal allocation. Accordingly, the study included 90 individuals consisting of 30 patients with allergic rhinitis, 30 patients with non-allergic rhinitis, and 30 with healthy control group. A consecutive sampling strategy was used in this study.

Ethics committee approval: Ethics committee approval obtained for this study (IEC No : 001/2026/IEC/ACSMCH).

Inclusion Criteria:

Allergic Rhinitis Group:

- Patients aged ≥ 18 years.
- Individuals with typical signs of Allergic rhinitis (nasal blockage, rhinorrhea, sneezing, and nasal itch)
- Clinical diagnosis of Allergic rhinitis supported by elevated serum total IgE.

Non-Allergic Rhinitis Group:

- Patients aged ≥ 18 years.
- Symptoms of rhinitis without evidence of allergic sensitization.
- Normal or non-elevated serum IgE and FeNO levels.

Control Group

- Healthy individuals without symptoms of rhinitis or other allergic diseases.

- No history of chronic respiratory or nasal inflammatory disease.

Exclusion Criteria

History of bronchial asthma or chronic obstructive pulmonary disease
Nasal polyposis, deviated nasal septum causing obstruction, or chronic sinusitis
Current use of systemic corticosteroids or antihistamines within the past two weeks
Pregnant women
Patients with immunological disorders

We characterised patients with allergic sensitization as those with symptoms such as sneezing, rhinorrhoea, nasal obstruction, nasal itching, and a total serum IgE level > 100 IU/mL.^{11,12} mTNSS score recorded from patients based on symptoms is shown in Table 1.

Table 1: Modified Total Nasal Symptom Score (mTNSS)

Score	Snee zing	Rhino rrhea	Nasal conge stion	Nas al itch ing	Postn asal drip
0					
1 (mild)					
2 (mode rate)					
3 (sever e)					

INTERPRETATION:

- Mild – 0-4
- Moderate – 5-9
- Severe - >9

Data was entered into an Excel sheet and analysed using SPSS software. Continuous variables were presented as mean $\pm$ standard deviation, while categorical variables were presented as frequencies and percentages. Demographic factors and mTNSS categories among groups were compared using Chi-square test. Statistical significance was defined as a P-value of <0.05 .

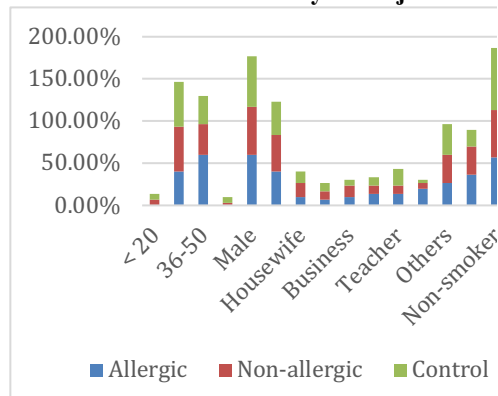
RESULTS

Demography (including age, gender, Occupation) and general characteristics diversified between

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allergic, Non allergic and control groups is shown in Figure 1.

Figure 1: Demography and general characteristics of study subjects



The distribution of mTNSS categories were significantly different across allergic, nonallergic, and control groups ($p < 0.001$) as shown in Table 2.

Table 2: Comparison of mTNSS between groups

mTnss category	ALLER GIC	NON-ALLER GIC	CONTR OLS	χ^2 -value (P-value)
Nil (score 0)	0 (0.0%)	0 (0.0%)	15 (50.0%)	120.0 (<0.001)
Mild (1-4)	0 (0.0%)	27 (90.0%)	15 (50.0%)	0.001
Moderate (5-9)	13 (43.3%)	3 (10.0%)	0 (0.0%)	
Severe (10-15)	17 (56.7%)	0 (0.0%)	0 (0.0%)	
Mean $\pm$ SD	9.93 $\pm$ 1.59	2.8 $\pm$ 1.37	0.53 $\pm$.57	

Association between mTNSS and inflammatory markers(Ig E and FeNO) is depicted in Table 3. Serum IgE levels were higher with higher mTNSS categories, with most patients with a score of 10–15 having IgE levels >500 IU/mL.

Table 3: Association between mTNSS and inflammatory markers

Variable	Category	mTNSS			χ^2 (P-VALUE)
		1-4	5-9	10-15	
Serum IgE (IU/mL)	<100	27 (90.0%)	3 (10.0%)	0 (0.0%)	58.21 (<0.001)
	100–300	3 (100.0%)	0 (0.0%)	0 (0.0%)	
	301–500	0 (0.0%)	6 (75.0%)	2 (25.0%)	
	>500	0 (0.0%)	7 (31.8%)	15 (68.2%)	
FeNO (ppb)	<25	27 (90.0%)	3 (10.0%)	0 (0.0%)	52.57 (<0.001)
	25–50	3 (18.8%)	1 (6.2%)	12 (75.0%)	
	>50	0 (0.0%)	12 (41.4%)	17 (58.6%)	

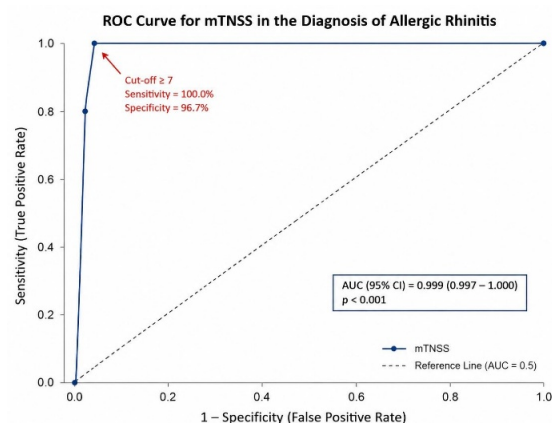
ROC curve analysis was utilized to explore the diagnostic performance of mTNSS for diagnosis of allergic rhinitis. The analysis showed that mTNSS

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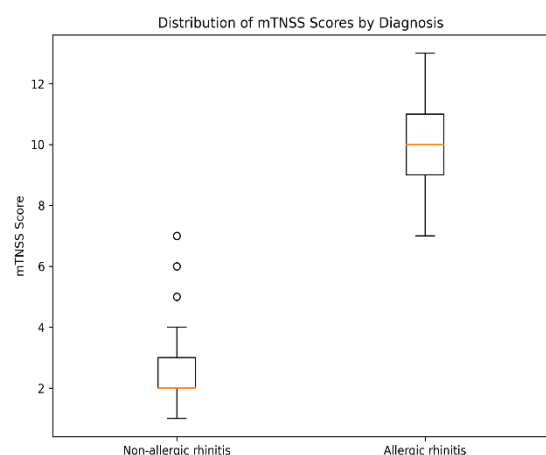
has a very strong discrimination capacity with an area under curve (AUC) of 0.999. The optimal cut-off point of mTNSS for diagnosis of allergic rhinitis was ≥ 7 , 100% sensitive and 96.7% specific.

Figure 2: A. ROC curve for mTNSS in the diagnosis of AR. B. Distribution of mTNSS scores for diagnosis

A



B



DISCUSSION

Allergic rhinitis is a prevalent IgE-mediated inflammatory condition that results in considerable morbidity in both children and adults globally. The pathogenesis of allergic rhinitis involve the release of several proinflammatory mediators triggered by an allergen (hypersensitivity reaction), clinically presenting as nasal blockage and rhinorrhea.^{13,14}

The TNSS is a validated and widely used assessment tool that evaluates the severity of nasal congestion, rhinorrhea, nasal pruritus, sneezing on a scale ranging from 0 to 3. The TNSS is determined by aggregating the symptom scores. The enhancement of the nasal system is ascertained through clinical evaluation or patient assessment of symptom severity. Clinical or patient evaluation of the intensity of symptoms determines if the nasal system has improved.^{15,16}

Postnasal drip was incorporated into the modified TNSS as a common, clinically relevant presentation of rhinitis that contributes considerably to patient discomfort and quality-of-life impairment. Postnasal drip has been combined alongside other

symptoms in some studies to allow a more complete evaluation of the severity.¹⁷

As mTNSS covers a wider range of nasal symptoms without added complexity or cost, this may be a more practical and clinically relevant measure. The mean mTNSS score among the allergic, non-allergic rhinitis and controls was observed to be 9.93 ± 1.59 , 2.8 ± 1.37 and $0.53 \pm .57$ respectively, indicating the significant difference in score between groups.

Previous studies reported that Nitric oxide (NO) measures as well as assessment of inflammatory mediators in nasal lavages, cytology and nasal biopsies can be used to objectively assess the severity of Allergic rhinitis.^{18,19} In our study, we performed FeNO and IgE analysis, and the results demonstrated that higher mTNSS and FeNO levels are positively associated with a very substantial P-value. Most of the patients with low mTNSS scores (1–4) had FeNO levels <25 ppb and serum IgE levels <100 IU/mL.

Higher mTNSS categories were highly related to higher values of FeNO and IgE. The results demonstrate a substantial positive correlation between the severity of symptoms and inflammatory markers in allergic rhinitis ($p < 0.001$). Previous studies have similarly reported findings that employed the TNSS alone for evaluating the severity and diagnosis of AR.^{20,21}

The mTNSS cut-off value of 7 showed good diagnostic accuracy with 100% sensitivity and 96.7% specificity for diagnosis of AR, which indicates that mTNSS is a reliable tool for the diagnosis of AR patients and differentiation of these patients from NAR individuals.

In our current study, the modified TNSS was expanded to include postnasal drip as an extra symptom metric that is not included in the standard TNSS and have improved the discriminatory ability of the score through a more comprehensive assessment of the nasal symptom burden.²² This may account for the good ROC performance in the present study.

The main limitation of the study was the recruitment of both patients and controls from the hospital, which increased the possibility of selection bias. The small and single-centric sample size is another drawback that restricts how far our findings may be applied. The severity of symptoms could not be linked to exposure to specific allergens since problematic allergens were not assessed.

CONCLUSION

The modified Total Nasal Symptom Score (mTNSS) demonstrated a significant association with inflammatory markers in patients with allergic rhinitis, indicating that higher symptom scores reflect greater underlying inflammatory activity. Higher mTNSS categories were highly correlated with higher values of FeNO and IgE. With an optimal cut-off value of ≥ 7 , it showed excellent

diagnostic performance in identifying allergic rhinitis. As a simple, inexpensive and non-invasive tool, mTNSS may complement clinical evaluation and aid in the screening and assessment of disease severity, particularly in primary care and resource-limited settings where access to allergy testing and biomarker assessment is limited. Further multicenter studies with larger populations are warranted to validate its broader clinical applicability.

Author's Contribution

Dr Sumitha. A., did the research, execution and writing. The work plan, review, and revisions were done by Dr CS Brethis, Dr Karthik VP, Dr Purushothaman, Dr Sarath Kumar. Every author has read and consented for the published version of the study.

Conflict of Interest: None

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