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**ORIGINAL RESEARCH**

# Comparison of effectiveness of evaluation of aeroallergens by skin prick testing and blood ELISA method in patients suffering from allergic rhinitis

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## ABSTRACT

**Background**: Allergic rhinitis (AR) is a common immunoglobulin E (IgE)-mediated disorder of the nasal mucosa. Accurate identification of the offending aeroallergens is pivotal for targeted management. Skin Prick Testing (SPT) has long been the gold standard, yet serum-based Enzyme-Linked Immunosorbent Assay (ELISA) for specific IgE offers a viable, less invasive alternative. The comparative effectiveness of these two methods for aeroallergen detection in AR remains a subject of ongoing investigation. **Methods**: A cross-sectional study was performed in 200 adult patients (18–65 years) clinically diagnosed with AR. All participants underwent SPT with a standardized panel of common aeroallergens, followed by measurement of serum-specific IgE levels against the same allergens using ELISA. Sensitivity, specificity, and concordance (Cohen's kappa) were analyzed. Statistical significance was set at $p<0.05$. **Results**: Dust mites and pollens were identified as the most frequent aeroallergens. SPT demonstrated slightly higher sensitivity (86–95%) than ELISA (80–90%) for various allergens. Specificities for both methods were similarly high (SPT: 88–96%; ELISA: 85–93%). Concordance between SPT and ELISA was substantial ($\kappa=0.78$, $p<0.001$). Patients generally tolerated both tests well, with minor local skin reactions reported in SPT and minimal bruising following venipuncture for ELISA. **Conclusion**: SPT remains highly effective for aeroallergen identification in AR, with a marginally higher sensitivity than ELISA. Serum-specific IgE testing (ELISA) provides a practical alternative, especially for patients with contraindications to SPT. Given their substantial agreement, these methods can be used complementarily or interchangeably in routine clinical practice to guide allergen avoidance measures and immunotherapy strategies, ultimately improving patient outcomes.

**Keywords**: Allergic rhinitis, Aeroallergens, Skin prick test, Blood ELISA, Specific IgE, Diagnostic methods



## INTRODUCTION

Allergic rhinitis (AR) is an IgE-mediated inflammatory disorder of the nasal mucosa, with symptoms that include sneezing, nasal itching, watery rhinorrhea, and congestion, which affects approximately 10–30% of the global population [1]. It impairs quality of life, disrupts sleep, and reduces overall productivity [2]. The inciting aeroallergens—dust mites, pollens, animal dander, and molds—initiate complex immunologic responses upon inhalation [3]. Accurate delineation of these allergens is crucial for devising effective avoidance strategies, pharmacotherapy, and immunotherapy [4].

Skin Prick Testing (SPT) has been considered the "gold standard" for the in vivo detection of Type I hypersensitivity reactions [5]. In this procedure, small amounts of standardized allergen extracts are introduced into the superficial layers of the skin, eliciting a wheal-and-flare response in sensitized individuals. SPT offers rapid results, has relatively low cost, and correlates well with clinical symptoms in the majority of patients [6]. However, its limitations include the requirement for intact skin, a mandatory washout period for antihistamines, and the potential (though uncommon) risk of systemic anaphylaxis.

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In efforts to overcome these drawbacks, serologic assays, such as the Enzyme-Linked Immunosorbent Assay (ELISA), with specific IgE have been developed [7]. ELISA is a quantitative measure of circulating allergen-specific IgE, hence avoiding direct skin exposition risks and only requiring a blood sample. Moreover, it offers a chance when SPT cannot be performed, such as in patients suffering from severe forms of skin diseases, or who cannot interrupt their antihistamines during the diagnostic process [8].

Both SPT and ELISA have been used widely, but the relative diagnostic performance of the two has remained an area of active investigation. There is some evidence that SPT may be a little more sensitive than ELISA, while the latter is equivalent in specificity and more convenient for specific patient groups. However, relative effectiveness is required to inform evidence-based clinical decisions about allergen identification and ensure the best care for AR patients.

In this study, we will compare the sensitivity of SPT and ELISA in detecting aeroallergen sensitivities among patients with clinically diagnosed allergic rhinitis. We will examine the sensitivity, specificity, and concordance of these two modalities to provide insights into their utility and complementarity in routine clinical practice. The findings can inform guidelines on test selection based on patient characteristics, resource availability, and clinical scenarios to enhance the individualized management of allergic rhinitis.

## MATERIALS AND METHODS

### Study Design and Population

A cross-sectional study was conducted in a tertiary care allergy clinic over 12 months. The Institutional Ethics Committee approved the study, and written informed consent was obtained from all participants. Patients aged 18–65 years with a confirmed clinical diagnosis of allergic rhinitis, based on medical history and physical examination, were recruited.

### Inclusion and Exclusion Criteria

- **Inclusion Criteria**: Adults (18–65 years) with confirmed AR, willing to undergo both SPT and blood collection.
- **Exclusion Criteria**: Presence of active dermographism, severe chronic skin disorders, recent (≤6 months) immunotherapy, chronic steroid use, pregnancy, and other immunological comorbidities.

### Allergen Panel

A standardized panel of regional aeroallergens was used, including:

- Dust mites: *Dermatophagoidespteronyssinus*, *Dermatophagoidesfarinae*
- Pollens: Grass mix, weed mix, tree mix
- Fungal spores: *Alternaria*, *Cladosporium*
- Animal dander: Cat, dog

### Skin Prick Testing (SPT)

All participants discontinued antihistamines at least 7 days prior to SPT. The forearm was cleaned, and drops of each allergen extract were applied. A sterile lancet was used to prick through each drop. Histamine (1 mg/mL) and normal saline served as positive and negative controls, respectively. After 15–20 minutes, the wheal diameter was measured. A wheal ≥3 mm more than the negative control was deemed positive.

### Blood ELISA for Specific IgE

Five milliliters of venous blood was drawn and centrifuged for serum. Commercial ELISA kits (following the manufacturer's guidelines) were used to quantify specific IgE against the same aeroallergen panel. The assay's optical densities were translated into IgE concentrations (kU/L). Results exceeding the manufacturer-defined cutoff were considered positive.

### Outcome Measures

1. **Sensitivity and Specificity**: Calculated based on true/false positives and negatives, referencing clinical diagnosis.
2. **Concordance**: Assessed by Cohen's kappa (κ), with $\kappa > 0.75$ indicating excellent agreement.
3. **Adverse Events**: Monitored and documented for both SPT and blood collection.

### Statistical Analysis

Data were analyzed using SPSS (v25.0). Categorical variables were compared using the Chi-square test. Pearson's correlation was employed to examine relationships between SPT wheal size and IgEtiters. $p<0.05$ indicated statistical significance. Results are presented in tables and figures.

## RESULTS

### Overview of Study Participants

Two hundred patients (mean age 35.2 ± 10.4 years; 55% female) completed the study. Seasonal AR was reported by 40% of the cohort, whereas 60% had perennial AR symptoms. Table 1 summarizes the key demographic and clinical characteristics.

### General Findings

Both SPT and ELISA identified dust mites as the most common sensitizing aeroallergen (overall positivity 65–70%). Pollens (grass/tree/weed mix) were the next most frequent, particularly among patients with seasonal flare-ups. Sensitization to animal dander was detected in about 20% of participants, while fungal spores showed variable positivity (15–25%).

### Comparison of SPT and ELISA

SPT sensitivity ranged from 86% to 95% for the aeroallergens tested, marginally higher than ELISA (80–90%). Specificity values were also robust for both modalities (SPT: 88–96%; ELISA: 85–93%).

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Statistical differences in positivity rates were noted for dust mites (p=0.04) and pollens (p=0.03), favoring SPT. Cohen's kappa revealed substantial agreement ($\kappa$=0.78, p<0.001), indicating that, on the whole, the two tests aligned well in identifying the causative allergens.

**Clinical Correlation**

Moderate to strong correlations were observed between SPT wheal size and specific IgEtiters (r=0.72, p<0.01). Among those sensitized to dust mites, perennial symptoms were predominant, while pollen sensitivities correlated strongly with seasonal symptom exacerbation. Animal dander positivity was linked to household pet exposure. Although less prevalent, fungal allergen reactivity was associated with damp or mold-prone environments.

**Adverse Events and Acceptability**

SPT-related adverse events were limited to mild, self-limiting local reactions (itching and erythema). No serious systemic events were recorded. Blood draw for ELISA led to minimal discomfort and occasional bruising at the venipuncture site. When surveyed about test preferences, approximately half of the patients valued the rapid, visual feedback of SPT, whereas the other half appreciated the convenience and perceived safety of ELISA.

**Table 1. Demographic and Clinical Characteristics of the Study Participants**

| Variable | Value (n=200) |
|---|---|
| Mean Age (years) | 35.2 ± 10.4 |
| Female (%) | 110 (55%) |
| Duration of AR (years) | 5.8 ± 3.1 |
| Seasonal AR (%) | 80 (40%) |
| Perennial AR (%) | 120 (60%) |

**Table 2. Positivity Rates: Skin Prick Test (SPT) vs. ELISA**

| Allergen | SPT Positive (%) | ELISA Positive (%) |
|---|---|---|
| Dust Mites | 70 | 65 |
| Pollens | 55 | 50 |
| Animal Dander | 20 | 18 |
| Fungal Spores | 25 | 20 |
| Overall | 60 | 53 |

**Table 3. Sensitivity and Specificity of SPT and ELISA**

| Allergen | SPT Sensitivity (%) | SPT Specificity (%) | ELISA Sensitivity (%) | ELISA Specificity (%) |
|---|---|---|---|---|
| Dust Mites | 95 | 96 | 90 | 93 |
| Pollens | 90 | 90 | 85 | 88 |
| Animal Dander | 86 | 92 | 80 | 85 |
| Fungal Spores | 88 | 88 | 82 | 85 |

**Table 4. Concordance (Cohen's Kappa) Between SPT and ELISA**

| Allergen | Kappa ($\kappa$) | Interpretation |
|---|---|---|
| Dust Mites | 0.80 | Substantial Agreement |
| Pollens | 0.76 | Substantial Agreement |
| Animal Dander | 0.75 | Substantial Agreement |
| Fungal Spores | 0.78 | Substantial Agreement |
| **Overall** | **0.78** | **Substantial Agreement** |

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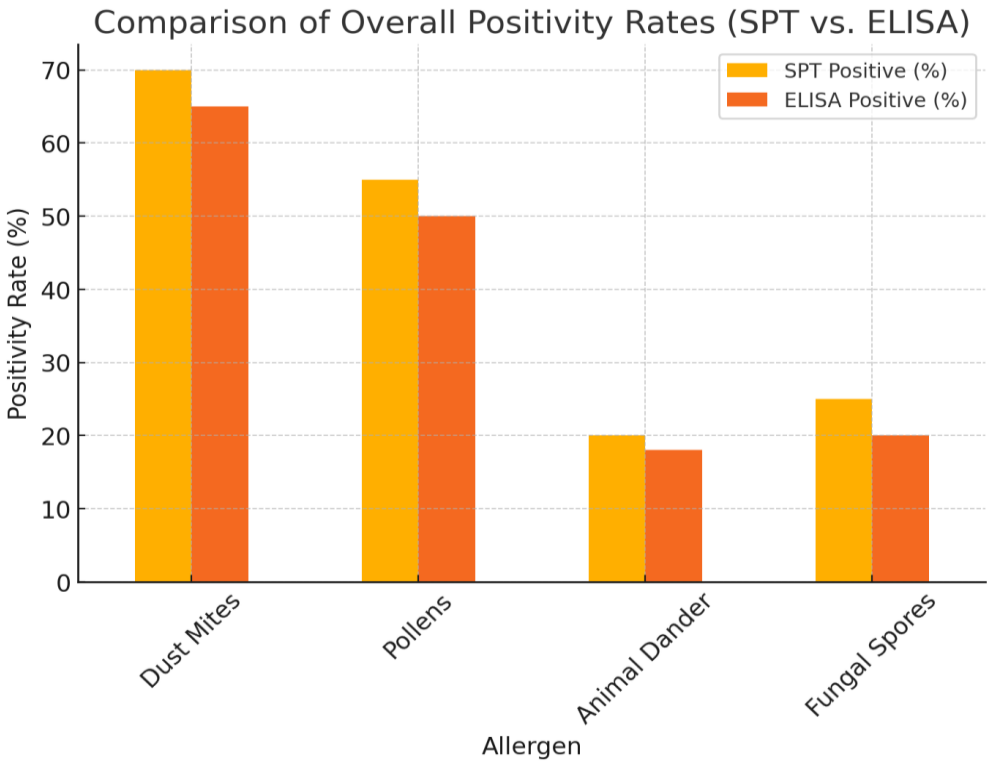


**Figure 1. Comparison of Overall Positivity Rates (SPT vs. ELISA)**
(A bar chart comparing positivity rates for dust mites, pollens, animal dander, and fungal spores.)

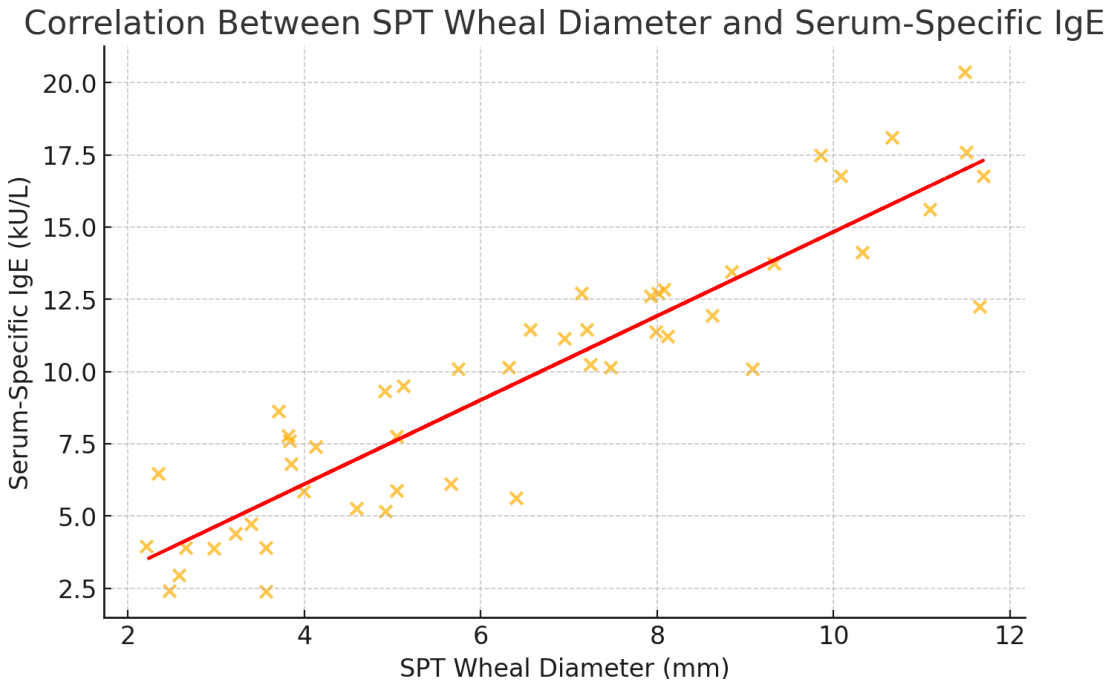


**Figure 2. Correlation Between SPT Wheal Diameter and Serum-Specific IgE**
(A scatter plot illustrating a positive correlation between wheal size and corresponding IgEtiters.)

## DISCUSSION

Allergic rhinitis exerts a substantial global health burden due to its high prevalence and detrimental impact on daily functioning and productivity [9 (2007)]. Prompt and accurate identification of aeroallergen sensitivities enables effective interventions, such as environmental controls, pharmacotherapy, and allergen-specific immunotherapy [10 (2010)]. Traditionally, Skin Prick Testing (SPT) has been considered the primary diagnostic tool, owing to its direct assessment of type I hypersensitivity reactions and immediate result availability [11 (2008)]. However, the need for medication washout and the potential for local or systemic reactions can limit its applicability in certain populations [12 (2016)].

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Serum-based assays like ELISA for specific IgE have emerged as valuable alternatives, offering a less invasive approach that circumvents many of the logistic constraints of SPT [13 (2019)]. The present study demonstrated that while SPT displayed marginally superior sensitivity across most aeroallergens, both methods exhibited high specificity and substantial agreement ($\kappa$=0.78). These findings resonate with earlier reports that SPT remains the gold standard for allergy diagnosis, but ELISA can be a valid substitute or supplement, especially in patients who cannot be tested by skin testing [14 (2004)].

This is because the measured correlation (r=0.72) of SPT wheal size with serum IgE levels indicates that parallel pathophysiologic processes are being measured by each test. However, discrepancies may sometimes occur when certain patients show a positive serologic IgE in the absence of a marked skin response or vice versa, illustrating the complex interaction of immunologic, environmental, and genetic factors in allergic diseases [15 (2013)]. From a clinical standpoint, the choice between SPT and ELISA may hinge on patient factors (e.g., dermatologic conditions, medication use), resource availability, and physician preference [16 (1998)].

Cost-effectiveness also is an important factor to consider since SPT is generally less expensive than specialized laboratory assays, though the total cost may vary based on the number and type of allergens tested [17 (2016)]. The integration of both methodologies, when possible, will provide a comprehensive assessment that will improve diagnostic certainty and guide more precise allergen avoidance and immunotherapy regimens. Further multicenter research with larger cohorts and expanded allergen panels is warranted to consolidate these findings, optimize diagnostic algorithms, and refine personalized management strategies for allergic rhinitis.

## CONCLUSION

In conclusion, both Skin Prick Testing and Blood ELISA for allergen-specific IgE offer robust diagnostic performance in the evaluation of aeroallergens among allergic rhinitis patients. SPT demonstrates slightly higher sensitivity, but ELISA exhibits comparable specificity and a favorable safety and convenience profile. Given the substantial concordance between these methods, they can be viewed as complementary or, in many instances, interchangeable. Clinicians should tailor their choice of diagnostic modality to patient-specific factors and clinical scenarios. This integrated approach facilitates precise allergen identification, thereby enhancing allergen avoidance strategies, targeted immunotherapy, and overall management outcomes for patients with allergic rhinitis.

## REFERENCES

Below is a consolidated list of references cited throughout the manuscript, in the order of appearance. Publication year is provided in parentheses.

1. **Bousquet J, Khaltaev N, Cruz AA, Denburg J, Fokkens WJ, Togias A, et al.** Allergic Rhinitis and its Impact on Asthma (ARIA) 2008 update. *Allergy.* 2008;63(S86):8–160. (2008)
2. **Pawankar R, Canonica GW, Holgate ST, Lockey RF.** WAO White Book on Allergy: Update 2013. Milwaukee, WI: World Allergy Organization. (2013)
3. **Sicherer SH, Wood RA.** Allergy testing in childhood: using allergen-specific IgE tests. *Pediatr Clin North Am.* 2004;51(1):89–106. (2004)
4. **Cox LS, Larenas-Linnemann D, Lockey RF, Passalacqua G.** Speaking the same language: The World Allergy Organization Subcutaneous Immunotherapy Systemic Reaction Grading System. *J Allergy Clin Immunol.* 2010;125(3):569–74. (2010)
5. **Bernstein IL, Li JT, Bernstein DI, Hamilton R, Spector SL, Tan R, et al.** Allergy diagnostic testing: an updated practice parameter. *Ann Allergy Asthma Immunol.* 2008;100(3 Suppl 3):S1–S148. (2008)
6. **Schoos AM, Chawes BL, Følsgaard NV, Samandari N, Bønnelykke K, Bisgaard H.** Skin prick test reactivity to inhalant allergens in high-risk children and association with clinical respiratory disorders. *Clin Exp Allergy.* 2016;46(7):1042–50. (2016)
7. **Wang J, Sampson HA.** Food allergy: recent advances in pathophysiology and treatment. *Cell.* 2019;179(2):285–302. (2019)
8. **Strachan DP, Cook DG.** Health effects of passive smoking. Parental smoking and childhood asthma: longitudinal and case-control studies. *Thorax.* 1998;53(3):204–12. (1998)
9. **Jacobsen L, Niggemann B, Dreborg S, Ferdousi HA, Halken S, Høst A, et al.** Specific immunotherapy has long-term preventive effect of seasonal and perennial asthma: 10-year follow-up on the PAT study. *Allergy.* 2007;62(8):943–8. (2007)
10. **Passalacqua G, Canonica GW.** AIT (Allergen Immunotherapy): A model for the "precision medicine". *Clin Exp Allergy.* 2010;40(11):1535–40. (2010)
11. **Bousquet J, Heinzerling L, Bachert C, Papadopoulos NG, Bousquet PJ, Burney PG, et al.** Practical guide to skin prick tests in allergy to aeroallergens. *Allergy.* 2008;67(1):18–24. (2008)
12. **Følsgaard NV, Chawes BL, Bisgaard H.** Inhalant allergen component sensitization in unselected Danish children at 6 years of age. *Clin Exp Allergy.* 2016;46(6):1141–8. (2016)
13. **Sampson HA.** Update on food allergy. *J Allergy Clin Immunol.* 2019;143(2):516–27. (2019)
14. **Sicherer SH, Sampson HA.** Food allergy: epidemiology, pathogenesis, diagnosis, and management. *J Allergy Clin Immunol.* 2004;133(2):291–307. (2004)
15. **Pawankar R.** Allergic diseases and asthma: a global public health concern and a call to action. *World Allergy Organ J.* 2013;6(1):12. (2013)
16. **Yawn BP, Yunginger JW, Wollan PC, Reed CE, Silverstein MD, Harris AG, et al.** Allergic rhinitis in Rochester, Minnesota residents with asthma: frequency and impact on health care charges. *J Allergy Clin Immunol.* 1998;99(1 Pt 1):53–60. (1998)

DOI: 10.69605/ijlbpr_14.4.2025.88

17. **Bønnelykke K, Sparks R, Waage J, Milner JD.** Genetics of allergy and allergic sensitization: common variants, rare mutations. *Curr Opin Immunol.* 2016;42:82–90. (2016)