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# FOOD ALLERGEN SENSITIZATION AND IGE PROFILES IN CHILDREN WITH ATOPIC DERMATITIS: A CROSS-SECTIONAL STUDY

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**Abstract**

**Introduction:** Atopic dermatitis (AD) is a chronic inflammatory skin disease frequently associated with allergic sensitization and elevated immunoglobulin E (IgE) levels. Food allergen sensitization is common in children with AD, but its relationship with disease severity and clinical relevance remains uncertain.

**Objective:** To evaluate patterns of food allergen sensitization in children with AD and their association with total IgE levels, disease severity, and polysensitization.

**Material and methods:** This cross-sectional study included 54 pediatric patients (≤18 years) with AD evaluated at the University Clinic of Dermatology. Disease severity was assessed using the SCORing AD (SCORAD) index. Allergy testing included skin prick testing (SPT) and in vitro specific IgE assays for common food allergens. Total serum IgE levels were measured in all participants. Polysensitization was defined as sensitization 3≤ allergens.

**Results:** Food allergen sensitization was detected in 35.2% of patients by SPT and in 37.0% by in vitro IgE testing. Polysensitization occurred in 14.8% and 18.5% of patients, respectively. Egg allergens were the most frequently detected sensitizers. Total IgE levels showed a moderate positive correlation with SCORAD severity (Spearman $\rho = 0.396$, $p = 0.003$). Polysensitization patterns involving egg allergens were strongly associated with markedly elevated IgE levels (>1000 kU/L), with the egg white–egg yolk combination showing the strongest association (OR 31.5, p=0.000196).

**Conclusion:** Food allergen sensitization is common in pediatric AD, with egg allergens representing the dominant sensitization pattern. However, sensitization does not necessarily indicate clinically relevant food allergy, and allergy testing should guide targeted management while avoiding unnecessary restrictive diets.

***Keywords:*** atopic dermatitis, food allergen sensitization, polysensitization, total IgE, skin prick testing, specific IgE, pediatric allergy

## Introduction

Atopic dermatitis (AD) is a chronic inflammatory skin disease characterized by recurrent eczematous lesions, intense pruritus, and impaired epidermal barrier function. It represents one of the most common dermatologic disorders of childhood, affecting up to 15-20% of children worldwide[1,2]. In addition to its cutaneous manifestations, atopic dermatitis is frequently associated with other atopic conditions, including food allergy, allergic rhinitis, and asthma, forming part of the so-called "atopic march" [3,4].

The relationship between AD and food allergy has been extensively studied, particularly in infants and young children with moderate-to-severe disease. Sensitization to

food allergens is frequently detected in children with AD, although the prevalence of clinically relevant food allergy varies considerably between studies[5,6]. Epidemiologic studies suggest that food sensitization may occur in up to 30-40% of children with moderate-to-severe AD, while the prevalence of challenge-proven food allergy is substantially lower[7,8].

Several mechanisms have been proposed to explain the association between AD and food allergen sensitization. Impairment of the epidermal barrier, particularly in individuals with filaggrin gene mutations, increases transepidermal water loss and facilitates the penetration of environmental allergens through the skin (9,10). Transcutaneous exposure to food proteins may promote allergen sensitization through activation of type 2 helper T-cell (Th2) immune responses, leading to immunoglobulin E (IgE) production[11]. Cytokines such as interleukin-4 and interleukin-13 promote IgE class switching and amplify allergic inflammation, contributing to the systemic atopic phenotype observed in many patients with AD[12].

Despite the frequent detection of food allergen sensitization in patients with AD, the clinical significance of positive allergy tests remains controversial. Both skin prick testing and in vitro specific IgE assays are sensitive tools for detecting sensitization, but their specificity for clinically relevant food allergy is limited (6-8). Numerous studies have demonstrated that sensitization detected by laboratory testing does not necessarily correlate with clinical symptoms after food ingestion[5,11,13].

This distinction is particularly important because misinterpretation of allergy test results may lead to unnecessary dietary restrictions. Elimination diets are frequently prescribed for children with AD based solely on positive sensitization tests, despite the absence of clear clinical reactions[14]. Such dietary restrictions may have unintended consequences, including nutritional deficiencies, impaired growth, and reduced quality of life[15,16].

Recent systematic reviews and meta-analyses have emphasized the need for cautious interpretation of food allergy testing in patients with AD[5,15]. These findings highlight the importance of targeted allergy evaluation and individualized patient management.

In addition to individual food allergen sensitization, patterns of polysensitization may provide valuable insight into the immunologic phenotype of pediatric AD. Children sensitized to multiple allergens often exhibit higher total IgE levels and may represent a subgroup characterized by stronger systemic Th2 immune activation[6]. Identifying such patterns may improve the interpretation of allergy testing results and contribute to more precise clinical decision-making.

Given these considerations, the present study aimed to analyze food allergen sensitization patterns in children with AD and to examine their relationship with disease severity, total IgE levels, and polysensitization profiles. Particular attention was given to combinations of allergens associated with markedly elevated IgE levels, as these patterns may reflect underlying immunologic mechanisms relevant to disease pathogenesis and clinical management.

## Material and methods

This cross-sectional case series included pediatric patients diagnosed with AD who were evaluated at the PHI University Clinic of Dermatology. A total of 54 children aged ≤18 were included in the analysis. The diagnosis of AD was established according to established clinical criteria, and demographic as well as clinical data were collected for all participants during routine dermatologic evaluation.

Disease severity was assessed using the SCORing Atopic Dermatitis (SCORAD) index, which was calculated on the day of clinical examination. The SCORAD system integrates objective measures of disease extent and intensity with subjective symptoms, including pruritus and sleep disturbance, providing a comprehensive assessment of disease activity.

All patients underwent allergy evaluation that included both skin prick testing and in vitro specific IgE measurements for common food allergens. Skin prick testing was performed using standardized allergen extracts according to established protocols, and test results were interpreted based on wheal size relative to negative and positive controls. In vitro specific IgE assays were performed using standardized laboratory methods, allowing quantitative assessment of allergen-specific IgE.

In addition to allergen-specific testing, total serum IgE levels were measured in all participants. Total IgE values were analyzed in relation to both disease severity and sensitization patterns. For the purposes of this study, polysensitization was defined as sensitization to 3 or more food allergens.

Descriptive statistical methods were used to summarize demographic characteristics, allergen sensitization frequencies, and IgE levels. Fisher's exact test was used to evaluate associations between specific allergen combinations and markedly elevated IgE levels. Odds ratios were calculated to estimate the strength of association between sensitization patterns and IgE elevation.

## Results

A total of 54 pediatric patients diagnosed with AD were included in the analysis. The study population consisted of 28 females (51.9%) and 26 males (48.1%), reflecting a balanced sex distribution within the cohort (Table 1). Disease severity was assessed using the SCORing Atopic Dermatitis (SCORAD) index calculated on the day of clinical evaluation. Most patients presented with moderate to severe disease.

**Table 1.** Demographic characteristics, disease severity distribution, IgE levels, and food allergen sensitization patterns in children with atopic dermatitis

| Category | Variable | Result |
|---|---|---|
| *Demographics* | Total patients | 54 |
| | Female | 28(51.9%) |
| | Male | 26(48.1%) |
| *Disease severity (SCORAD)* | Mild | 4 |
| | Moderate | 31 |
| | Severe | 19 |
| *Total IgE by disease severity* | Mild | Mean 147 kU/L, Median 62.5 |
| | Moderate | Mean 184 kU/L, Median 61.7 |
| | Severe | Mean 920 kU/L, Median 546 |
| *Correlation analyses* | IgE vs SCORAD | Spearman $\rho = 0.396$, $p = 0.003$ |
| | Age vs IgE | Spearman $\rho = 0.265$, $p = 0.053$ |
| *Allergy testing* | ≥1 positive allergen (SPT) | 19 (35.2%) |
| | ≥1 positive allergen (in vitro IgE) | 20 (37.0%) |
| *Polysensitization (≥3 allergens)* | SPT | 8 (14.8%) |
| | In vitro IgE | 10 (18.5%) |
| *Most frequent allergens* | Egg white | Most common sensitizer |
| | Other common allergens | Hazelnut, milk, peanut |
| *Grouped allergen sensitization* | Egg allergens (white + yolk) | 15 patients |
| | Nut allergens (hazelnut + walnut + peanut) | 13 patients |
| *IgE >1000 within groups* | Egg allergens | 7 patients |
| | Nut allergens | 8 patients |
| *Statistical association* | Egg allergens vs IgE >1000 | $p = 0.0027$ |
| | Nut allergens vs IgE >1000 | $p = 0.000045$ |
| *Most common polysensitization pattern* | Egg white + Egg yolk | 8 patients |
| *Association with extreme IgE elevation* | Egg white + Egg yolk | OR = 31.5, $p = 0.000196$ |

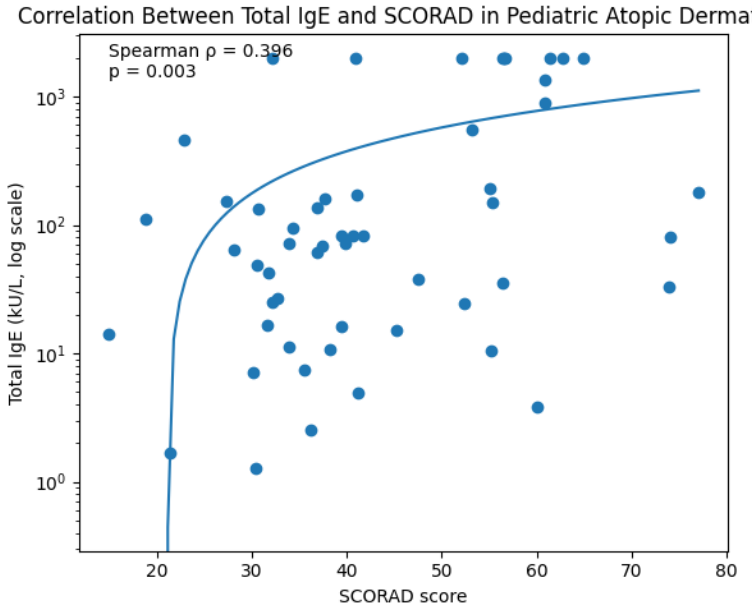


**Fig. 1.** Correlation between total IgE levels and SCORAD severity scores in children with atopic dermatitis. Scatter plot illustrating the relationship between total serum IgE levels and SCORAD scores. IgE values are presented on a logarithmic scale due to their wide distribution. A moderate positive correlation was observed (Spearman ρ = 0.396, p = 0.003).

Total serum IgE levels varied substantially across severity groups. Patients with mild AD (n=4) demonstrated relatively low IgE concentrations, with a mean value of 147 kU/L and a median value of 62.5 kU/L. In the moderate disease group (n=31), the mean IgE level was 184 kU/L with a median of 61.7 kU/L. In contrast, patients with severe AD (n=19) exhibited markedly elevated IgE concentrations, with a mean IgE level of 920 kU/L and a median value of 546 kU/L (Figure 2).

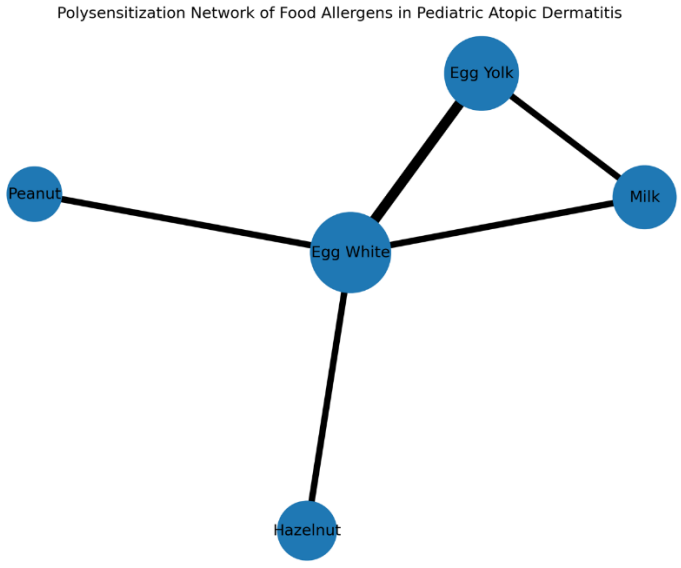


**Fig. 2.** Polysensitization network of food allergens in children with atopic dermatitis. Node size represents the number of sensitized patients, while edge thickness represents the frequency of allergen combinations observed in the cohort. Egg allergens form the central hub of the sensitization network and frequently co-occur with milk and nut allergens.

Correlation analysis demonstrated a moderate positive association between total IgE levels and disease severity assessed by SCORAD (Spearman ρ=0.396, p=0.003). Higher SCORAD scores were generally associated with increased IgE levels (Figure 1). In contrast, age showed only a weak positive correlation with IgE levels that did not reach statistical significance (Spearman ρ=0.265, p=0.053). Polysensitization was more frequently observed among patients with moderate-to-severe disease; however, this association did not reach statistical significance (Fisher's exact test, p=0.529).

Food allergen sensitization was evaluated using both skin prick testing and in vitro specific IgE assays. Sensitization to at least one food allergen was detected in 19 patients (35.2%) by skin prick testing and in 20 patients (37.0%) by in vitro testing. Polysensitization, defined as sensitization to three or more food allergens, was observed in 8 patients (14.8%) according to skin prick testing and in 10 patients (18.5%) according to in vitro specific IgE analysis. A comparison between the diagnostic modalities is presented in Table 1.

Among the individual allergens tested, egg white emerged as the most frequently detected sensitizer. Egg white sensitization was identified in 24.1%[13] of patients using in vitro assays and in 13.0%[7] of patients using skin prick testing. Other commonly detected food allergens included hazelnut, milk, and peanut. The distribution of allergen sensitization frequencies is illustrated in Figure 3, highlighting egg-related allergens as the dominant sensitization pattern within the cohort.

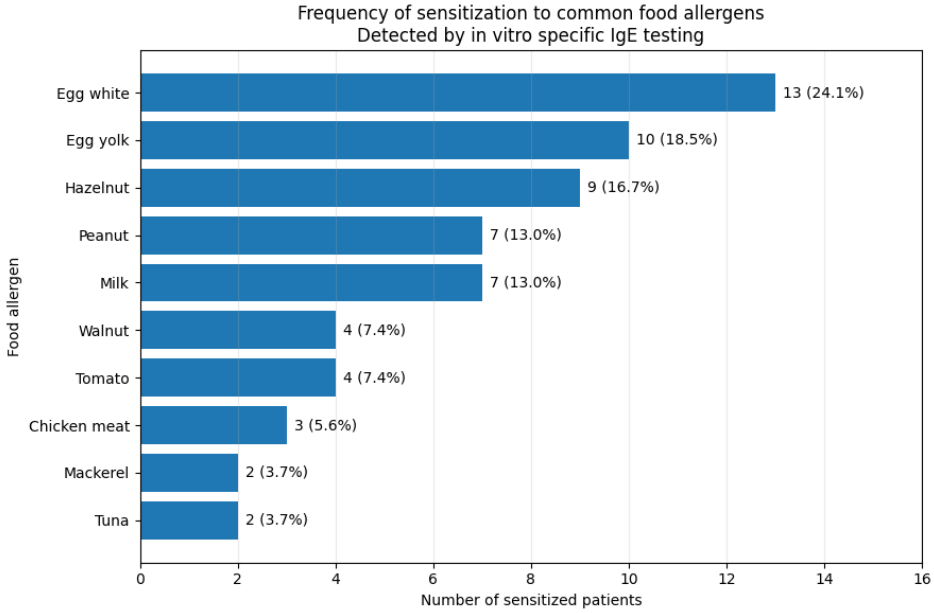


**Fig. 3.** Frequency of sensitization to common food allergens detected by in vitro specific IgE testing in children with atopic dermatitis. Bars represent the number and percentage of sensitized patients for each allergen. Egg white was the most frequently detected sensitizer, followed by egg yolk, hazelnut, peanut, and milk.

Analysis of IgE levels across age groups revealed variability throughout childhood. In children <2 years (n=6), the mean total IgE level was 682 kU/L, although the median value remained relatively low at 42.8 kU/L, suggesting a skewed distribution influenced by individual high values. In the 2-6 year age group (n=25), the mean IgE concentration was 299 kU/L with a median of 48.6 kU/L. Patients aged 6-10 years (n=9) demonstrated similar mean IgE levels of 302 kU/L and a median of 82.0 kU/L. In the 10-14 year age group (n=12), the mean IgE concentration increased to 457 kU/L with a median value of 82.7 kU/L. The highest IgE values were observed in adolescents aged 14-18 years (n=2), with both mean and median

IgE levels reaching 2000 kU/L. However, this group included only two patients, and therefore these results should be interpreted with caution.

Polysensitization patterns were identified in 10 patients within the cohort. The most frequent combination involved sensitization to both egg white and egg yolk, which was detected in 8 patients. Among these individuals, 6 exhibited IgE levels greater than 1000 kU/L. Statistical analysis revealed a strong association between this sensitization pattern and elevated IgE levels, with an odds ratio of 31.5 and a highly significant p-value of 0.000196. Additional allergen combinations associated with high IgE levels included egg white with milk, egg white with hazelnut, egg white with peanut, and egg yolk with milk. Each of these combinations was identified in 5 patients, four of whom demonstrated IgE levels exceeding 1000 kU/L.

Visualization of these co-sensitization patterns in Figure 3 demonstrates that egg allergens represent the central node of the polysensitization network, frequently co-occurring with milk and nut allergens.

When allergens were analyzed as biologically related groups, sensitization to egg allergens (egg white and egg yolk combined) was detected in 15 patients, of whom 7 demonstrated markedly elevated total IgE levels (>1000 kU/L). This association was statistically significant (Fisher's exact test, p=0.0027). Sensitization to nut allergens (hazelnut, walnut, and peanut combined) was identified in 13 patients, including 8 with IgE levels exceeding 1000 kU/L, demonstrating an even stronger statistical association with elevated IgE levels (p=0.000045) (Table 1).

Taken together, these findings indicate that grouped allergen sensitization patterns, particularly those involving egg allergens, are strongly associated with extreme elevations of total IgE levels in children with atopic dermatitis.

**Discussion**

This study provides insight into patterns of food allergen sensitization and associated immunologic profiles in children with atopic dermatitis. In our cohort, food allergen sensitization was detected in approximately one third of patients, with comparable detection rates between skin prick testing and in vitro specific IgE assays (Table 1). These findings are consistent with previous reports indicating that food allergen sensitization is common in pediatric AD, particularly among patients with moderate-to-severe disease[5,7].

Egg allergens represented the most frequently detected sensitizers in this cohort, with egg white showing the highest prevalence of sensitization across both diagnostic modalities. The distribution of sensitized allergens illustrated in Figure 3 demonstrates that egg-related allergens dominate the sensitization profile of this population. This observation is consistent with epidemiologic studies indicating that egg allergy is among the earliest and most prevalent food allergies in infants and young children with atopic dermatitis[6,8]. One proposed explanation involves early allergen exposure through impaired skin barrier function, allowing transcutaneous allergen penetration and subsequent IgE sensitization[9,11].

A particularly notable finding of this study was the strong association between polysensitization patterns involving egg allergens and markedly elevated total IgE levels. As summarized in Table 1, combinations including egg white and egg yolk demonstrated the strongest association with IgE concentrations exceeding 1000 kU/L, with an odds ratio greater than 30. Visualization of allergen co-sensitization patterns further supports this observation. The network representation presented in Figure 2 illustrates that egg allergens occupy a central position within the polysensitization network and frequently co-occur with milk and nut allergens. These findings suggest that egg-related sensitization may represent an important contributor to the high-IgE atopic phenotype observed in some children with AD.

The presence of polysensitization likely reflects a distinct immunologic endotype characterized by enhanced type 2 immune activation. In AD, T-helper-2 cytokines, including

interleukin-4, interleukin-5, and interleukin-13, promote class switching to IgE and contribute to amplification of allergic inflammation[12].

Our results also demonstrated a significant relationship between total IgE levels and clinical disease severity. Higher SCORAD scores were associated with increased IgE concentrations, and correlation analysis confirmed a moderate positive relationship between IgE and disease severity (Spearman $\rho=0.396$, $p=0.003$, (Figure 2)). These findings are consistent with previous studies reporting that elevated IgE levels are frequently associated with more severe AD and greater systemic immune activation[3,4].

Age-related variability in IgE levels was also observed in this cohort. Although elevated IgE concentrations were detected across several age groups, early childhood represents a particularly important period for allergic sensitization. During infancy, impaired epidermal barrier function facilitates environmental allergen penetration, which may lead to early IgE sensitization and subsequent development of allergic disease[11].

Despite the relatively high prevalence of laboratory sensitization observed in this cohort, it is important to emphasize that sensitization does not necessarily equate to clinically relevant food allergy. Previous studies have shown that positive allergy tests often exceed the prevalence of food allergy confirmed by oral food challenge[5,6]. Consequently, allergy testing results must always be interpreted within the clinical context and in conjunction with a detailed patient history.

This distinction is particularly important when considering dietary management in children with AD. Overinterpretation of sensitization results may lead to unnecessary elimination diets, which can negatively affect nutritional status and quality of life. Furthermore, prolonged avoidance of allergenic foods during early childhood may interfere with the development of oral tolerance and potentially increase the risk of persistent food allergy[15,16].

Recent systematic reviews and meta-analyses further support a cautious approach to dietary elimination. While elimination diets may benefit selected patients with confirmed food allergy, routine elimination diets in unselected patients with AD have not consistently demonstrated improvement in eczema severity[17,18]. These findings underscore the importance of targeted allergy testing and careful interpretation of sensitization results.

From a clinical perspective, identification of sensitization patterns may nevertheless provide useful information regarding the immunologic phenotype of children with AD. In particular, patients demonstrating polysensitization patterns involving egg allergens appear to represent a subgroup characterized by markedly elevated IgE levels and more pronounced systemic atopic responses[19,20].

Several limitations of this study should be acknowledged. The relatively small sample size and single-center design may limit the generalizability of the findings. Additionally, oral food challenges were not performed to confirm clinical food allergy, and therefore the clinical relevance of sensitization could not be definitively established. Nevertheless, this study provides valuable real-world insight into allergen sensitization patterns and IgE profiles in a pediatric dermatology population.

Future studies involving larger cohorts and longitudinal follow-up will be necessary to further clarify the relationship between sensitization patterns, disease severity, and long-term allergic outcomes in children with AD.

## Conclusion

In conclusion, this study demonstrates that food allergen sensitization is a frequent finding in children with atopic dermatitis and is associated with elevated total IgE levels and increased disease severity. Skin prick testing and in vitro specific IgE assays showed comparable diagnostic performance and substantial agreement, supporting their complementary role in clinical practice. Egg allergens, particularly egg white, represented the dominant

sensitization pattern and were strongly associated with polysensitization and markedly elevated IgE concentrations, suggesting their relevance in the allergic-inflammatory phenotype of pediatric AD. At the same time, positive allergy test results should not automatically be interpreted as clinically relevant food allergy. Careful clinical correlation remains essential in order to avoid unnecessary elimination diets that may adversely affect growth, nutritional status, quality of life, and oral immune tolerance. Overall, these findings support a selective, phenotype-guided approach to allergy testing in pediatric atopic dermatitis and highlight the potential role of sensitization patterns in defining immunologic endotypes and individualized management strategies.

*Conflict of interest statement.* None declared.

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