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Pattern of Allergen-Specific IgE Sensitization Relative to Total Serum IgE Concentration in Young Adults

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Many studies have shown that total serum IgE concentrations are associated with the likelihood of having detectable allergen-specific IgE.^{1–3} However, the relationship of sensitization to various allergens (i.e., perennial, seasonal, and food) relative to total serum IgE concentration has not been studied. Our specific question was whether a relationship exists between increasing total IgE concentrations and the development of sensitization to different types of allergens. To examine this question, we analyzed the number of positive

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allergen-specific IgE results for ten common allergens for each 5th percentile of total IgE in young adults from a relatively large, geographically based, unselected, birth cohort.

The selection of the study population has been previously described.^{4, 5} Briefly, subjects in this study were selected by location of residence and not by risk of allergic disease. Participants were enrolled as infants born between 1987 and 1989. The cohort was from northern suburbs of Detroit, MI. For this study, 675 of the original 831 eligible subjects were contacted and completed a survey between 18 and 21 years of age. Total serum and allergen specific IgE concentrations were assayed in blood samples from 570 participants using the Pharmacia UniCAP system (Phadia, Portage, MI). Allergen-specific IgE to dust mite (*Dermatophagoides farinae*), cat, dog, ragweed, *Alternaria*, timothy grass, peanut, cow milk, hen egg, and shrimp was measured. The laboratory performing the IgE testing was CLIA certified and regular quality assurance checks were done including repeating 1% of all samples. The coefficient of variation between runs averaged 5.9% for all allergens. As seen in table 1, serum samples were not adequate to assay all allergens in all samples therefore the total number of samples tested varied by allergen. Allergen-specific IgE concentrations of 0.35 IU/mL or higher were considered positive. Total serum IgE concentrations were stratified into percentiles (i.e., 5th, 10th, 15th100th percentile) based on the IgE concentrations among all participants and the number of positive allergen-specific IgE results for each allergen was determined for each 5th percentile. The institutional human subject review boards of both participating institutions approved all aspects of this study.

The median total IgE concentration was 40.75 IU/mL and the geometric mean was 38.4 ± 46.8 IU/mL for the 570 subjects who had an adequate sample. Of the 675 participating subjects, 320 were male and 630 white. Among participants with specific IgE data 93.3% were white compared to 92.5% of all participants ($p=0.692$). Similarly, 47.6% of those with IgE data were male compared to 46.2% without this data ($p=0.791$).

We observed interesting patterns of sensitization for perennial, seasonal, and food allergens occurring at different relative total IgE concentrations (Table 1). Specific IgE to dust mite and *Alternaria* were first seen in the lowest 10th percentile of total serum IgE concentrations. In comparison, a positive result for ragweed did not occur until the 20th percentile and none for timothy grass until the 25th percentile was reached. With the exception of 2 responses to egg, positive responses to food allergens were not found until total serum IgE reached the 40th percentile. Specifically, up to the 40th percentile only 2 (4.1%) of 49 positive specific IgE tests to all allergens were related to foods while overall 113 (14.1%) positive tests were specific for foods and the majority (77.0%) of positive food specific IgE tests were not found until total IgE was above the 60th percentile.

The main finding from our study is that sensitization to perennial, seasonal, and food allergens can be found at different relative total IgE levels. Specific IgE to perennial allergens is detectable at lower concentrations of total serum IgE compared to both seasonal and food allergens (with the exception of egg). The rationale for this apparent sequence of sensitization in this cohort of young adults is not clear. With regards to the inhalant allergens, we speculate the constant/chronic exposure to perennial allergens may explain why sensitization was seen at relatively lower total IgE concentrations compared to seasonal allergens. The age of this cohort may be the reason sensitization to food allergens was present at relatively higher total IgE concentrations since it is rare for “new” food sensitization to occur at this age or it may be that food allergen sensitization is waning at this age.

In conclusion, our data from this cohort suggests that a pattern of allergen-specific IgE sensitization occurs in relation to total IgE concentration.

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Total serum IgE concentration stratified into percentiles and the number of positive allergen-specific IgE test results at each percentile interval of total IgE.

Table 1

IgE Percentile (IgE IU/mL) *	Allergen									
	<i>D. farinae</i> †	Cat †	Dog †	Ragweed †	<i>Alternaria</i> †	Timothy †	Peanut †	Cow milk †	Hen egg †	Shrimp †
5 (2.68)	0	0	0	0	0	0	0	0	1 (5.6)	0
10 (5.64)	2 (1.2)	0	0	0	1 (0.9)	0	0	0	1 (5.6)	0
15 (8.65)	3 (1.8)	1 (0.9)	1 (1.0)	0	2 (1.8)	0	0	0	1 (5.6)	0
20 (11.5)	5 (3.1)	2 (1.7)	1 (1.0)	1 (0.6)	3 (2.7)	0	0	0	1 (5.6)	0
25 (13.8)	7 (1.3)	5 (4.4)	2 (2.0)	3 (1.8)	6 (5.4)	1 (0.7)	0	0	1 (5.6)	0
30 (17.5)	11 (6.8)	5 (4.4)	3 (2.9)	6 (3.7)	11 (9.9)	2 (1.4)	0	0	2 (11.1)	0
35 (21.5)	13 (8.0)	6 (5.2)	3 (2.9)	8 (4.9)	13 (11.7)	4 (2.8)	0	0	2 (11.1)	0
40 (27.9)	14 (8.6)	7 (6.1)	5 (4.9)	13 (7.9)	14 (12.6)	7 (4.8)	1 (2.1)	0	2 (11.1)	1 (3.6)
45 (33.0)	16 (9.8)	7 (6.1)	5 (4.9)	14 (8.5)	18 (16.2)	10 (6.9)	2 (4.3)	0	6 (33.3)	1 (3.6)
50 (40.6)	22 (13.5)	10 (8.7)	8 (7.8)	22 (13.4)	21 (18.9)	13 (9.0)	2 (4.3)	2 (9.5)	6 (33.3)	1 (3.6)
55 (49.1)	32 (19.6)	13 (11.3)	9 (8.8)	27 (16.5)	25 (22.5)	21 (14.5)	3 (6.4)	3 (14.3)	7 (38.9)	3 (10.7)
60 (55.2)	41 (25.2)	20 (17.4)	16 (15.7)	37 (22.6)	32 (28.8)	30 (20.7)	4 (8.5)	6 (28.6)	10 (55.6)	6 (21.4)
100 (55.3+)	163 (100)	115 (100)	102 (100)	164 (100)	111 (100)	145 (100)	47 (100)	21 (100)	17 (100)	28 (100)
Percent of all positive tests **	28.6	20.2	17.9	28.8	19.5	25.4	8.2	4.9	3.9	6.9
Total number of individuals tested † †	570	570	570	570	570	570	570	427	439	405

* Percentile of total serum IgE and in parentheses the concentration defining the percentile.

† Number of positive results for allergen at each designated percentile of total serum IgE concentration; percent positive results for the allergen at the indicated percentile of total serum IgE concentration in parentheses.

** The percentage of all positive tests represented by that particular allergen.

†† The total number of individuals tested for each allergen varies because the volumes of serum obtained were not sufficient to complete all tests for all individuals.