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## Total IgE levels and skin test results in children under three years of age with food hypersensitivity

Elżbieta Malinowska<sup>1</sup>, Maciej Kaczmarek<sup>1</sup>, Jolanta Wasilewska<sup>1</sup>

3rd Clinic of Pediatric Diseases, Medical University of Białystok, Poland

### Summary

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Background:</b>       | The most common tools of allergologic diagnostics are skin prick tests (SPT) and total serum IgE (IgE <sub>total</sub> ) determinations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Material/Methods:</b> | The study was carried out in a group of 348 children aged 5 to 36 months. All the children underwent SPT using 12 food allergens and in 229 of them also 9 inhalant allergens were tested. Assessment of test positivity utilized relative criteria, i.e. the result was regarded as positive if a wheal with S surface area exceeding or equal to 0.25 of the surface area S0 of a control wheal was formed. In this study group, 291 had IgE <sub>total</sub> levels determined. They were divided into the groups with elevated and normal IgE <sub>total</sub> levels on the basis of two standards, i.e. the standards recommended by the manufacturer of the test reagents used to determine IgE <sub>total</sub> (BioWhittaker) and the population standards. |
| <b>Results:</b>          | Positive SPT results for food allergens were obtained in 15.8% of the examined children, for inhalant ones in 21.8%. The factors taken into account in the analysis of impact on SPT results included age, sex, living place and the use diet. Elevated IgE <sub>total</sub> levels according to the manufacturer's standards were detected in 35.0%, and according to the population standards in 67.0% of the examined children. The obtained positive test results were compared with elevated IgE <sub>total</sub> in the studied patients.                                                                                                                                                                                                                      |
| <b>Conclusions:</b>      | 1. Feasibility of SPT at this age. 2. Determination of normal IgE <sub>total</sub> range in the group of children below three requires further studies.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>key words:</b>        | skin prick tests (SPT) • IgE level • food allergy in children                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

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**Author's address:** Professor Maciej Kaczmarek MD PhD, 3rd Clinic of Pediatric Diseases, Medical University of Białystok, Waszyngtona 17, 15-274 Białystok, Poland

## BACKGROUND

In view of growing incidence of allergic diseases, continuous search for good diagnostic methods, especially with respect to the youngest group of children (below 3) remains an important issue [1–4]. Food allergy in this age group is regarded as the first sign of potential atopy [2,5–7]. It is an abnormal systemic response, repeatable and reproducible, involving qualitatively altered reaction to ingested food or food additives [8,9].

In youngest children, the allergic symptoms involving either single or multiple organs are non-specific [10]. In order to confirm the atopic etiology of the reported complaints (or to exclude it) the results of skin prick tests (SPT) and determination of serum IgE<sub>total</sub> levels are commonly used, just like in older children. These two diagnostic methods are closely connected with each other because skin prick tests are useful for assessment of IgE-dependent atopic hypersensitivity only. The diagnostic value of results obtained by using both these methods in the youngest group of children below 3 is still questionable [11,12].

Most investigators believe that determination of serum IgE<sub>total</sub> has a limited value in allergologic diagnostics, because the increase of its values does not always correlate with the clinical symptoms of atopy, and, on the other hand they are not excluded by normal IgE<sub>total</sub> levels [11–15]. According to Gordon, ca. 9% of children with elevated serum IgE<sub>total</sub> demonstrate no symptoms of allergy [16]. It is worth emphasizing that according to some authors determination of IgE<sub>total</sub> levels is characterized by high sensitivity (94%) and specificity (80%) with respect to food allergy; these indexes are higher than in case of other allergic diseases [1,14,17].

Skin prick tests are considered to be the *in vivo* diagnostic method which should initiate allergologic diagnostics [18]. According to Menardo, Moneret-Vautrin, SPT are diagnostic tests used also in infants and small children. However, lower skin reactivity to histamine in children below 2 should be taken into account [19,20].

Like in older children and adults, the results of SPT are variable and dependent on external (technical) factors, e.g. the type of allergen extracts (quality and standardization), knife type, method of wheal size measurement and biological factors, such as individual reactivity of the patient's skin [5,20–26].

## MATERIAL AND METHODS

The study was carried out in a group of 348 children aged 5 to 37 months (median 25), referred to the Outpatient Department of Allergologic Tests in order to undergo skin testing. Children below two years of age accounted for over a half of the study group (55.5%); children aged below 12 months constituted only 10% of the total number of patients.

In the analyzed group, boys were slightly more numerous than girls – 196 (56.3%) vs. 152 (43.7%), respective-

**Table 1.** Information concerning the patients' age.

| Investigated children | min [months] | max [months] | 5th percentile [months] | median [months] | 95th percentile [months] |
|-----------------------|--------------|--------------|-------------------------|-----------------|--------------------------|
| <b>Sex</b>            |              |              |                         |                 |                          |
| boys                  | 4.7          | 36.8         | 9.1                     | 24.2            | 35.5                     |
| girls                 | 8.0          | 36.8         | 9.8                     | 26.3            | 35.7                     |
| <b>Living place</b>   |              |              |                         |                 |                          |
| town                  | 4.7          | 36.8         | 9.7                     | 25.7            | 35.7                     |
| country               | 5.2          | 36.0         | 8.8                     | 24.2            | 34.1                     |

ly. A 4-fold higher number of children living in towns (279 – 80.2%) than those living in the country (69 – 19.8%) is notable.

The essential parameters concerning age distribution of the examined children living in the town and in the country, as well as among boys and girls, are presented in Table 1. There are no apparent differences in age at the moment of testing – the whole group was relatively homogeneous.

The study was carried out among children followed up in the Outpatient Department of Food Allergy, Gastrology or hospitalized in the 3rd Clinic of Pediatric Diseases of the Medical University in Białystok. The most common indications for skin tests among the examined children were allergic type skin lesions or recurrent respiratory tract infections.

On physical examination, detailed information concerning the time of breastfeeding, the moment of cow milk introduction and current diet type was collected. It was determined that nearly all children (94%) had been breast-fed for over a month and that most of them (ca. 72%) were on milk-free hypoallergic diet at the moment of testing. Moreover, their histories revealed that ca. one third of the examined children – 120 (34.5%) had never had cow milk introduced to their diet.

Skin tests with food allergens were performed in all the examined children, i.e. 348, whereas 229 underwent additional tests with inhalant allergens. The tests with food allergens were performed using test kits containing 12 native allergens, and those with inhalant ones using kits of 9 commercial allergens. Occasionally, in cases of limited testing surface area or no co-operation on the part of the child, testing of some allergens was abandoned.

The tests were performed using the prick technique by piercing the skin surface through a drop of a particular allergen with the tip of a morphologic knife at a ca. 45° angle. This technique was used for commercial allergens, whereas the 'prick by prick' method involving piercing the epidermis through an applied layer of native food was used for tests with the remaining food allergens.

The tests with food allergens were performed using a kit composed according to Moneret-Vautrin of 12 native allergens: milk, soy, peanuts, egg white, egg yolk, chicken meat, beef, wheat flour, banana, fish (cod), white sesame, tangerine. The kits had been prepared

**Table 2.** Normal IgE<sub>total</sub> value range according to the manufacturer's standards (BioWhittaker) and the population standards (according to Stasiak-Bermuta [Stasiak]).

| Manufacturer's standards |                                                 | Population standards |                                                 |
|--------------------------|-------------------------------------------------|----------------------|-------------------------------------------------|
| Age [months]             | Normal IgE <sub>total</sub> value range [IU/ml] | Age [months]         | Normal IgE <sub>total</sub> value range [IU/ml] |
| neonates                 | $z \leq 1$                                      |                      |                                                 |
| $1 < w \leq 11$          | $z \leq 12$                                     | $w \leq 11$          | $z \leq 2.3$                                    |
| $11 < w \leq 24$         | $z \leq 15$                                     | $11 < w \leq 23$     | $z \leq 5.2$                                    |
| $24 < w \leq 48$         | $z \leq 33$                                     | $23 < w \leq 35$     | $z \leq 7.2$                                    |
| $w > 48$                 | $z \leq 85$                                     | $w > 35$             | $z \leq 7.4$                                    |

immediately before testing and the individual food products were suspended in 0.9% physiological saline solution.

The tests with inhalant allergens were performed using a kit composed of 9 allergens manufactured by Bencard, including house dust mites, mixed feathers, cat and dog hair, grass pollens, tree pollens, pollens of weeds and shrubs, cotton, sheep wool.

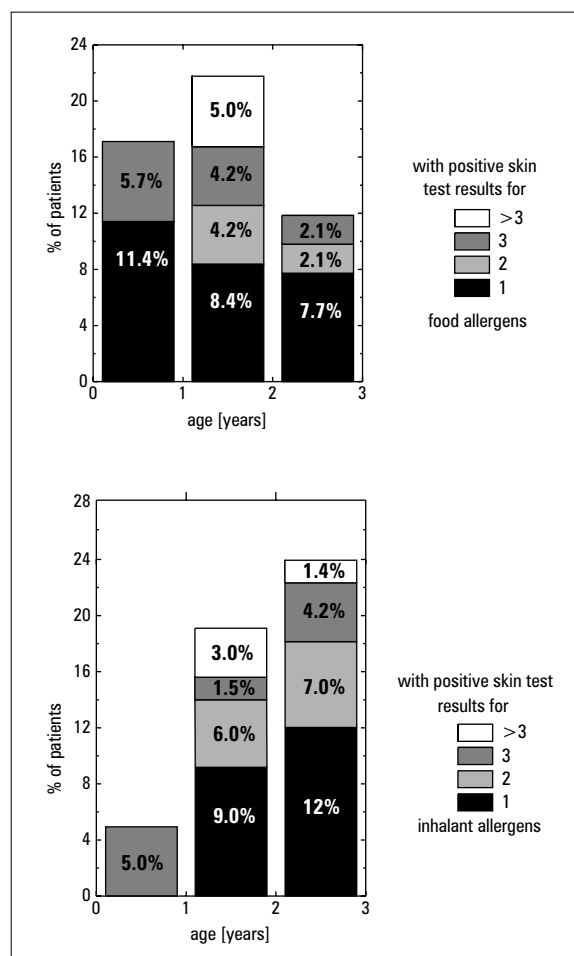
The fact that the capability of immediate type response to individual allergens is acquired gradually during the ontogenesis and increases with age should be taken into consideration in the assessment of the study. It seems that in small children, because of lower skin reactivity, even the presence of relatively small quantities of specific IgE molecules (IgE<sub>s</sub>) in the skin may indicate the presence of an allergic process. Skin reactivity is measured by its reaction to a control substance. Therefore, the use of the absolute wheal size criterion was abandoned in the study and the relative criterion only adopted according to the recommendations of EAACI [25,27]. The result was regarded as positive if a wheal with S surface area exceeding or equal to 0.25 of the surface area S<sub>0</sub> of a control wheal was formed.

In the group of 291 children (80.0% of patients) total IgE concentrations were determined. The children were divided into the groups with elevated and normal IgE<sub>total</sub> levels on the basis of two standards, i.e. the standards recommended by the manufacturer of the test reagents used to determine IgE<sub>total</sub> and the population standards.

The population standards were elaborated on the basis of studies carried out on healthy children living in the region of Białystok by Stasiak-Barmuta [28]. The normal range of IgE values according to the manufacturer's as well as population standards is presented in Table 2.

## RESULTS

Using the relative criterion of skin prick test assessment, hypersensitivity to trophic allergens was detected in

**Figure 1.** Positive results of skin tests for food and inhalant allergens in various age groups**Table 3.** Quantitative comparison of skin test results with food and inhalant allergens.

| Age group<br>[years] | Number of children<br>subjected to skin<br>tests | Positive results for: |      |             |     |             |     |              |     |
|----------------------|--------------------------------------------------|-----------------------|------|-------------|-----|-------------|-----|--------------|-----|
|                      |                                                  | 1 allergen            |      | 2 allergens |     | 3 allergens |     | >3 allergens |     |
|                      |                                                  | N                     | %    | N           | %   | N           | %   | N            | %   |
| food allergens       |                                                  |                       |      |             |     |             |     |              |     |
| 0–1                  | 35                                               | 4                     | 11.4 | 0           | 0   | 2           | 5.7 | 0            | 0   |
| 1–2                  | 119                                              | 10                    | 8.4  | 5           | 4.2 | 5           | 4.2 | 6            | 5.0 |
| 2–3                  | 194                                              | 15                    | 7.7  | 4           | 2.1 | 4           | 2.1 | 0            | 0   |
| inhalant allergens   |                                                  |                       |      |             |     |             |     |              |     |
| 0–1                  | 20                                               | 0                     | 0    | 0           | 0   | 1           | 5.0 | 0            | 0   |
| 1–2                  | 67                                               | 6                     | 9.0  | 4           | 6.0 | 1           | 1.5 | 2            | 3.0 |
| 2–3                  | 142                                              | 17                    | 12.0 | 10          | 7.0 | 6           | 4.2 | 2            | 1.4 |

**Table 4.** Patients with positive test results according to sex and living place.

| Investigated children |         | Patients with positive results of test for any allergen |      |
|-----------------------|---------|---------------------------------------------------------|------|
|                       |         | N                                                       | %    |
| <b>Sex</b>            | boys    | 47                                                      | 14.2 |
|                       | girls   | 43                                                      | 17.5 |
| <b>Living place</b>   | town    | 70                                                      | 15.3 |
|                       | country | 20                                                      | 16.7 |

**Table 5.** Positive results of skin tests for food and inhalant allergens according to sex and living place of the patients.

| Investigated children     |         | Patients subjected to skin tests (tested) | Patients with positive results (pos) | pos/tested [%] |
|---------------------------|---------|-------------------------------------------|--------------------------------------|----------------|
| <b>food allergens</b>     |         |                                           |                                      |                |
| <b>Sex</b>                | boys    | 196                                       | 32                                   | 16.3           |
|                           | girls   | 152                                       | 23                                   | 15.1           |
| <b>Living place</b>       | town    | 279                                       | 43                                   | 15.4           |
|                           | country | 69                                        | 12                                   | 17.4           |
| <b>inhalant allergens</b> |         |                                           |                                      |                |
| <b>Sex</b>                | boys    | 135                                       | 24                                   | 17.8           |
|                           | girls   | 94                                        | 25                                   | 26.6           |
| <b>Living place</b>       | town    | 178                                       | 37                                   | 20.8           |
|                           | country | 51                                        | 12                                   | 23.5           |

15.8% of examined children below 3, and to air-borne allergens in 21.8%. Table 3 presents the numbers of children with positive results of skin tests with food and inhalant allergens in particular age groups.

As far as the number of children with positive test results is concerned, no systematic age-related variability was observed in case of food allergens. On the other hand, in case of inhalant allergens the percentage of patients with positive test results markedly increases with age (fig. 1). Among the examined children below 1 year of age, only 5% had positive test results, among children aged from 1 to 2 – 19.5%, and over 2 – almost 25%. The above results reflect the natural process of development of IgE-dependent response with age and confirm the commonly known phenomenon of predominant hypersensitivity to trophic allergens in infancy, whereas hypersensitivity to inhalant allergens gradually develops at a later time (starting from the age of 3–4 years).

Table 4 presents the numbers of patients with positive results for any allergen (either trophic or inhalant) according to age and living place. The percentage of girls with positive results of at least one test was higher by over 3% than the respective percentage of boys. The difference between patients living in the country and in the town reached no statistical significance. In order to answer the question concerning the reasons for the difference between the results obtained for girls and boys, the distribution of positive results was analyzed separately for tests with food and inhalant allergens. As it follows from Table 5, the examined girls were markedly

**Table 6.** Results of skin tests in investigated children according to the diet and division into food and inhalant allergens.

| Diet type                         | Number of children<br>on diet subjected<br>to the tests | Children with at least one positive<br>test result |      |
|-----------------------------------|---------------------------------------------------------|----------------------------------------------------|------|
|                                   |                                                         | N                                                  | %    |
| to a food allergen                |                                                         |                                                    |      |
| general                           | 42                                                      | 2                                                  | 5    |
| with restricted<br>dairy products | 59                                                      | 9                                                  | 15   |
| hypoallergic                      | 247                                                     | 44                                                 | 18   |
| to an inhalant allergen           |                                                         |                                                    |      |
| general                           | 26                                                      | 5                                                  | 19   |
| with restricted<br>dairy products | 39                                                      | 6                                                  | 15   |
| hypoallergic                      | 164                                                     | 38                                                 | 23   |
| to a food or an inhalant allergen |                                                         |                                                    |      |
| general                           | 42                                                      | 7                                                  | 16.7 |
| with restricted<br>dairy products | 59                                                      | 13                                                 | 22.0 |
| hypoallergic                      | 247                                                     | 70                                                 | 28.3 |

more frequently hypersensitive to inhalant allergens than boys, with the difference reaching almost 9%. The tests with inhalant allergens also demonstrated a slightly more evident difference between patients living in the country and in the town – the percentage of country children hypersensitive to them was higher by ca. 3%.

The diet type was also considered among the factors which might influence the results of skin tests. It was established by anamnesis that almost 2/3 of the studied group were fed on milk-free (hypoallergic) diet, whereas only 10% received a general diet. It seems interesting that in the group of children on hypoallergic elimination diet the percentage of patients with positive test results for any allergen was considerably higher (by almost 12%) in comparison with those on diet with limited dairy products only and by ca. 6% in comparison with those receiving general diet (Table 6). No definite correlation between the diet and skin test results was found in case of inhalant allergens, where the 'more restrictive' diet was not associated with increased percentage of positive tests. For tests with food allergens, the observed correlation was more consistent: the percentage of children on the most restrictive diet with at least one positive result was 18.15 – for the 'less restrictive' diet and was reduced to 5 in the group on general diet (only 2 out of 42 examined patients).

In view of the fact that the most frequently recommended type of elimination diet in the studied group of children was milk-free diet, the size of wheals developed in skin tests with this allergen was compared in two subgroups. The first one had never had milk and its products introduced to their diet, whereas the second one consisted of patients whose diet included cow milk protein. The impact of presence of cow milk in diet or its elimination on mean wheal size developed in response to that allergen in skin prick test has been presented in Table 7. Mean serum IgE<sub>total</sub> level in the group on diet including cow milk is markedly lower than that found in

**Table 7.** Mean wheal size in skin test with cow milk albumin according to diet type used.

| Cow milk introduced | Number of children | Mean IgE <sub>total</sub> * value | Mean control wheal size S <sub>0</sub> [mm <sup>2</sup> ] | Positive result of skin test for milk |                               |                           |
|---------------------|--------------------|-----------------------------------|-----------------------------------------------------------|---------------------------------------|-------------------------------|---------------------------|
|                     |                    |                                   |                                                           | Number of children                    | Mean wheal size               |                           |
|                     |                    |                                   |                                                           |                                       | absolute S [mm <sup>2</sup> ] | relative S/S <sub>0</sub> |
| no                  | 120                | 51.1±8.4 (N <sub>det</sub> =120)  | 18.0±1.2                                                  | 12 (10%)                              | 8.0±2.0                       | 0.81±0.28                 |
| yes                 | 228                | 32.2±4.1 (N <sub>det</sub> =189)  | 22.2±1.6                                                  | 10 (4.4%)                             | 3.6±1.1                       | 0.32±0.15                 |

\* N<sub>det</sub> – number of children in whom IgE<sub>total</sub> was determined

**Table 8.** Number of investigated children with IgE<sub>total</sub> elevated according to the manufacturer's and population standards.

| Age<br>[months]                           | Number of investigated children          |                                       | $N_{el}/N_{det}$<br>[%] |
|-------------------------------------------|------------------------------------------|---------------------------------------|-------------------------|
|                                           | with determined<br>$IgE_{total} N_{det}$ | with elevated<br>$IgE_{total} N_{el}$ |                         |
| according to the manufacturer's standards |                                          |                                       |                         |
| $1 < w \leq 11$                           | 30                                       | 12                                    | 40.0                    |
| $11 < w \leq 24$                          | 108                                      | 43                                    | 39.8                    |
| $24 < w \leq 48$                          | 153                                      | 48                                    | 31.4                    |
| according to population standards         |                                          |                                       |                         |
| $w \leq 11$                               | 30                                       | 19                                    | 63.3                    |
| $11 < w \leq 23$                          | 95                                       | 69                                    | 72.6                    |
| $23 < w \leq 35$                          | 145                                      | 94                                    | 64.8                    |
| $w > 35$                                  | 21                                       | 14                                    | 66.7                    |

children on milk-free diet as well as the rate of positive skin tests for milk, 2-fold lower in the former group. On the other hand, mean size of wheal due to the challenge with that allergen in children on milk-free diet was over 2-fold larger (both in absolute and relative terms) than that observed in the group of children on diet including cow milk protein. The obtained results provide indirect support for the feasibility of medical management involving the use of elimination diet in the group of atopic children.

The obtained results of skin tests were compared with the values of IgE. To obtain better characteristics of the studied group as well as to assess the utility of serum IgE<sub>total</sub> determinations two types of standards were applied. 103 children, i.e. 35.4% of the examined patients had IgE<sub>total</sub> elevated according to the standards set by the manufacturer of reagents. The application of population standards resulted in obtaining elevated IgE<sub>total</sub> values in as many as 196 patients, i.e. 67.5% of the studied group. The distribution of elevated IgE percentages in particular age groups, for which the ranges of IgE regarded as normal with respect to the manufacturer's and to the population standards are different have been presented in Table 8.

Figure 2 presents positive results of skin tests compared with normal and elevated IgE<sub>total</sub> values according to the manufacturer's and population standards. The analysis takes into account the number of examined children, type of allergens (trophic or inhalant), number of positive test results for n allergens (n=1, 2, 3 or >3) as well as IgE<sub>total</sub> values in relation to the two standards. Figure 2 a presents the results obtained in children with positive tests for food allergens, Figure 2 b – those obtained in children positive for inhalant allergens, and Figure 2

**Table 9.** Mean IgE<sub>total</sub> values in the group of children with positive results for food and inhalant allergens.

| Investigated group                                    | Mean age at the time of IgE <sub>total</sub> determination [months] | Mean IgE <sub>total</sub> value [IU/ml] |
|-------------------------------------------------------|---------------------------------------------------------------------|-----------------------------------------|
| no positive test results                              | 23.2±0.6                                                            | 24.8±3.1                                |
| at least one positive result for any allergen         | 23.9±1.0                                                            | 74.0±11.0                               |
| at least one positive result for a food allergen      | 22.1±1.2                                                            | 75.4±13.6                               |
| at least one positive result for an inhalant allergen | 27.0±1.2                                                            | 75.9±15.6                               |

c – the results of children with positive results for either food or inhalant allergens. The analysis of IgE<sub>total</sub> values based on two standards revealed very pronounced differences in the percentage rates considered as elevated and normal in almost all analyzed group of children. .

The mean IgE<sub>total</sub> value in the group of children with positive test results for food and inhalant allergens was determined. As presented in Table 9, there is no apparent difference between children positive for at least one food allergen and patients positive for at least one inhalant allergen, as far as mean IgE<sub>total</sub> values in these groups are concerned. However, mean serum IgE<sub>total</sub> levels obtained in both cases were ca. 3-fold higher than the corresponding values in the group of children with no positive results obtained for any of the tested allergens. It is noteworthy that mean age values in the tested subgroups are very similar. Thus, age differences have no impact on the obtained results.

## DISCUSSION

The incidence of immediate positive reactions in healthy subjects ranges from 9% to 71% and depends predominantly on the potency of allergen extracts used in tests [25]. The assessment of hypersensitivity rates in the general population are more consistent – it is estimated that they range from 19% to 44% [25], and the cited discrepancy does not reflect the actual differences in incidence but rather results from the variety of techniques and potency of allergen preparations [25,29,30].

Positive skin reactions are gradually acquired in childhood. Positive test results in the group of children aged below 2 have been estimated to account for ca. 5–7% of the general population [19,31,32]. In a study carried out in a randomly selected group of 710 infants aged 7 months, Nilsson observed positive results of skin tests

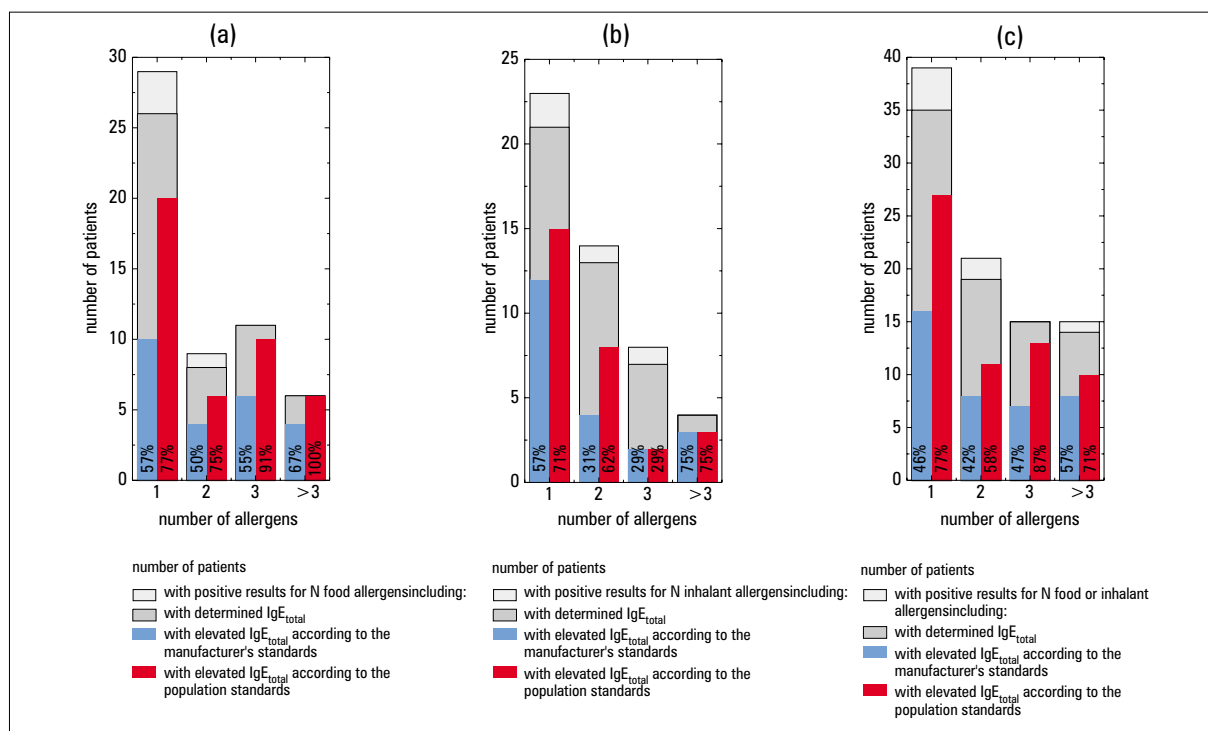


**Figure 2.** Elevated  $IgE_{total}$  values (according to the manufacturer's and population standards) in children with positive skin test results

with native food allergens (cow milk and hen eggs) in 13% of cases [33]. Wąsowska-Królikowska obtained a similar rate of positive skin test results in infants (12.5%) using commercial food allergens [34].

In a group of 146 children with atopic disease (selected from a population of 3920 children) aged from 5 to 48 months (median – 18 months), Cantani obtained positive results in skin tests with milk allergens in 37% (with  $IgE$  present in blood in 43.2%). Positive skin test results obtained for other allergens were as follows: egg in 54.1% (with coincident presence of  $IgE_s$  in 54.1%), soy in 12.3% ( $IgE_s$  – 24%), flour in 10.9% ( $IgE_s$  – 10.9%) and fish in 7.5% [35]. It can be seen that except for egg white the percentages of positive skin tests in the group of selected patients oscillated around the value of 10.0%. Charubczyk, using commercial food and inhalant allergens in a selected group of infants ( $n=30$ ) with obstructive bronchitis, obtained at least 1 positive skin test result in 97.0% of patients; the most common allergens were eggs and house dust mites [36]. The above results demonstrate considerable diversity from the study by Delacourt, who observed positive skin test results in 25% of infants with 'wheezing' only [37].

In the own studies presented in the paper, the incidence of allergy in the group of children below 3 years of age was as follows: 15.8% were hypersensitive to food allergens, and 21.8% – to inhalant allergens. During the first year of life, the predominance of food allergy was observed – in 17.0% of examined children belonging to this age group, whereas only one child below one year of age was positive for inhalant allergens. At the age of over 2 years, in turn, hypersensitivity to inhalant aller-

gens is definitely predominant – positive test results were obtained in 24.6% of children belonging to this age group, as compared with food allergens, for which the results were positive in 12.0% of cases only.

Comparative analysis of elevated serum  $IgE_{total}$  values (assessed according to two standards) with the results of skin prick tests indicates that the low predictive value of the determination of serum  $IgE_{total}$  alone may result from the adopted value ranges regarded as normal for the particular age groups.

It is notable that the population standards are more sensitive, because the percentage of children with positive skin prick tests and concomitant elevated  $IgE_{total}$  is markedly higher. It can be seen clearly in the group of children with skin test results positive for one or two allergens, especially in the case of food allergens. In this group,  $IgE_{total}$  values elevated according to the manufacturer's standards were observed in 38.0% of children vs. 77.0%, according to population standards (cf. fig. 2). In case of children positive for inhalant allergens, these differences are less pronounced, amounting to ca. 25.0% – 30.0%, whereas in the group of children with concomitant response to several inhalant allergens application of both standards yields identical values. The obtained results indirectly suggest that children hypersensitive to air-borne allergens may have higher  $IgE_{total}$  levels in comparison with other patients.

Some authors believe that besides genetic predisposition, exposure of the organism to particular antigens is necessary to develop allergic disease [38].

Kajosaari, Björkstén, Oldaeus proved in their study that breast-feeding combined with milk-free hypoallergic diet and later introduction of solid foods (at the age of over 6 months) leads to reduction of the incidence of allergic diseases in children [39–41]. Hide and Bishop agree with this opinion only partially and believe that the dietary restrictions should apply only to mothers belonging to the high risk group for developing atopy and that hypoallergic diet without appropriate supplementation may be dangerous both for the mother and the child, while it does not have any impact on the incidence of atopic diseases over 5 years of age [42,43].

About 1/3 of children in the examined group had never had milk and dairy products introduced into their diet; as many as 2/3 of patients were on milk-free diet at the time of the study. This may explain the fact that although in children below 3 the predominance of hypersensitivity to food allergens can be expected, positive test results for inhalant allergens were more frequent in the studied group than those for food allergens. The obtained data may therefore provide support for the opinion of Hide and Bishop that elimination diet does not prevent the development of inhalant allergy in atopic children. In the studied group, positive skin tests for any allergen (either trophic or inhalant) were more frequently obtained in children kept on hypoallergic diet (28.3%) and those on diet with partially restricted dairy products (22.0%) than in children observing no dietary regimens (16.7%). The fact that as far as food allergens alone are concerned, skin tests with that type of allergens were also more frequently positive in children kept on diet (in 18% and 15% of cases, respectively) than in children on general diet (5%) seems particularly interesting. The interpretation of the data should certainly take into consideration significant differences in the size of both groups: 289 children on milk-free diet and the diet with restricted dairy products supply vs. Only 38 children on general diet. However, if the fact that in the group of children who received no milk the mean size of wheal formed in response to this allergen was markedly larger than in other children is taken into account, it can be concluded that skin prick tests confirm the feasibility of this type of diet and define adequately the population of atopic children.

Patients living in towns predominated in the studied group; on the other hand, it is noteworthy that the percentage of patients with elevated IgE<sub>total</sub> (according to the manufacturer's and population standards) was markedly higher among country children. However, the percentages of children with positive skin test results were comparable in both groups. In case of food and inhalant allergens it was only 1.4% and ca. 3% higher in country children than in town children, respectively. The second most common cause of elevated serum IgE<sub>total</sub> levels besides allergic diseases are parasitic invasions [9,26,30]. The observed discrepancy between the results of IgE<sub>total</sub> determinations and skin tests in the group of country children may be due to higher incidence of parasitic invasions. On the other hand, higher percentage of patients with elevated IgE<sub>total</sub> values and higher number of positive skin test results observed

among country children, accounting for 20% of the studied group only, may indicate the existing disproportion in availability of specialist diagnostics in our country.

## CONCLUSIONS

Skin prick tests and determination of total serum IgE level are useful in allergologic diagnostics of youngest children. Testing for inhalant allergens is not necessary only in children below one year of age. The diet type may have an impact on the results of skin prick tests. The normal range of serum IgE<sub>total</sub> values in the group of children below 3 requires further studies.

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