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Original Research Article

Characteristics of sensitization among children with allergic rhinitis

Silviya Novakova[1], Manuela Yoncheva[2], Maria Stoykova[3], Nina Musurlieva[3] and Daniela Taneva[4]

[1]Allergy Unit, Inner Consulting Department, University Hospital "Sv. Georgi" - Plovdiv, Bulgaria

[2]Inner Consulting Department. University Hospital "Sv. Georgi" - Plovdiv, Bulgaria

[3]Department of Social medicine and Public Health; Faculty of Public Health; Medical University of Plovdiv; Bulgaria

[4]Department of Nursing Care; Faculty of Public Health; Medical University of Plovdiv; Bulgaria

***Corresponding Author's E-mail: novakova66@yahoo.com**

Abstract

It is critical for successful management of allergic rhinitis to identify clinically relevant sensitizations. Polysensitization is a frequent phenomenon among young patients and its understanding is of significant practical importance. The aim of this cross-sectional study was to characterize the sensitization of children with newly diagnosed allergic rhinitis by skin prick - test. The study included 221 children with newly diagnosed allergic rhinitis (AR) [mean age 9, range 3–17 years, 142 boys (64.25%)]. Both type and number of sensitizations were assessed. The mean age and the duration of symptoms were considered at the time of diagnosis. Sensitization to house dust mite (HDM), grass pollen and Alternaria were the most prevalent in children with allergic rhinitis. Polysensitization was demonstrated in 46.61% of children at the time of diagnosis of AR. The mean age of monosensitized children was significantly lower (8.86) than in polysensitized children (11.13) (p < 0,001). The duration of symptoms was 2.39 years in mono - and 2.63 in polysensitized children with no significant difference between both groups (p >0.05). Our study demonstrated the high prevalence of sensitization to HDM and grass allergens in children with AR. Alternaria was also found to be a relevant allergen. Polysensitization occurring frequently in children with allergic rhinitis depended upon the age of the children rather than the duration of symptoms. The results suggested that children with allergic rhinitis are polysensitized from the beginning of the disease and that polysensitization is its own phenotype.

Keywords: Allergic rhinitis, children, monosensitized, polysenzitised, prevalence, sensitization, skin-prick test.

INTRODUCTION

Allergic rhinitis (AR) is Ig-E inflammatory disease of the nasal membrane as a result of contact with allergens, which is characterized by symptoms such as sneezing, rhinorrhea, nasal congestion and nasal itching. It is often associated with eye symptoms such as itching, redness and tearing (Bousquet et al., 2008). AR is caused by sensitization to one or more aeroallergens (Boulet et al., 1997; Savolainen et al., 1990). These are proteins, glycoproteins and rarely glycans (Savolainen et al., 1990).

Allergic rhinitis is the most common form of non-infectious rhinitis worldwide affecting as many as 40% of children (Pavankar et al., 2011). About 80% of patients with AR develop symptoms before 20 years of age [30]. Although boys are more likely than girls to have AR this tendency reverses at puberty (Bousquet et al., 2001). Early and in time diagnosis might minimize the likelihood of progression of the disease to asthma especially in children (Liu, 2006). The diagnosis is based on detailed medical history, physical examination and the presence of clinically relevant sensitization. Assessment of sensitization could be done by skin prick-test or by measurement of allergen – specific serum IgE antibodies. Bousquet et al. found a global rate of sensitization to inhalant allergens 68.2% (Bousquet, 2009). To identify clinically relevant sensitization is of great importance for

Table 1. General characteristics of the children / („*" - number of sensitizations are higher than number of patients because of polysensitization in some of them).

Number of children	**221**
Gender: boys	142 / (64.25 %)
Girls	79 / (35,75 %)
Age: mean ± SD (in years)	9.18 ± 3.97
Type of sensitization:	
monosensitized	118 (53.39%)
polysensitized	103 (46.61%)
Sensitization to:	
House dust mite (HDM)	97 (43.89%)
Alternaria	60 (27.15%)
Aspergillus mix	27 (12.22%)
Penicillum mix	33 (14.93%)
Cladosporium	14 (6.33%)
5 Grasses	78 (35.29%)
4 Cereals	76 (34.39%)
Fagaceae	15 (6.79%)
Betulaceae	15 (6.79%)
Salicaceae	6 (2.71%)
Cat	15 (6.79%)
Dog	5 (2.26%)
Cockroach	15 (6.79%)
	overall sensitizations * - 456

the management of the disease. It can facilitate implementation of adequate environmental control, as well as allergen specific immunotherapy.

Polysensitization is a frequent phenomenon among adults and children. Several studies have pointed out that up to 90% of patients are polysensitised (Ciprandi et al., 2008; Migueres et al., 2011). Baatenburg de Jong and colleagues concluded that polysensitisation is common in children of school age, particularly boys (Baatenburg de Jong et al., 2011). In polysensitized children the symptom scores and levels of total IgE are higher and the course of atopic diseases is more severe (Ciprandi et al., 2008; Kim et al., 2006).

Epidemiologic studies show that the prevalence of AR continues to increase worldwide (Pavankar et al., 2011). Yet, studies on allergic rhinitis in Bulgaria are rare, especially those relating specifically to children.

The aim of this study was to characterize the sensitization of children with newly diagnosed AR by skin prick - test.

Patients and Methods

This observational cross-sectional study included 221 children with newly diagnosed allergic rhinitis [mean age – 9.92 years (SD – 4.30); male gender - 142 (64.25%)]. The study was conducted in the Allergy Union of University Hospital "Sv. Georgi" - Plovdiv, Bulgaria. The children were referred either by their general practitioners

Table 2. Type of sensitization in monosensitezed children with allergic rhinitis. (n – number of children)

Sensitization to:	n	%
HDM	68	57.63
Grasses	30	25.42
Alternaria	11	9.32
Cladusporium	1	0.85
Aspergillus mix	2	1.69
Cockroach	1	0.85
Salicaceae	2	1.69
Betulaceae	3	2.54
	overall 118	100%

or by their parents who had allergy concerns and a routine checkup was followed. The diagnosis of allergic rhinitis was based on detailed medical history, physical examination, and the presence of clinically relevant sensitization.

The presence of sensitization was assessed by skin–prick test, performed by the European Academy of Allergology and Clinical Immunology (Bousquet, 2009; Heinzerling et al., 2013; Eigenmann et al., 2013; Bosquet et al., 2012). Fourteen aeroallergens were tested: *Dermatophagoides pteronyssinus, Dermatophagoides farinae*, cat, dog, cockroach, *Alternaria, Penicillum mix, Aspergillus mix, Cladosporium*, 5 grasses (*Doctylis glomerata, Lolium perenne, Phleum pretense, Anthoxanthum odoratum, Poa protensis)*, 4 cereals (*Avena sativa, Triticum vulgare, Zea mays, Hordeum vulgare*), *Fagaceae; Betulaceae, Salicaceae* and *Ambrosia elatior,* using commercial allergen extracts Alyostal Prick 100IR - IC/ml (Stallergens, France). Patients were tested on the volar surface of the forearm with the distance between tests at least 2 cm to avoid cross-contamination. 1 mm prick lancets (Stallerpoint®) were used. Histamine hydrochloride 10mg/ml was used as a positive control and glycerol buffer diluents of the allergen preparations, used as a negative control. A skin prick test was considered positive when the wheal diameter was 3 mm larger than that produced by the negative control after 15 minutes.

Statistical analysis

Statistical analysis was conducted using IBM SPSS Statistics 20 software (Chicago, IL, USA). Data was expressed as mean with standard deviation (SD). Fisher's exact test was used for the comparison of the mean age and the duration of symptoms in mono - and polysensitized children with allergic rhinitis (*P*-value < 0.05 was regarded as statistically significant).

RESULTS

Monosensitization was established in 118 children (53.39%) with newly diagnosed allergic rhinitis while 103 children (46.61%) were polysensitized. General characteristics of children with the type of sensitizations are presented in table 1.

Sensitization to HDM allergen was the most prevalent – 97 children (43.89%). The second frequent sensitization was to grasses – 78 children (35.29%) *Alternaria* was the third relevant allergen - 60 children (27.15%). The most frequent causes of sensitization in monosensitized children were HDM and grass allergens (table 2).

It was determined that the number of sensitizations in polysensitized children varied from two to six. The distribution of number of patients based on number of sensitizations is presented in table 3.

The mean age of monosensitized and polysensitized children at the time of diagnosis was evaluated and compared: 8.86 years (SD 3.99) in monosensitized and 11.13 years (SD 4.32) in polysenitized (figure 1). Polysentized children were significantly older than monosensitized - ($p < 0, 001$).

The duration of symptoms before diagnosis of allergic rhinitis was analyzed: 2.39 years (SD 1, 76) in monosensitized children and 2.63 years (SD 1.75) in polysensitized children (fig. 2). No significant difference in

Table 3. Distribution of polysensitezed children with allergic rhinitis according to number of sensitization. (n – number of children)

number of sensitizations	n	%
2	62	60.19
3	33	32.04
4	2	1.94
5	5	4.85
6	1	0.97
	overall - 103	100 %

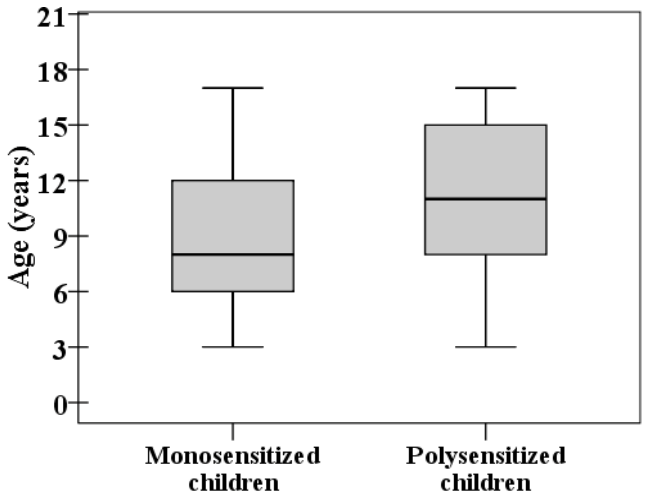

Figure 1. The mean age of mono and polysensitized children at the time of diagnosis.

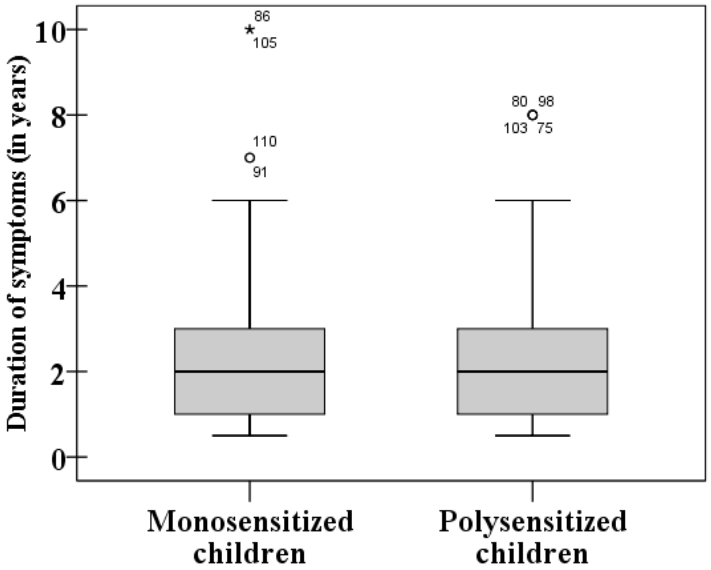

Figure 2. The duration of symptoms before diagnosis in mono and polysensitized children

duration of symptoms in either group was established ($p > 0.05$).

DISCUSSION

To characterize the sensitization of children with allergic rhinitis is clinically relevant and presents issues with practical significance. Our study was designed to highlight important considerations concerning Bulgarian children with AR that have not been explored previously.

There are publications demonstrating that mite allergen and grass pollen are the most relevant aeroallergens in both children and adults (Bousquet et al., 2007; Fasce et al., 2004; Esch, 1999). We confirmed the importance of those allergens. Sensitization to HDM allergen was the most relevant in both monosensitized and in polysensitized children with AR as demonstrated in the present study. The next sensitization in prevalence was to grasses. Almost all children sensitized to grasses were sensitized to cereals. This might be explained by the characteristics of those allergens.

It was interesting to identify the role of moulds, especially *Alternaria* in children with AR. Sensitization to moulds had been found to be associated with allergic rhinitis in clinical observations (Cantani and Ciaschi, 2004; Ciprandi et al., 2008; Ciprandi and Cirillo, 2011; Ciprandi et al., 2008; De Bot et al., 2013; Eigenmann et al., 2013; Esch, 1999; Fasce et al., 2007; Fasce et al., 2004; Gulbahar et al., 2003; Heinzerling et al., 2013; Hesselmar et al., 1999; Kim et al., 2006; Liu, 2006; Marogna et al., 2006; Migueres et al., 2011; Pavankar et al., 2011; Peternel et al., 2007; Platts-Mills et al., 2002; Randriamanantany et al., 2010). In our study we confirmed a link between *Alternaria* sensitization and allergic rhinitis in children. Although the data on population levels was insufficient, the results showed that *Alternaria* was the second sensitization in frequency among monosensitized children.

The study revealed a low prevalence of sensitization to pets. We found very few children with AR monosensitized to pets. The low rate could be explained by the relatively new phenomenon of pets in Bulgarian houses. Not as many households own pets in Bulgaria as in other European countries. Sensitization to cats was higher than dogs. It was connected to the characteristics of cat allergen, which could be detected even in houses without cats (Platts-Mills et al., 2002; Hesselmar et al., 1999; Gulbahar et al., 2003).

Ambrosia is known to be a relevant allergen in North America and recently in Europe (Peternel et al., 2007). In contrast to other European countries no sensitization to Ambrosia was detected either in monosensitized or in polysensitized children.

An important finding in our study suggested that polysenstised patients might have been allergic to multiple allergens from the very beginning of the disease. We observed that almost half of the patients were polysensitized at the time of diagnosis. Polysensitization is clinically significant and relevant from an epidemiological point of view, as recently reported in some surveys (Fasce et al., 2004; Ciprandi et al., 2008). The increase of sensitizations in patients seems to characterize the natural history of allergy. Ciprandi et al. estimated that percentage of polysensitized patients may widely range from 20 to 90% Ciprandi et al., 2008). Polysensitisation to multiple allergens occurs frequently in children with allergic rhinitis in general practice (De Bot et al., 2013). Polysensitization might also be associated with different clinical features compared with monosensitized patients, and especially with a more impaired quality of life and more severe symptoms (Ciprandi et al., 2008; Peternel et al., 2007).

We demonstrated that polysensitized patients were older than monosensitized, while the duration of symptoms for those two groups of patients was the same. This suggested that polysensitization is affected more by the age of appearance than by the duration of allergic rhinitis. Fasce cited that polysensitization was a secondary phenomenon that always followed monosensitization (Fasce et al., 2007). Another research of Ciprandi demonstrated that monosensitized patients might remain in that state over time and mono and polysensitized patient with allergic rhinitis could constitute two different categories (Ciprandi and Cirillo, 2011). Our results implied that most children are polysenstized from the very beginning of allergic rhinitis. It could be assumed that polysensitization is a definite phenotype.

Limitations of the Study

The limitations of the study include: (i) almost all patients lived around or in the second largest city in Bulgaria - Plovdiv. Plovdiv is situated in the south part of the country, on the border of the Continental Mediterranean climate zone which determines the distribution and relevance of allergens; (ii) only children, consulted by allergists were included; (iii) the number of patients was limited.

CONCLUSION

Our study demonstrated the high prevalence of sensitization to house dust mite and grass allergens of children with allergic rhinitis. Alternaria was also found to be a relevant allergen. We confirmed that polysensitization occurs frequently and depends upon the age of the children rather than the duration of symptoms. The results suggested that children with allergic rhinitis are polysensitized from the beginning of the disease and that polysensitization is its own phenotype. Further investigations are needed using broader and more

representational samples.

Conflicts of Interest

The authors declare that they have no conflicts of interest in relation to this article.

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