

PREVALENCE OF FOOD ALLERGIES IN THE POPULATION OF PRESCHOOL CHILDREN FROM THE CITY OF OSIJEK

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Original scientific paper

Summary

Introduction: Food allergy is an immune-mediated hypersensitivity to allergens in food. This allergy affects about 6-8% of children younger than three years, about 4% of school-age children and about 2% of the adult population in the world.

Aim: To investigate the prevalence of food allergies in the population of preschool children from the city of Osijek and to identify the most common causes of these allergies in the study population.

Materials and methods: This cross-sectional study was conducted during April and May 2007, among preschool children (mean age 5.9±0.7 years, 401/810, 49.5% of boys and 409/810, 50.5% of girls) attending kindergartens in Osijek. The 810 parents of mentioned children filled out the specially designed questionnaire. The questionnaire contained questions on age, sex and body weight of the child, the existence of a diagnosis of food allergy and type of food allergy.

Results: In the studied population of preschool children there were 5.4% (44/810) of children diagnosed with food allergies. The most common causes of food allergies in the study population were different food additives (40.9%), eggs (18.2%), peanut (13.7%), milk (9.2%) and honey, pesticides, fish and gluten with the same frequency of 4.5% each.

Conclusion: Food allergies often occur among preschool children from the city of Osijek with the particularly significant prevalence of allergic reactions to various food additives. In children with confirmed allergy to food ingredients, it is necessary to exclude such ingredient from the diet. In this sense, it is essential that manufacturers mark in detail the content of each foodstuff so that consumers can avoid eating those foodstuffs to which they are allergic.

Key words: food allergy, food additives, preschool children, Croatia.

Introduction

More than 20% of adults believe that they have an allergic reaction to food or food additive (artificial colorings, preservatives) (Turkalj and Mrkić, 2012). Reactions to foods are not new and have been described for two thousand years. The ancient Greek physician, Hippocrates, describes a reaction to milk in the 1st century. Anaphylactic reactions to egg and fish have been described as earlier as the 16th and 17th century (Cianferoni and Spergel, 2009).

Food allergy refers to an abnormal immunologic response to allergens in food, most frequently proteins, that occurs in a susceptible host. These reactions are reproducible each time the food

is ingested and they are often not dose dependent. Based on the immunological mechanism involved, food allergies may be further classified in: IgE-mediated, which are mediated by antibodies belonging to the Immunoglobulin E (IgE) and are the best-characterized food allergy reactions; cell-mediated when the cell component of the immune system is responsible for the food allergy and mostly involve the gastrointestinal tract; and mixed IgE-mediated-cell mediated when both IgE and immune cells are involved in the reaction (Lee and Burks, 2006; Nowak-Wegrzyn and Sampson, 2006; Cianferoni and Spergel, 2009; Sicherer and Sampson, 2009; Turkalj and Mrkić, 2012).

The prevalence of food allergies, as well as the

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prevalence of all allergic diseases appears to be rising, during last few decades, especially in developed countries (Cochrane et al., 2009). The incidence of the allergic reactions to food is associated with the type of diet, mode of food preparation, cultural and social factors inherent to particular countries and cultures. Anaphylactic reactions to food are one of the most important medical problems because they are one of the most common causes of systemic anaphylaxis that is life threatening and one of the most important reasons for seeking emergency medical care (Sampson, 2003). Food allergy is the leading cause of anaphylaxis treated in hospital emergency departments in Western Europe and the United States. Food allergy alone in the United States appears to account for approximately 30,000 anaphylactic reactions, 2,000 hospitalizations, and possibly 200 deaths each year. Furthermore, food allergy is the most common cause of anaphylaxis in children (Cianferoni and Spergel, 2009).

In majority of Western countries the most frequently occurring allergies are those to cow's milk protein, eggs, peanuts, nuts, fish, shellfish, flour and soya (Chapman et al., 2006). In children younger than three years the most common allergy is allergy to cow's milk proteins. This allergy in most allergic children (about 80% of them) disappears until the age of five, unlike peanut allergy in which only 20% of allergic children develops tolerance during adulthood. Some recent studies suggest that tolerance to certain food develops significantly slower. Accordingly, at the age of four, only 19% of children have become tolerant to cow's milk protein, 11% of children have become tolerant to egg protein, and only at the age of 16 years, about 80% of children have become tolerant to the protein of cow's milk and eggs (Savage et al., 2007; Skripak et al., 2007). The most common food allergies in children after the allergy to cow's milk proteins are the allergies to eggs, peanuts and flour, and in adults the most common food allergies are those to peanuts, nuts, fishes and shellfishes (Turkalj and Mrkić, 2012). Additionally, there are more and more concerns regarding the food additives as a potential allergens in children and adults although their adverse reactions seem to be very

rare in the general population (0.01-0.23%) but higher in atopic individuals (2-7%) (Randhawa and Bahna, 2009). Food additive means any substance not normally consumed as a food by itself and not normally used as a typical ingredient of the food, whether or not it has nutritive value, the intentional addition of which to food for a technological (including organoleptic) purpose in the manufacture, processing, preparation, treatment, packing, packaging, transport or holding of such food results, or may be reasonably expected to result, (directly or indirectly) in it or its by-products becoming a component of or otherwise affecting the characteristics of such foods (WHO and FAO, 2013).

Food allergy affects about 6-8% of children younger than three years, about 4% of school-age children and about 2% of the adult population in the world (Cianferoni and Spergel, 2009; Kolaček, 2011; Turkalj and Mrkić, 2012). Food allergies are, accordingly, more common in children and the prevalence of allergies is greater among younger children. To our knowledge, to this point, in Croatia there have been no studies aiming to determine the prevalence of food allergies in preschool children as one of the most vulnerable population subgroups concerning this issue.

The aim of this study was to investigate the prevalence of food allergies in the population of preschool children from the city of Osijek (Eastern Croatia) and to identify the most common causes of these allergies in the study population.

Materials and Methods

This cross-sectional study was conducted during April and May 2007, among parents of preschool children attending kindergartens in Osijek (Eastern Croatia). Participation in the study was voluntary, and the study was approved by the Ethics Committee of the Institute of Public Health for the Osijek-Baranja County. A total number of 1 378 specially designed questionnaires were delivered randomly to parents of preschool children attending kindergartens in Osijek. The overall response rate was 58.8% (810/1378), and all of the 810 completed questionnaires, were included in further statistical analyses.

The final sample size consisted of 810 preschool children mean age 5.9 ± 0.7 years, 49.5% (401/810) of boys and 50.5% (409/810) of girls. The questionnaire contained questions on age, gender and body weight of the child, the existence of a diagnosis of food allergy and type of food allergy.

Statistical analysis

Descriptive statistics were used for data processing and analyzed using SPSS Statistical Package for Windows, version 13.0 (SPSS Inc., Chicago, IL, USA).

Results and Discussion

The study sample consisted of 810 preschool children, 49.5% (401/810) of boys aged 5.9 ± 0.7 years and 50.5% (409/810) of girls aged 5.8 ± 0.7 years. The overall prevalence of food allergies in the studied population was 5.4% (44/810).

The most common causes of food allergies in the study population were different food additives (40.9%; 18/44), eggs (18.2%; 8/44), peanut (13.7%; 6/44), milk (9.2%; 4/44) and honey, pesticides, fish and gluten with the same frequency of 4.5% (2/44) each (Table 1).

Table 1. The most common causes of food allergies among six years old preschool children from Osijek (Eastern Croatia).

Causes of food allergy	Preschool children with food allergy N (%)
Food additives	18 (40.9)
Eggs	8 (18.2)
Peanut	6 (13.7)
Milk	4 (9.2)
Honey	2 (4.5)
Pesticides	2 (4.5)
Fish	2 (4.5)
Gluten	2 (4.5)
Total	44

The majority of data currently available on food allergy prevalence among children are only based on self-reporting or parent reporting questionnaire data like the data from this study, although there are some regions of the world such as Central and South America, Africa, Eastern Europe and the Middle East where food allergy prevalence data (of any kind) are still lacking (Prescott et al., 2013).

This study revealed that the overall prevalence rate of food allergy among six years old preschool children from Osijek (Eastern Croatia) was 5.4% that is in compliance with the prevalence established among preschool children from Portugal and Turkey (5.7%) but higher than the prevalence established among preschool children from Korea (3.7%), Japan (3.6% to 4.8%) and Hong Kong (4.8%) (Orhan et al., 2009; Ho et al., 2012; Kusunoki et al., 2013; Gaspar-Marques et

al., 2014; Park et al., 2014). Similarly to the latter ones the self/parent-reported prevalence of food allergy in some European countries, such as Austria, Slovenia, Switzerland, Greece and Belgium has also been less than 5.0% in some studies that is also in contrast with the results obtained in this study among Croatian preschool children from Eastern Croatia (Steinke et al., 2007). Also in contrast to the results of this study there are some studies that showed higher prevalence of food allergy in children. In Canada and the USA, for example, survey reports suggest childhood food allergy prevalence rates of around 7-8%, with similar or even higher rates reported in some European countries such as Spain, Poland, Finland and the Netherlands (Brugman et al., 1998; Steinke et al., 2007; Fernández Rivas, 2009; Gupta et al., 2011).

The most common causes of food allergy in the

study population were different food additives (40.9%), eggs (18.2%), peanut (13.7%), milk (9.2%) and honey, pesticides, fish and gluten with the same frequency of 4.5% each. These findings are somewhat different from the results of similar studies conducted elsewhere because in these studies the food additives, pesticides, honey and gluten were not reported as a possible cause of allergic reactions (Steinke et al., 2007; Orhan et al., 2009; Fernández Rivas, 2009; Gupta et al., 2011; Ho et al., 2012; Park et al., 2014).

The prevalence of allergic reactions to eggs ranged between 13.6% and 20.2% (Steinke et al., 2007; Fernández Rivas, 2009; Orhan et al., 2009; Ho et al., 2012; Park et al., 2014) that is similar to the prevalence established in this study. The prevalence of allergic reactions to peanut established in this study was higher than those established in the studies conducted in Korea (9.3%) and Hong Kong (8.5%), but lower than the prevalence established in the United States (25.2%) (Gupta et al., 2011; Ho et al., 2012; Park et al., 2014). When comparing the prevalence of allergy to cow's milk established in this study (9.2%) with those established in similar studies conducted elsewhere it is evident that this allergy is less frequent among six year old children from Eastern Croatia than among children of similar age from Korea (31.4%), the United States (21.1%), Turkey (18.1%) and Spain (13.9%) but similar, although still slightly lower, than the prevalence established among children of similar age from Hong Kong (10.8%) (Fernández Rivas, 2009; Orhan et al., 2009; Gupta et al., 2011; Ho et al., 2012; Park et al., 2014). The above mentioned foodstuffs are especially important bearing in mind that those are the three leading causes of food-induced anaphylaxis among children (Park et al., 2014).

It is interesting that majority of studies conducted elsewhere have recognized fruits as an important potential cause of allergic reactions while that was not case in this study. Accordingly, parent's reported prevalence of allergic reactions to fruits among children from Korea, Austria, Belgium, Denmark, Finland, Germany, Greece, Italy, Poland, Slovenia, Switzerland and Spain ranged between 18.4% and 33.3% (Steinke et al., 2007; Fernández Rivas, 2009; Park et al., 2014). This

is possible explanation for the extremely high reported prevalence of allergy to various food additives among children from Eastern Croatia. Namely, all parents of the children with allergic reactions to foods containing canned fruit and fruit juices have reported that their children are allergic to food additives, and it is likely that the majority of them are actually allergic to some kind of fruit contained in the product that initiated an allergic reaction.

Furthermore it is interesting that studies conducted elsewhere in the world have frequently recognized fish and shellfish as potential causes of allergic reactions in children while none of the children in this study was allergic to shellfish and only 4.5% of them to fish (Fernández Rivas, 2009; Gupta et al., 2011; Ho et al., 2012; Park et al., 2014). This finding can easily be explained with dietary habits in Croatia, because it is well known that the fish consumption in Croatia is relatively low especially in Eastern Croatia whereby the population of Eastern Croatia has worse dietary habits in relation to the population of other regions (Pucarín-Cvetković et al., 2010; Periš et al., 2012).

This study has several limitations that should be considered when evaluating the obtained results. One of the refers to the lack of application of the specially designed questionnaire that would serve as a tool for collecting additional data concerning the subjects' personal and family history and information about possible risk factors for the occurrence of food allergy among each of them. Also because of the sensitivity of parents in regard to some types of foodstuffs and their ingredients such as food additives it is possible that some causes of allergic reactions such as latter ones were unconsciously been more reported than other ones that maybe even have far larger allergic potential.

Nevertheless, this study, as a first study in Croatia dealing with the issue of food allergy in children has certainly provided some valuable data regarding this problem in Croatia. Hopefully, there will be more similar studies in other Croatian regions that will help creating the broader picture of this issue with some new insights. All of this can be important part of promotion of the food allergy awareness for health policy and

health care system to better anticipate the growing impact and growing need for better services, community education and training to cope with this rising global health issue.

Conclusions

The results of this study have confirmed that food allergies are important issue among preschool children in Croatia. Bearing in mind that food allergy continues to increase in prevalence in many countries, one can say that the problem of food allergy is becoming a major public health issue, with practical implications for the food industry, educational establishments and healthcare systems.

In this sense, it is essential that manufacturers mark in detail the content of each foodstuff so that consumers can avoid eating those foodstuffs to which they are allergic. But it is also necessary to further educate consumers regarding the potential of particular foodstuff to initiate the allergic reactions and also to continuously educate health care workers in order to enable them to timely recognize and adequately treat allergic reactions, especially those that can potentially be life-threatening, such as anaphylaxis.

Literature

1. Brugman E, Meulmeester JF, Spee-van der Wekke A et al (1998) Prevalence of self-reported food hypersensitivity among school children in The Netherlands. *Eur J Clin Nutr* 52:577–581
2. Chapman JA, Bernstein IL, Lee RE et al (2006) Food allergy, a practice parameter. *Ann Allergy Asthma Immunol* 96:S1–68
3. Cianferoni A, Spergel JM (2009) Food allergy: review, classification and diagnosis. *Allergol Int* 58:457–466
4. Cochrane S, Beyer K, Clausen M et al (2009) Factors influencing the incidence and prevalence of food allergy. *Allergy* 64:1246–1255
5. Fernández Rivas M (2009) Food allergy in Alergológica-2005. *J Investig Allergol Clin Immunol* 19(Suppl 2):37–44
6. Gaspar-Marques J, Carreiro-Martins P, Papoila AL et al (2014) Food Allergy and Anaphylaxis in Infants and Preschool-Age Children. *Clin Pediatr (Phila)* 53:652–657
7. Gupta RS, Springston EE, Warrier MR et al (2011) The prevalence, severity, and distribution of childhood food allergy in the United States. *Pediatrics* 128:e9–e17
8. Ho MH, Lee SL, Wong WH et al (2012) Prevalence of self-reported food allergy in Hong Kong children and teens--a population survey. *Asian Pac J Allergy Immunol* 30:275–284
9. Kolaček S (2011) Preosjetljivost na hranu u dječjoj dobi. *Acta Med Croatica* 65:155–161
10. Kusunoki T, Morimoto T, Sakuma M et al (2013) Effect of eczema on the association between season of birth and food allergy in Japanese children. *Pediatr Int* 55:7–10
11. Lee LA, Burks AW (2006) Food allergies: prevalence, molecular characterization, and treatment-prevention strategies. *Annu Rev Nutr* 26:539–565
12. Nowak-Węgrzyn A, Sampson HA (2006) Adverse reactions to foods. *Med Clin North Am* 90:97–127
13. Orhan F, Karakas T, Cakir M et al (2009) Prevalence of immunoglobulin E-mediated food allergy in 6-9-year-old urban schoolchildren in the eastern Black Sea region of Turkey. *Clin Exp Allergy* 39:1027–1035
14. Park M, Kim D, Ahn K et al (2014) Prevalence of immediate-type food allergy in early childhood in Seoul. *Allergy Asthma Immunol Res* 6:131–136
15. Periš D, Miškulin M, Šincek D (2012) Povezanost socio-ekonomskog statusa i indeksa tjelesne mase umirovljenica s područja Osječko-Baranjske županije. *Med Jad* 42:103–109
16. Prescott SL, Pawankar R, Allen KJ et al (2013) A global survey of changing patterns of food allergy burden in children. *World Allergy Organ J* 6:21
17. Pucarín-Cvetković J, Kern J, Vuletić S (2010) Regionalne karakteristike prehrane u Hrvatskoj. *Acta Med Croatica* 64:83–87
18. Randhawa S, Bahna SL (2009) Hypersensitivity reactions to food additives. *Curr Opin Allergy Clin Immunol* 9:278–283
19. Sampson HA (2003) Food allergy. *J Allergy Clin Immunol* 111:540–547
20. Savage JH, Matsui EC, Skripak JM et al (2007) The natural history of egg allergy. *J Allergy Clin Immunol* 120:1413–1417
21. Sicherer SH, Sampson HA (2009) Food allergy: recent advances in pathophysiology and treatment. *Annu Rev Med* 60:261–277
22. Skripak JM, Matsui EC, Mudd K et al (2007) The natural history of IgE--mediated cow's milk allergy. *J Allergy Clin Immunol* 120:1172–1177

23. Steinke M, Fiocchi A, Kirchlechner V et al (2007) Perceived food allergy in children in 10 European nations. A randomised telephone survey. *Int Arch Allergy Immunol* 143:290–295
24. Turkalj M, Mrkić I (2012) Alergijske reakcije na hranu. *Liječ Vjesn* 134:168–173
25. World Health Organization (WHO)/Food and Agriculture Organization of the United Nations (FAO) (2013) *Codex Alimentarius Commission, procedural manual*. 21st edition. WHO/FAO, Rome