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Frequency and type of nutritional allergies in preschool children

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Abstract

Food allergy is a very current health problem that tends to constantly increase the number of sufferers. The most common nutritional allergens, which are responsible for more than 90% of adverse reactions, are proteins from cow's milk, eggs, peanuts, nuts, soy, wheat flour, fish and marine molluscs, arthropods and cephalopods. The goal of the research was to determine the frequency and type of nutritional allergies in preschoolers aged 2-6 years. As a research method, a cross-sectional study was used, which was carried out at the "Dr. Sima Milosevic" preschool institution. A comparative descriptive analysis of medical records in the institution was used and the number of children with nutritional allergies and the type of nutritional allergies was determined in relation to 4123 children aged 2-6 years. A specially created survey questionnaire for parents was used as a research instrument, which collected data on nutritional allergies. Statistical data processing was done in the SPSS Windows version 25 software package. Descriptive and analytical statistics methods were used in statistical data processing. Of the total number of

children, 1% had a nutritional allergy. The results obtained in the examined group show that the frequency of nutritional allergies is to milk and eggs, with boys to milk and eggs, and girls to milk, peanuts, and tree nuts. The data show the importance and need for monitoring and adequate marking of the declaration on products.

Key words: *nutritional allergy; cross-sectional study; preschool children.*

INTRODUCTION

Food allergy is a very current health problem that tends to constantly increase the number of sufferers. Although it occurs at any age, it most often affects children under the age of three, estimating that 4% of children have a food allergy, with this number increasing significantly in recent decades [1]. It has been found that 8% of children develop food allergies early in life, which is a vital period of growth and development [2].

The most common nutritional allergens, which are responsible for more than 90% of adverse reactions, are proteins from cow's milk, eggs, peanuts, nuts, soy, wheat flour, fish and marine mollusca, arthropods, and cephalopods [3]. Previous studies suggest that nutri-

tional allergies to milk, or milk proteins, are positively correlated with malnutrition and lower body weight in children [4,5]. Clinical manifestations of allergic intolerance to food antigens can be different.

Nutritional allergies are clinical reactions to food proteins that manifest on the skin, digestive, and respiratory systems. The development and phenotypic expression of atopic diseases depend on a complex interaction between genetic factors, exposure to environmental allergens and non-specific factors, such as tobacco smoke, air pollution, and infections [6].

In the last few decades, there has been an increase in the prevalence of IgE-mediated food allergy. For an effective prevention strategy, it is necessary to determine the causal factors that encourage this growth.

Genetic factors are clearly important in the development of nutritional allergies, but given the dramatic increase in prevalence over a short period of time, it is unlikely that food allergy appears as a germline genetic change [7].

Greater exposure to environmental allergens, or the lack of them, induces epigenetic changes that result in reduced immunity.

Nutritional allergies affect the quality of life of patients and their families and represent a significant financial burden [7].

There are many risk factors associated with the development of food allergies, including atopic family history, sex, atopic dermatitis, and related genetic polymorphisms. Although genetic factors are important in the development of food allergy, their increasing prevalence implies that food allergy does not appear as a result of genetic changes. There are several factors that can cause epigenetic changes, including diet, intrauterine environment, and lifestyle, which can play a role in gene expression through epigenetic modification [7].

Allergens can be found in various foods. According to our law "Regulations on declaration, labeling, and advertising of food" mandatory allergens that must be declared on food products are defined [8].

Food allergy symptoms usually begin within minutes to half an hour after consuming a minimal amount of the food allergen [9]. The severity of symptoms is influenced by the age of the patient, the speed of food absorption, and physical effort [10]. Nutritional allergies mediated by IgE are clinically divided into those with sudden onset and manifested immediately after food intake (urticaria, angioedema, anaphylactic shock, asthma, oral allergy syndrome, gastrointestinal allergy) and syndromes with early and delayed onset (eczema, atopic dermatitis, and eosinophilic gastroenteritis) [9]. In patients with non-IgE or mixed IgE/non-IgE type hypersensitivity, symptoms may appear hours or days after food intake [10].

A cow's milk allergy is a reaction of the immune system to cow's milk proteins. An immune reaction occurs due to the interaction of one or more milk proteins with one or more immune mechanisms and as a result, an allergic reaction mediated by immunoglobulins (IgE) occurs [6]. The body's immune reactions occur between 1 minute and 2 hours after food intake. Allergy to cow's milk proteins occurs in early childhood and is found in 2-3% of children, mostly in infants and small children. The most common proteins that cause milk allergies in children are alpha-albumin, less often casein, and in adults it is alpha-globulin [11]. Eggs are very often the cause of nutritional allergies, due to numerous proteins (ovalbumin, ovomucoid, ovomucin, and lysozyme) [11].

Most people with food allergies develop a tolerance in childhood. For egg allergy, 30% of patients acquire tolerance before the age of 3 years, and 73% acquire tolerance before the age of 6 years. Egg allergy is one of the most common food allergies in children. Egg whites contain ovomucoid and ovalbumin, and they are the main allergens in the egg [12].

Peanut allergy occurs in about 0.5-1% of the adult population and 0.5% of children. It has not been scientifically proven that hypersensitivity can also occur intrauterine, but for this purpose, pregnant women who have a predisposition to allergies or the child's father has allergic asthma are advised to avoid peanuts and peanut products during pregnancy [11]. Very often, peanut allergy is associated with allergies to stone fruits (walnuts, almonds, hazelnuts, pistachios, chestnuts) because the proteins of these two types of fruit are very similar. This allergy occurs in even 1-2% of the population, usually in the first years of life, and in about 80% of sufferers, it remains for the rest of their lives [11].

One of the most common causes of food allergy is fish and fish products, crustaceans and crustacean products, shellfish, and other mollusca. The most common fish allergies are salmon. Salmon protein is composed of 113 amino acids. Asthma attacks can occur even by inhaling the smell of fish. The allergen responsible for this reaction is tropomyosin from fish muscles and the protein parvalbumin [10].

Gluten is a heterogeneous mixture of gliadin and gluten proteins in wheat, rye, barley, and oats. The most important amino acids that make up gluten are glutamine (30%) and proline (10%). Based on the high content of glutamine, gluten is rich in nitrogen, which is necessary for seed germination, and the high content of proline makes gluten resistant to degradation by gastrointestinal enzymes and thus allows large gluten peptides to reach the surface of the mucosa and promote the development of inflammatory and immune reactions [13].

The aim of the research was to examine the frequency and types of nutritional allergies in children aged 2-6 years.

METHOD

The research was carried out as a cross-sectional study that took place in the "Dr. Sima Milosevic" preschool institution. The children who were examined are enrolled and stay in the preschool institution Dr. Sima Milosevic, where they are provided with services of social protection, care, educational work, and nutrition. Preschool institution Dr. Sima Milosevic is located on the territory of the municipality of Zemun, which includes,

in addition to the central core of Zemun, the suburban settlements of Galenika, Zemun polje, Altina, Batajnica and Ugrinovci. The children and mothers who were questioned live in the territory of the municipality of Zemun. A comparative descriptive analysis of medical records in the institution was used and the number of children with nutritional allergies and the type of nutritional allergies was determined in relation to 4123 children aged 2-6 years.

A specially created survey questionnaire for parents was used as a research instrument. The questionnaire designed for this research collected data on the sex and age of the child, as well as data on nutritional allergies.

Statistical data processing was done in the SPSS Windows version 25 software package. Descriptive and analytical statistics methods were used in statistical data processing. Descriptive statistical methods included absolute and relative numbers, measures of central tendency (arithmetic mean), and measures of dispersion (SD). Analytical statistical methods were used to test the significance of the difference using the Chi-square test (contingency table) to test the significance of the differences, with a significance level of 0.05.

RESULTS

The largest number of children are in the age group of 6-7 years, which also includes children attending the preparatory preschool program, a total of 2432 children, or 59%. Out of the total number of children, 41 children or 1% of children have nutritional allergies. Most children with nutritional allergies are represented in the age group of 4-5 years, i.e. 0.43% of allergic children, followed by 0.30% in the age group of 2-3 years and 0.27% in the age group of 6-7 (**Table 1**)

Table 1. Frequency of nutritional allergies according to the age group.

Age groups	Number of children (N)	Total number of children expressed in %	Number of children with nutritional allergies by age group	Allergic children expressed in %
2-3	989	24%	12	0.30%
4-5	702	17%	18	0.43%
6-7	2432	59%	11	0.27%
Total	4123	100%	41	1%

The largest number of children are allergic to milk (51.2%) and eggs (9.8%), peanuts, and nuts. The smallest number of children are allergic to wheat flour (gluten) and honey (7.3%). Other allergies (leguminoses) are represented in 2.4% of cases (**Table 2**).

Table 2. Distribution of nutritional allergies according to the types of food to which children are allergic.

Type of food	Frequency	Valid Percentage %	Cumulative Percentage %
Milk	21	51.2	51.2
Eggs	4	9.8	61.0
Fish and sea-food	1	2.4	63.4
Peanuts	4	9.8	73.2
Stone fruit	4	9.8	82.9
Wheat flour	3	7.3	90.2
Other	1	2.4	92.7
Honey	3	7.3	100.0
Total	41	100.0	

Allergies are more common in boys than in girls (26 vs 15). In boys, allergies to milk and eggs are most common, and in girls to milk, peanuts, and tree nuts. These differences did not show statistical significance ($p = 0.857$, $\chi^2 = 3.285$, $df = 7$, $p > 0.05$) (**Table 3**).

Table 3. Types of allergenic foods classified by gender.

Type of food								Total
Milk	Eggs	Fish and seafood	Peanuts	Stone fruit	Wheat flour	Other	Honey	
14	3	0	2	2	2	1	2	26
7	1	1	2	2	1	0	1	15
21	4	1	4	4	3	1	3	41

The represented age group is from 2-6 years old and one child is seven years old but still stays in preschool. The most allergic boys are aged 5 and 6, followed by 4 and 2. The most allergic girls are aged 5, followed by 4 and 3. There is no statistically significant difference between the gender and age distribution of allergic children. There are more boys than girls and they are older on average than girls ($\chi^2 = 5.354$, $p > 0.05$, $df = 5$) (**Table 4**).

Table 4 Distribution by gender and age.

Gender	Age						Total	p
	2.00	3.00	4.00	5.00	6.00	7.00		
Male	5	3	5	6	6	1	26	0.05
Female	0	4	2	5	4	0	15	
Total	5	7	7	11	10	1	41	

The most allergic children are five-year-olds (11), followed by six-year-olds (10). An equal number of allergic children are three and four years old. Most children are allergic to milk (21), followed by eggs, peanuts, and tree nuts. These differences did not show a significant difference (**Table 5**).

Table 5. Distribution of allergies according to type of food in relation to age.

Age	Food type								Total
	Milk	Eggs	Fish and seafood	Peanuts	Stone fruit	Wheat flour	Other	Honey	
2.00	3	1	0	0	0	0	0	1	5
3.00	4	1	0	1	0	1	0	0	7
4.00	5	0	0	0	0	2	0	0	7
5.00	7	0	1	1	1	0	0	1	11
6.00	2	2	0	2	2	0	1	1	10
7.00	0	0	0	0	1	0	0	0	1
Total	21	4	1	4	4	3	1	3	41

DISCUSSION

In the last ten years, the number of children with allergic reactions is constantly increasing. For the development of allergic manifestations, not only genetic factors such as the atopic status of the parents are responsible, but also environmental factors, i.e. “in utero” exposure to the environment: diet and maternal obesity, smoking and use of drugs during pregnancy, season of birth, gestational maturity, etc. [11].

A large meta-analysis of nutritional allergies in Europe determined the overall prevalence of nutritional allergies in the period from 2000 to 2012 and it is 5.9% [14]. Hereditary factors play a significant role in the risk of food allergies, and it is estimated that it can range from 40 to 80 depending on the number of family members with food allergies [14].

Diet plays an important role in the development of nutritional allergies. Adequate nutrition for the mother is a prevention of the appearance of nutritional allergies in children and it should be rich in fruits, vegeta-

bles, fish, milk, butter and foods rich in vitamin D. The nutrition of the child that starts from breastfeeding is very important, as well as the time of introducing foods into the diet for the onset of allergies [15].

It has been proven that the avoidance of allergens by expectant mothers does not have a protective role. Foods with various types of probiotics should be included in the child’s diet in order to prevent the development of atopic disease. Eating fresh fruits and vegetables in the first year of life also has a protective role. Children who ate fish during the first year of life were also less likely to develop nutritional allergies later in life. Primary allergenic foods that are present in children’s diets, such as milk, eggs, wheat, and soy, are also present in many industrial foods. Therefore, children with nutritional allergies may have a lower body weight because a large number of foods are excluded without consulting a professional.

An elimination diet is used as the main medical nutritional therapy with the use of an adequate supplemental substitute for the food to which the child is allergic [15].

The immune system is a key factor in the body’s defense that protects the body from various infectious pathogens of bacteria, viruses, fungi, and parasites. Lymphocytes participate in the body’s defense forces, which act throughout the body through the lymphatic system and bloodstream [16].

Cow’s milk is often an allergenic food for children. Milk allergy is diagnosed by the presence of Immunoglobulin E (IgE). It often occurs in the first year of life. The symptoms that do occur are almost exclusively gastrointestinal and have not been associated with IgE. Most milk allergies have stopped by the time of adolescence at 16 years of age. Twice as many girls as boys report allergy symptoms at the beginning of adolescence, especially gastrointestinal symptoms. Milk-allergic children with persistent symptoms have both a higher prevalence and higher levels of IgE, compared to other phenotypes [9]. and breastfeeding infants with human milk for up to six months is considered the main form of prevention.

There are many potential allergens in eggs, specifically, egg whites contain 23 different glycoproteins, and most of them have been purified. Egg whites are the main source of egg allergens, which include ovomucoid, ovalbumin, ovotransferrin, and lysozyme. Ovomucoid is the dominant allergen in eggs and it is thermostable and retains its allergenic properties even after heating. In contrast, the ovalbumin found in the egg white is thermolabile and reduces its allergenic properties after thermal processing. Children who are

allergic to ovomucoid have a high hypersensitivity, while children who are not allergic to ovomucoid have a high tolerance to boiled eggs [17].

Food allergies can cause various symptoms, and in some rare cases, pancreatitis can occur [18]. Allergy to peanuts and tree nuts is characterized by IgE-mediated reactions to nut proteins. Allergy to nuts is present in all ages and populations. Limited epidemiological data indicate different prevalence in different geographical areas. Primary nut allergy affects more than 2% of children and 0.5% of adults in the UK. Children with severe eczema and egg allergy have a higher risk of peanut allergy. Primary nut allergy most often appears in the first five years of life. Clinical diagnosis of primary nut allergy can be determined by the presence of specific IgE Ig, which is determined by a positive skin test or specific IgE test. Since the nut allergy is lifelong, it is necessary to eliminate the nut from the diet. It is necessary to educate patients about the presence of walnuts in various industrial products [19].

The proteins found in fish are very different; however, some pan-allergens, including parvalbumin, troponomyosin, and arginine kinase, cause immunological and clinical cross-reactivity [20]. The clinical picture of seafood allergy is similar to other food allergies. Single or multiple symptoms usually appear immediately or within two hours of exposure; however, they can occur eight hours after consuming fish. Allergies are most often manifested after eating the fleshy part of fish, although allergies can be manifested when eating any part of fish [12].

Recently, some global regulatory agencies have begun to require quantitative analysis of individual allergens, including non-permitted allergens, as part of the risk assessment for genetically modified soy products. The results of this study confirmed that b-conglycinin and glycinin are the two main clinically important soy allergens [13].

The three main principles for the treatment of allergic diseases in children are avoidance of allergens, treatment of inflammation, and symptomatic treatment [21]. The drugs used for the treatment of nutritional allergy are histamines and systemic corticosteroids, and in case of anaphylactic shock, adrenaline [21]. However, in the treatment of nutritional allergies, avoidance of allergenic foods and administration of emergency medications after accidental exposure to the allergen are most often used [17].

An elimination diet is a medical nutritional therapy where the intake and quantity of liquids, food, and drugs are controlled, and the composition of food and drink components is monitored. It is very important to monitor the time and types of foods that are consumed, as well as the symptoms that occur, their duration, as well as whether insomnia occurs [22]. This type of elimination diet is effective in food sensitivities and acute nutritional allergies. In children with a chronic

form of nutritional allergy, the child's recovery may take up to several months. After all the symptoms have disappeared, foods suspected to be allergens should be introduced into the diet, with constant supervision and monitoring of clinical signs of hypersensitivity with laboratory diagnostics [21].

Study limitations

The study had certain limitations, primarily related to the study design as well as the number of examined children.

CONCLUSION

The results obtained in the examined group show that the frequency of nutritional allergies is to milk and eggs, with boys to milk and eggs, and girls to milk, peanuts, and tree nuts. The data show the importance and need for monitoring and adequate marking of the declaration on products.

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Učestalost i vrsta nutritivnih alergija kod dece predškolskog uzrasta

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Kratak sadržaj

Alergija na hranu je veoma aktuelan zdravstveni problem koji ima tendenciju konstantnog povećanja broja obolelih. Najčešći nutritivni alergeni koji su odgovorni za više od 90% neželjenih reakcija, jesu proteini kravljeg mleka, jaja, kikirikija, jezgrastog voća, soje, pšeničnog brašna, ribe i morskih mekušaca, zglavkara i cefalopoda. Cilj istraživanja bio je da se utvrdi učestalost i vrstu nutritivnih alergija kod predškolske uzrasta od 2-6 godina. Kao metod istraživanja korišćena je studija preseka koja se obavila predškolskoj ustanovi „Dr Sima Milošević“. Korišćena je komparativna deskriptivna analiza zdravstvene dokumentacije u usta-

novi i utvrđen je broj dece sa nutritivnim alergijama i vrstom nutritivnih alergija u odnosu na 4123 dece uzrasta od 2-6 godine. Kao instrument istraživanja korišćen je posebno kreiran anketni upitnik za roditelje kojim su prikupljeni podaci o nutritivnim alergijama. Statistička obrada podataka je bila urađena u programskom paketu SPSS Windows verzija 25. U statističkoj obradi podataka bile su korišćene metode deskriptivne i analitičke statistike. Od ukupnog broja dece 1% imao je nutritivnu alergiju. Dobijeni rezultati u ispitivanoj grupi pokazuju da je najveća učestalost nutritivnih alergija na mleko i jaja, pri čemu kod dečaka na mleko i jaja, a kod devojčica mleko, kikiriki i orašasti plodove. Podaci pokazuju značaj i potrebu praćenja i adekvatnog obeležavanja deklaracije na proizvodima.

Ključne reči: nutritivna alergija; studija preseka; deca predškolskog uzrasta.