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EVALUATION OF ELIMINATION DIETS, APPLIED IN ALLERGY AND FOOD INTOLERANCE TREATMENT IN CHILDREN

Review: **Dorota Żyżlewicz, Ph. D.**

Data of an evaluation of daily alimentary rations in 49 children, aged between 1 and 3 years, with food allergy and in children with both allergy and food intolerance, was compared with 25 healthy controls. That evaluation revealed too many restrictions in product selection for dietary consumption on one hand, without simultaneous correction of dietary levels of necessary elements on the other. The highest abnormalities in the consumption of nutrients were observed in the strictly limited diet of children with allergy and food intolerance, resulting from constant consideration of possible atopic symptoms, feared to occur, when the range of consumed products was in any way extended. The examined elimination diets have been poorly balanced, considering the energetic values, the contents of proteins, fat, carbohydrates, vitamins and microelements.

Introduction

The most frequent food allergens include cow milk proteins, present in elementary products, used in the nourishment/alimentation of young children. The cause of systemic oversensitivity may be traced in each of the five major protein fractions of cow milk, out of which, β lactoglobuline sensitizes most frequently, while it is not present in human milk [1-4]. However, an allergic person is usually sensitive to

more than one antigen and the clinical symptoms are not connected with any single organ but with the whole system, sometimes even expressing cytotoxic reactions. It is worth remembering that the clinical symptoms, observed after milk consumption, may result not only from protein allergy but also from intolerance of milk sugar – lactose [5,6]. The substances with a potential to induce adverse immunological reactions in the organism are also found in vegetable products. Grain proteins – glutens – cause allergic reactions most frequently. Gluten is responsible not only for food allergy but also for food intolerance, which is either temporary, imposing an immediate necessity of gluten-free diet or permanent celiac disease, demanding life time dietetic treatment [7].

Clinical confirmation of allergy or food intolerance is followed by a question of appropriate diet control to suppress undesired symptoms, as well as, in case of a young organism, to assure proper growth and development. An elimination diet, completed with nutritional values, should be the right answer [8-11]. On the other hand, elimination diet is rather difficult, when the elimination involves too wide a range of products, which normally provide young organism with properly balanced diet, ensuring right somatic development and nourishment status [8, 12, 13]. Uncontrolled elimination diet may lead to either overt or concealed nutritive deficiency, its consequences, especially in young children, likely leading to a number of diseases, both in childhood and adulthood.

The above questions had become the leitmotiv for the research, reported in this paper and aimed at evaluating 24 hour food rations for children with food allergy and children with both allergy and food intolerance, in order to estimate the levels of used energy and of selected nutritive ingredients with strong impact on child's growth and development.

Materials and Methods

An evaluation of the nourishing mode was undertaken in a group of 49 children at the age from 1 to 3 years with previously diagnosed allergy for cow milk proteins, who had been on elimination diet since the first months of their life. The results were juxtaposed with a control group of 25 healthy children.

All examined children fit into the wide centile chart medical norm. Percentage of girls and boys in every group was similar. Average body mass in each of the examined groups (presented in a table) was at the level indicated by reference values 10-15 kg for age group 1 – 3. [Ziemiański et al.]. No statistically relevant difference between the groups was reported either for body mass or the age of the children examined.

Table 1

Characteristics of the studied children

	Age Mean±SD	Body mass Mean±SD
Group I	1,5±0,6	11,3±2,6
Group II	1,7±0,5	11,8±2,6
Group III	1,9±0,9	10,2±2,8
Group IV	1,8±0,6	12,5±2,6

The research was carried out between the years 2004 and 2006, involving patients of allergological out-patient clinics in Lodz, Poland. The local ethics committee (in Polish Mother's Memorial Hospital – Research Institute, Lodz) approved the study. In order to obtain the most reliable nourishment picture, the children were divided into three groups, whereas the fourth group (control) included healthy children only:

Group I – 23 children with food allergy

All children from this group suffered only from food allergy to cow milk proteins. Due to genetic affinity, elimination in diet also related to beef meat proteins.

Group II – 16 children with food and inhalatory allergy

All children exhibited food allergy (to a number of ingredients) and inhalatory allergy at the same time. This included the following:

– 35% children were allergic to cow milk proteins, and moreover – suffered from food allergy to: soy (50%), gluten (80%), rice, eggs, (10%) celery, as well as inhalatory allergy to grass (100%) and cereal (100%) (different for individual persons), trees (50%), house dust mite (30%), molds (20%)
– 65% children were food-allergic to egg proteins (50% allergic to egg yolk), including allergies to soy (20%), pork meat, cherries, gluten (80%), celery (20%), as well as exhibited inhalatory allergy to: grass (100%) and cereal (wheat, rye) (87%), trees (48%), house dust mite (25%), molds, fungi (45%).

Group III – 10 children with allergy and food intolerance

All children exhibited food allergy (to a number of ingredients) and food intolerance at the same time. This includes:

– food allergy: (100%) nuts, (100%) cocoa, (20%) tomatoes, (10%) apples, (40%) soy, (100%) citrus fruit, (30%) egg yolk, (10%) cow milk proteins,
food intolerance: (100%) lactose, (90%) saccharose, (90%) maltose.
There were no coeliac disease-afflicted children in group III.

Group IV (control group) – 25 healthy children.

The criteria for such a division resulted from general medical examination and allergological tests.

IgE allergen-specific antibodies from all examined children were determined (antibodies directed against proteins: cow milk, soy, egg proteins, various kinds of meat, cereal etc.). Patch tests were conducted for 3-years-old.

Hydrogen tests were used to determine deficiency of disaccharidases in biopsy material from small intestine for children with food intolerance (group III).

The consumption level of nutritive components was estimated from reported 24-hour nutritional intake, the observation being continued for 7 consecutive days. Altogether, 518 surveys were collected. The evaluation of the quantity and quality of consumed products was done on the basis of the data from the "Album of photos of food products and dishes" [14]. Before the study onset, each child's parent or tutor was instructed how to fill in the questionnaire form with data from the survey. In order to facilitate proper description of meals, an annex was enclosed to the questionnaire form, specifying the most common nutrition products, including their amounts in grams and respective household measures. An analysis of the survey results was carried out on the basis of an individually programmed application in the Microsoft Access 2000 format (Przysławski, oral information), which ensured full configuration and free access to the database, made from "The tables of composition and nutritional value of food, complemented with milk substitutes" [15]. Questions were defined, concerning the nutritional value of elimination diet, using the graphic interface of SQL (Structured Query Language). The standards, proposed by the Institute of Food and Nutrition, Warsaw [16], were used for the estimation of how much the evaluated elimination diet met the requirements. Individual interviews were made with people responsible for nutrition of each child. Regarding vitamins, the following correction values were applied: vitamin A: 25 %, E: 30%, B_1: 20%, B_2: 15%, PP (niacin): 20%, B_6: 20%, folic acid: 75%, vitamin C: 55%. In order to estimate the important differences among the analyzed variables, the single element variation analysis was used.

Results

As it appears from the data in Table 2, the nutritional value of the elimination diet varied from 521±88 kcal (children with allergy and food intolerance) up to 977±896 kcal (children with food and inhalatory allergy). The obtained values were lower than those in healthy children and the differences were statistically relevant ($p < 0.002$). The content of the basic ingredients: proteins, fat and carbohydrates, was also different ($p < 0.0002$). The highest content of those ingredients was found in diets of healthy children – 42.7±8.6 g of proteins, 41.3±10.9 g of fat and 172±36.9 g of carbohydrates. On the average, 25% less ingredients were found in the elimination diets of children with food allergy and food and inhalatory allergy, however, in the diet of children with allergy and food intolerance the values of that diet were twice lower, when compared to the group of healthy children. No statistically significant differences were observed in participation of the energy derived from proteins, fats, and carbohydrates, although the alimentation rations of healthy children had slightly lower energy input from carbohydrates (about 56%), when compared to the studied elimination diets (about 60%), however, the energy inputs from proteins (14%) and fats (30%) were higher. The contents of saturated (S)

and monounsaturated fatty acids (M) were nearly twice as high as those in the alimentary rations of children in the control group, compared to the diet of children with food allergy and food and inhalatory allergy, and tripled those in the diet of children with allergy and food intolerance ($p < 0.0002$) (Table 3).

The level of consumption of polyunsaturated fatty acids (P) was slightly different. In the diets of children with food and inhalatory allergy, it was similar to the alimentary rations in the control group (3.78 g/day vs. 3.87 g/day), while in children with food allergy − to the elimination diets in children with food allergy and food intolerance (2.62 g/day vs. 2.83 g/day), with a statistically significant difference ($p = 0.0002$). The significance of differences concerned also the energy input from S and M acids, as well as the lack of those differences in case of P acids ($p = 0.4631$), while the percent of energy, obtained from P acids, was the highest in the elimination diets of children with allergy and food intolerance (4.39%). It results from the data in Table 4 that the diets of the examined groups of children were clearly differentiated, concerning the content of vitamins with antioxidant features (A, E, C) and from group B (B_1, B_2, PP, B_6, folic acid) and the statistic differences were significant – independently from examined vitamin. Certain similarities could be noticed in vitamin consumption levels in the group of children with food allergy and food and inhalatory allergy but still, except vitamin E (5.76 mg/day vs. 2.42 mg/day), the elimination diets of children with allergy and food intolerance contained the lowest levels of vitamin consumption observed in this study: A (448 mg/day), E (1.44 mg/day), B_1 (0.225 mg/day), PP (2.66 mg/day) and C (18.1 mg/day). Vitamin consumption was the highest in the alimentary rations of the control group, except vitamin E (2.48 mg/day). Some interesting results may be found in Table 5, where similar contents of calcium (approx. 300 mg/day) are shown in the diets of children with food and inhalatory allergy (Group II) and food intolerance (Group III), phosphorus and iron – in diets of children with food allergy (Group I – 496 mg/day and 6.86 mg/day, respectively) and food and inhalatory allergy (Group II – 439 mg/day and 5.58 mg/day, respectively), magnesium (approx. 100 mg/day) – in all the 3 analyzed elimination diets. Zinc content in the diets ranged from 2.07 mg/day (allergy and food intolerance) up to 5.30 mg/day (food allergy), whereas copper content – from 0.4 up to 0.6 mg/day, respectively. The diet of the control group provided larger amounts of calcium, phosphorus and slightly higher amounts of magnesium and copper than the elimination diets did. The differences among consumption levels of the analyzed macro- and microelements were statistically significant. The degree of conformability with standard requirements, regarding energy, protein, fat, acid and carbohydrate percentual levels, is illustrated in Figure 1, whereas for vitamins and mineral components – in Figures 2 and 3, respectively.

Table 2

The energetic values and contents of elementary nutrients in the elimination diets of examined groups of patients; p – level of significance

Analyzed ingredients (expressed per day)	Examined groups of children								Statistic significance p < 0.05
	I		II		III		IV		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Energy (kcal)	869	180	977	296	521	88	1224	197	0.0000..
Protein (g)	29.1	15.9	27.9	11.5	16.3	8.68	42.7	8.57	0.0000..
Protein % energy	13.1	5.02	11.5	2.99	12.6	7.28	14.0	2.54	0.3133
Fat (g)	27.1	8.13	30.0	11.9	16.4	4.61	41.3	10.9	0.0000..
Fat % energy	27.9	5.77	27.3	5.34	28.1	4.63	30.3	5.93	0.3696
Carbohydrates (g)	128	25.9	149	47.1	77.4	17.6	172	36.9	0.0000..
Carbohydrates % energy	59.5	7.22	60.9	5.64	59.6	7.29	56.2	7.29	0.2133

I – children with food allergy (cow milk proteins); II – children with food and inhalatory allergy; III – children with allergy and food intolerance (cow milk proteins and gluten); IV – healthy children – control group

Table 3

The characteristics of fat consumption in the elimination diets of examined groups of children;
p – level of significance

Analyzed ingredients (daily values)	Examined groups of children								Statistic significance p < 0.05
	I		II		III		IV		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
S (g)	8.28	6.21	10.2	4.72	5.28	3.72	19.7	5.05	0.0000..
S % energy	8.31	5.84	9.47	3.51	9.45	7.40	14.5	3.16	0.0001
M (g)	6.81	4.20	8.44	4.39	5.31	0.544	14.3	4.65	0.0000..
M % energy	6.95	3.85	7.64	2.63	9.24	0.594	10.5	2.59	0.0005
P (g)	2.62	2.21	3.78	3.28	2.83	2.28	3.87	2.19	0.0002
P % energy	2.69	1.96	3.28	2.23	4.39	4.29	2.79	1.19	0.4631

S – the total amount of fat saturated acids; M – the total amount of monounsaturated fatty acids; P – the total amount of polyunsaturated acids

Table 4

The content of chosen vitamins in the elimination diets of examined groups of children; p – level of significance

Analyzed ingredients (daily values)	Examined groups of children								Statistic significance p < 0.05
	I		II		III		IV		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
A (µg)	636	497	649	648	448	328	905	469	0.0002
E (mg)	5.76	3.69	2.42	1.23	1.44	0.645	2.48	0.728	0.0001
B_1 (mg)	0.459	0.177	0.391	0.154	0.225	0.082	0.523	0.176	0.0000..
B_2 (mg)	0.641	0.364	0.587	0.282	0.536	0.362	0.993	0.283	0.0000..
PP (mg)	6.48	3.12	5.15	2.28	2.66	2.01	5.82	2.43	0.0000..
B_6 (mg)	0.780	0.414	0.665	0.264	0.608	0.392	0.972	0.256	0.0000..
Folic acid (µg)	17.4	9.47	17.5	9.93	17.8	10.6	26.4	9.97	0.0000..
Vitamin C (mg)	24.9	8.59	24.7	7.76	18.1	2.67	29.7	14.6	0.0000..

Table 5

The content of chosen microelements in the elimination diets of examined groups of children; p – level of significance

Analyzed ingredients (daily values)	Examined groups of children								Statistic significance p < 0.05
	I		II		III		IV		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
calcium (mg)	379	235	289	177	283	229	553	312	0.0021
phosphorus (mg)	496	237	439	180	318	215	687	147	0.0000..
magnesium (mg)	104	44.8	94.9	39.1	90.5	60.1	138	29.8	0.0000..
iron (mg)	6.86	2.43	5.58	2.25	3.15	2.44	5.61	1.50	0.0000..
zinc (mg)	5.30	2.65	3.87	1.60	2.07	1.28	4.87	1.24	0.0000..
copper (mg)	0.548	0.213	0.464	0.149	0.439	0.394	0.584	0.165	0.0000..

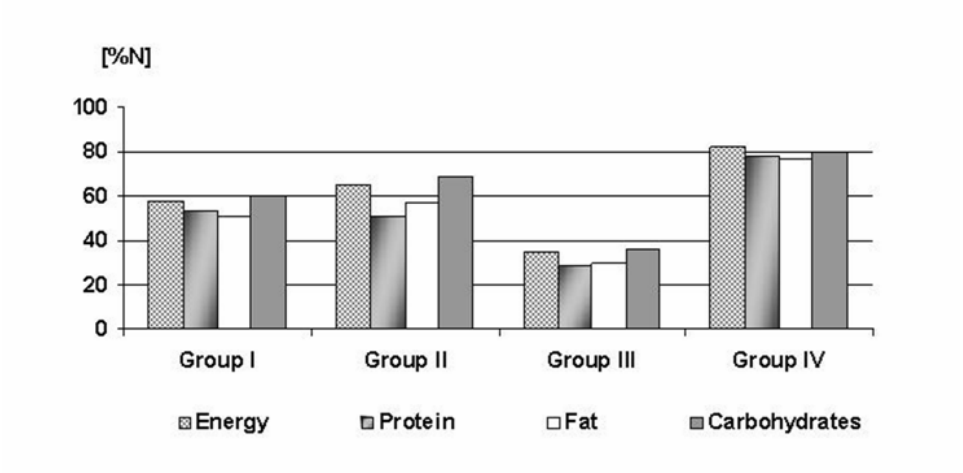

Figure 1. The degree of norm realization for energy and elementary ingredients in the elimination diets of examined children; the values are expressed as the percents of conformability with standard [% N]

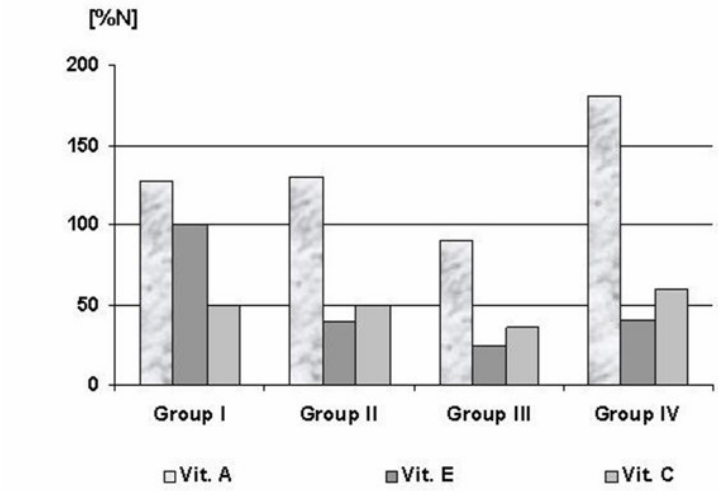

Figure 2. The degree of norm realization for vitamins in the elimination diets of examined children; the values are expressed as the percents of conformability with standard [% N]

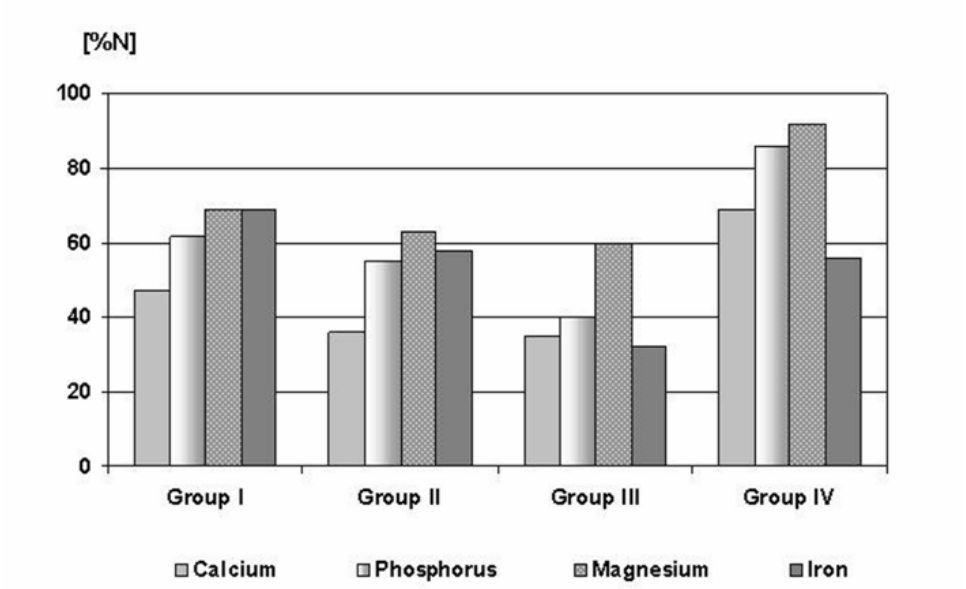

Figure 3. The degree of norm realization for microelements in the elimination diets of examined children; the values are expressed as the percents of conformability with the standard [% N]

It appears from Figure 1 that the fulfillment of the standard for energy and energetic ingredients was similar in the diets of children with food allergy and food and inhalatory allergy, ranging from 50 to 60% in the Group I, and 60 to 70% in Group II of the examined children. The deficiency of energy, as well as of proteins, fat and carbohydrates, was the highest among the children with allergy and food intolerance (Group III – meeting the standard requirements at the level of 35%!). Also, the alimentary rations of healthy children were deficient in the above-mentioned ingredients (80%). Considering the level standard fulfillment for selected vitamins (Fig. 2), a full coverage or even an excess of the suggested level of vitamin A intake was observed, while only 30-50% coverage was found for vitamins E and C (excluding vitamin E – in the elimination diets of children with food allergy); it also concerned the nourishment of healthy children. In case of microelements, all of the analyzed diets were deficient, considering the analyzed ingredients. The level of deficiency was the highest in the group of children with allergy and food intolerance, depending on the kind of ingredient: from 40% (magnesium) up to 60-70% (calcium, phosphorous, iron). Meeting the standard was slightly higher in the groups of children with food allergy (Group I) and food and inhalatory allergy (Group II). It is worth noticing that the diets of healthy children fulfilled the requirements of standards, regarding calcium and iron, only in 60-70%.

Discussion

The presented results concern the first – at least in the Polish literature – attempt of evaluation of the elimination diets, used by children suffering from allergy and food intolerance. Noticeable is the unconformability with the standards, regarding safe, but also recommended levels of practically all of the analyzed ingredients. As it is known, the energy consumption rate in daily alimentary rations of 1 – 4 years old children, should be about 100 kcal/kg body mass [16]. In our study, this value was covered in 86% in the control group, and in 69% (Group I), 76% (Group II) and only in 31% in Group III. These observations may, among others, be explained by the lack of diversification of the analyzed meals with respect to its sensory features – in particular, the taste and consistency, and by possible lack of appetite among the children. Furthermore, the parents did not always eliminate the antigen from the diet; instead, an exaggerated caution was often observed to eliminate safe products with necessary ingredients.

The participation of proteins in daily alimentary rations of children with allergy was reduced for obvious reasons. A question arose if that elimination was not too big, considering the proper development of young organisms. The recommended level of protein consumption for children in the age group of 1-3 years is 45 g/person/day [16]. Protein-energetic deficiency in the group of children with allergy and food intolerance (Group III) is worrying. The average daily supply of proteins was 16.3±8.68 g (0.79 g/kg body mass), so, it was below the safe level of consumption for this age group. It seems also that the quality of alimentary fat was disappointing, considering not only its amount but also the content of S, M and P fatty acids. Fats in diet not only play the role of a concentrated source of energy but they also are the carriers for fat-soluble vitamins and, most of all, they are the structural elements of cell membranes. Striking here is the low consumption of fats in general and, at the same time, an insufficient amount of long-chain P fatty acids, which are the source of essential unsaturated fatty acids. In literature, the reduced enzymatic activity of the mechanisms, participating in transformation of these acids, especially delta 6 (desaturase) has already described several times [11, 17-19].

From the clinical point of view, clear deficiency of vitamin C in the diets of all the examined children is a worrisome observation. This concerns also vitamin E (excluding the group of children with food allergy) and is clearly contrasting with the high levels of vitamin A consumption, the overdosing of which may exert hepatotoxic effects. At the same time, a low supply of vitamins E and C, which complement each other and create an efficient antioxidative system in the organism, indicates the necessity to design better balanced elimination diets and alimentary rations for healthy children. This remark concerns also the vitamins from group B. The unfavourable picture of the elimination diets, regarding the alimentary values in food of small children, is complemented by the analysis of consumption of selected micro- and macroelements. The demand for calcium depends on the actual needs of the organism; in this case, it concerns (children in the phase of intensive

growth) 800 mg/person. Major deficiency of calcium was noticed in Group III of children, whose diet required elimination of many products. In the usual alimentary ration, the degree of calcium utilization was about 40%. But - the basis is the mutual proportion between calcium and phosphorus (Ca:P) and, especially, the proper amount of active metabolites of vitamin D. The level of iron consumption was worrying – iron being a necessary ingredient for the synthesis of haemoglobin and also a catalyst of many enzymatic reactions [1, 20]. Similarly, low supplies of zinc – an element with biological features different from those of iron and copper – especially antioxidative – may be worrying for the clinician. It is to be recalled that the zinc properties are strongly connected with the proper functioning of the immunological system but also with the efficiency of cognitive processes [21]. The contribution of other elements should not be disregarded, either. Most frequently, they are part of enzymes, for example, like copper, which is included in the synthesis of certain biogenic amines and peptides, as well as in the formation of blood cells [1, 22]. It is also supposed that disorders in elastine production in the walls of blood vessels are determined by copper deficiency [23].

In conclusion, the elimination diets, applied in the treatment of children with allergy and food intolerance, have rather poorly been balanced, considering the energetic values, the contents of proteins, fat and carbohydrates, as well as the levels of vitamins and microelements. The highest abnormalities in the consumption of nutrients in Group III, resulted – most probably – from the fear to extend the range of products because of persistent atopic symptoms. The reductions in consumption of certain products were usually too radical, without simultaneous compensation of nutrient deficiency.

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WARTOŚĆ ODŻYWCZA DIET ELIMINACYJNYCH STOSOWANYCH W LECZENIU DZIECI Z ALERGIĄ I NIETOLERANCJĄ POKARMOWĄ

Streszczenie

Dokonano porównania pomiędzy racjami pokarmowymi spożywanymi przez 49 dzieci w wieku 1-3, cierpiące na alergię pokarmową oraz przez dzieci zarówno cierpiące na alergię, jak i nietolerancję pokarmową z 25 próbami kontrolnymi. Ocena wyników pozwoliła stwierdzić zbyt dużą ilość restrykcji w doborze produktów do konsumpcji oraz wskazała na problem braku jednoczesnej korekty poziomu niezbędnych pierwiastków w diecie. Najwyższe odchylenia od normy w konsumpcji składników odżywczych zaobserwowano w ściśle limitowanej diecie dzieci z alergią i nietolerancją pokarmową, co tłumaczyć można ciągłą obawą o możliwe wystąpienie atopowych objawów w konsekwencji spożycia jakichkolwiek produktów spoza dozwolonych w diecie. Badane diety eliminacyjne były źle zrównoważone w kwestii wartości energetycznej, zawartości białek, tłuszczów, węglowodanów, witamin i mikroelementów.