

VILNIUS UNIVERSITY

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**THE PREVALENCE OF ADVERSE REACTIONS TO FOOD AND FOOD
ALLERGY AMONG VILNIUS CITY (LITHUANIA) INHABITANTS**

Summary of the Doctoral Dissertation

Biomedical Sciences, Public Health (09 B)

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VILNIAUS UNIVERSITETAS

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**PADIDĖJUSIO JAUTRUMO MAISTO PRODUKTAMS IR ALERGIJOS
MAISTUI PAPLITIMAS TARP VILNIAUS MIESTO GYVENTOJŲ**

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1. INTRODUCTION

Food allergy is now recognized as a growing clinical and public health problem in westernized nations and worldwide, and like other atopic diseases, it appears to be on the increase. The main risk factors that contribute to the increasing prevalence of allergies are genetic predisposition, allergen exposure, environmental pollutants, decreased stimulation of immune system during the critical period of human development and lifestyle. Therefore, allergies can be considered diseases of modern civilisation and must be treated as a common health disorder.

Food is an integral part of every human life, but allergy to food and to its natural or artificial ingredients could be dangerous or even fatal, and especially in children, it causes many gruelling physical and even psychological disorders. Food allergy becomes a very serious problem not only for many children and their parents, but also to the entire medical staff and local communities. It affects all kinds of population groups. There is no cure or preventative treatment for food allergy at present. Therefore, management of this disease is restricted to avoidance of the implicated food via elimination diets. This has an adverse impact to patients' daily living and quality of life – allergic people have to get used to the additional discomfort, as have to be in constant control of what they eat; this raises additional difficulties in social life. Patients' and their relatives' anxiety about the potential severe reactions can lead to social isolation or even mental health problems.

Relevance of the problem is also enhanced by the fact, that though food allergy diagnosis and treatment should be well known among physicians, scientific studies have shown that specialists' knowledge is not sufficient, and food allergies are often not properly treated or misdiagnosed. Patients, even after anaphylactic shock, are discharged from the hospital without further allergist consultation or prescription for epinephrine and at the same time with unnecessary dietary restrictions.

Financial and social burden associated with this disease is also increasing, therefore scientists actively involve in research for possible solutions in order to figure out how to relieve life of these patients and their families and to reduce the burden on the state. Such factors, as appropriate doctor-patient communication, accuracy and particularity of diagnosis, education of patients and their families, as well as food labelling, are important in management of this problem. In many cases, it can be facilitated not only by the medical staff or the patient himself, but also by targeted policy decisions, or the private sector actions, such as labelling certain foods and providing information about the presence or absence of specific allergens in their composition.

The aim of the study was to determine the prevalence and pattern of adverse reactions to food and food allergy among primary schoolchildren and adult inhabitants in Vilnius city (Lithuania) and to assess attitude of schools administration towards food allergy.

Objectives of the study:

1. To determine the prevalence of adverse reactions to food and food allergy by gender and by separate age groups among primary schoolchildren and adult inhabitants of 19-57 years old in Vilnius city (Lithuania).
2. To assess main symptoms of adverse reactions to food and food allergy and foods that cause them by gender and by separate age groups among primary schoolchildren and adult inhabitants of 19-57 years old.
3. To estimate association between food allergy and mother's addictions (smoking, alcohol drinking during pregnancy), babies low birth weight and nursing duration, gender, treatment with antibiotics during first two years of life.
4. To assess attitude of schools administration of Vilnius region (Lithuania) towards food allergy.

Relevance of the study

It is presumed that the number of foods, that may cause adverse reactions, is increasing, as well as the number of severe allergic reactions, still there is a lack of reliable information, that could define exact extent of this problem. Prevalence of food allergy among children, especially of younger age, is also a major interest, since it is higher than among adults, according to the results of other studies.

Along with all the social and economic implications and impact to public health, prevention and treatment of adverse reactions to food is becoming a great challenge for scientists, doctors, policy makers and general society.

Studies carried out in the former East and West Germany have shown, that there are significant differences between Western Europe and Eastern Europe, particularly in its post-communist countries regarding incidence of allergic diseases. Food allergy might be prevalent up to 35% in the populations of the old EU. By the time, we use more new food products and medicine, more chemicals in industry and environment. Under such conditions, new allergens emerge, and the known ones proceed to modify, in addition.

Survey data show that from 3 to 35% of adults believe, that they or their children suffer from food allergies, but clinical studies reveal that, confirmed food allergies are prevalent in 6–8% of young children (up to 3 years), in 3–5% of older children and in 1.5 to 3% of adults. Still the exact estimation of the prevalence of food allergy is not simply feasible because of the diverse epidemiological data and the methods by which the results were obtained in different countries, populations groups, age, etc. It should be noted that food allergy is often identified to people with other atopic diseases: food allergy is diagnosed in 33–40% of children and young adults with moderate or severe atopic dermatitis, and about 6–17% of children with asthma. Thus, the disparities in the prevalence of these allergic diseases, not only in various age groups, but also within particular countries and regions, an abundance of new allergens, conditions the need to continue to go deep and explore more this public health issue.

Novelty of the study

There are not many studies carried out in Lithuania to determine consistent pattern of allergies. Moreover, there is lack of data about the epidemiology of food allergy, its prevalence, symptoms, and relevant foods.

By this study, for the first time in Lithuania, we estimated the prevalence of adverse reactions to food and food allergy among children and adults. The structure of food allergies was determined, food products that cause adverse reactions were assessed, symptoms, that are followed by these reactions were analysed, and role of school staff in management of food allergy and their attitude towards this issue was assessed.

To ensure methodological integrity of the study, we followed the EuroPrevall Manual of Procedures and consolidated methodology. To achieve our aim we organized two types of epidemiological studies – prevalence and case-control – each supplementing another and each in different age groups of population – in children and in adults, with more than 8000 participants in our study in total. Specially composed questionnaires for self-reported food allergy were followed by objective confirmative laboratory blood sample analysis for diagnosis of food allergy. It is one of the utmost studies, that were carried out in Lithuania, in its extent (and EuroPrevall is the largest ever project on food allergy across Europe). In addition, Lithuanians' blood samples, collected during this study, will be used for further DNA, mRNA analysis and genetic research and will contribute to the overall European database for risk factors.

Practical significance of the study

In this study, we present data from implementing EuroPrevall – an EU-funded multidisciplinary integrated research project looking at “The Prevalence, Costs, and Basis of Food Allergy across Europe” in Lithuania. It is EuroPrevall aim that by integrating information and developing tools for the use of European food allergy scientists, health professionals, food and biotech industries, and consumers, that causes of food allergy can become better understood, diagnosis of food allergy can become swifter and the quality of life of food allergy sufferers improved. Much of the project's research undertaken has focused on characterising the patterns and prevalence of food allergies across Europe in infants, children and adults, through the EuroPrevall Birth Cohort and community surveys. However, the project has also investigated the impact food allergy has on the quality of life and its economic cost associated with food allergies and has developed improved diagnostic techniques reducing the need for food challenge test, as well as investigating how processing and the food matrix affect allergenic potential.

Vilnius University was among other 66 partners from 24 countries (17 EU, Switzerland, Iceland, Ghana, Australia, New Zealand, Russia, China and India) in this project, all together providing a broad and diverse spectrum of cultural, nutritional, environmental, climatic and geographic factors and approaches. As an outcome, Lithuania, as a country member, now appears in the maps of epidemiological researches that were conducted. In addition, Lithuania with its neighbour country Poland represents the Eastern European region with its cultural and social aspects, associated with nutritional habits, which do influence the epidemiological situation of food allergies in

the country, herewith revealing and allowing to make comparisons in the international context. The study, that was carried out in Lithuania, serviced to create main tools of EuroPrevall – The Serum and Clinical databanks and allergen dictionary.

The research data will be used for further studies and effective measures to manage food allergies, as well as for national science programs. The obtained data will be useful in the future, when comparing the results to assess the changes and dynamics of the prevalence in the context of the etiopathogenesis of the disease.

The data on Lithuanian children and adult food allergy, its structure, symptoms and foods that cause them can serve to a medical practice, when diagnosing and treating this disease. This can contribute to specialists' better understanding of the disease patterns and its significance.

2. MATERIALS AND METHODS

Vilnius University was a partner in EuroPrevall integrated project – “The prevalence cost and basis of food allergy in Europe“, that is an EU-funded multi-disciplinary research study within the 6th framework programme (Contract Number: FOOD-CT-2005-514000). The project was launched at June 2005, and was officially completed at December 2009; however, the data that was collected during its implementation are still on the process of analysis and publication. The main coordinator of the project is Institute of Food Research (Norwich, UK).

The main objectives of EuroPrevall:

1. To investigate whether patterns of food consumption, environmental factors (such as pollen) and infections are linked to the prevalence and patterns of food allergies.
2. Provide a basis for investigating the possibility of a genetic predisposition to food allergy by collecting and analysing cellular samples to provide a resource for genetic studies in the future once molecular markers for atopy have been defined through other ongoing research efforts in Europe and beyond.
3. Assess lifestyle issues, including changes in patterns of food consumption and the household environment.
4. Compile searchable public databases from the information arising from the project, which will be linked to the InformAll allergenic food materials.

The EuroPrevall research studies were split into five different themes forming special work packages with their own tasks to achieve main goals. Vilnius University participated in the realisation of the first theme “Epidemiology of Food Allergy across Europe“ and its task – to obtain authoritative estimates of the prevalence of food allergy across the different areas of Europe and to provide a qualitative assessment of the variation of this prevalence through community based surveys, cross-sectional studies of severe allergies and a birth cohort. Participating countries in this theme are presented in Figure 1.

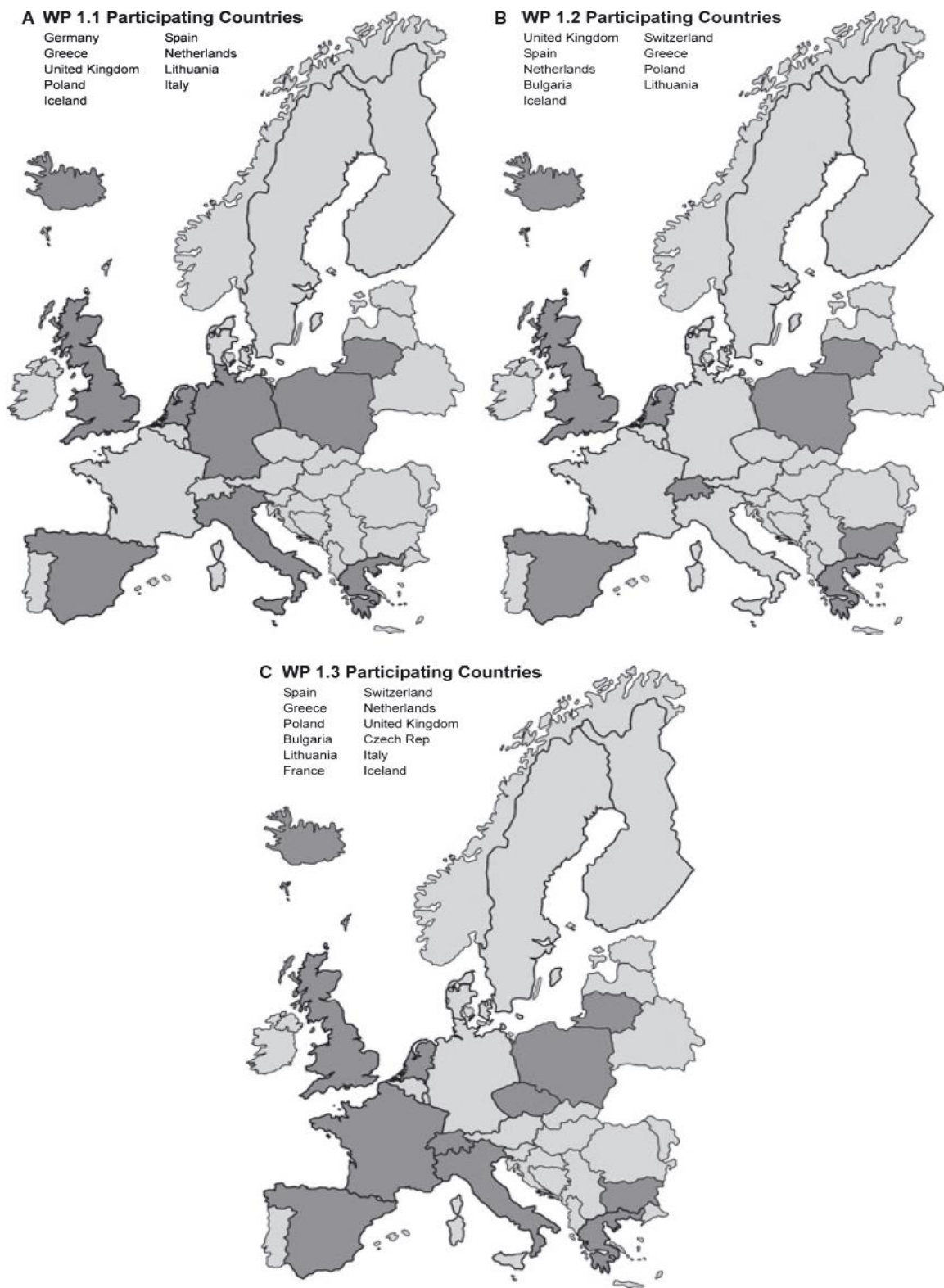


Figure 1. Centres in the pan-European EuroPrevall cohorts: (A) birth cohort study; (B) community surveys in adults and school-age children; (C) outpatient clinic study

We analysed the community surveys data from WP 1.2 with relevance to clinical study in this work.

To ensure the integrity of the study all partners followed consolidated methodology (Manual of procedures for Epidemiology of food allergy in children and adults), advice, and recommendations from main coordinator (Institute of Food Research) and WP coordinator (WP 1.2 coordinator – Imperial College London).

Type of the study

In order to accomplish our aim, we conducted two different investigations in their background – the prevalence and the case-control studies, and each in two stages among two different population groups – in adults and in children. First phase – the prevalence study satisfies screening fundamentals. By using short, easily and quickly filled questionnaire disseminated in a large population group we sought to estimate how many people have ever had a sickness or disease, caused by eating a food or foods, with respect to their ailments and foods that caused them. Later, in order to confirm or reject the diagnosis of food allergy, the study participants were invited to perform laboratory blood tests with the interview and completing a detailed questionnaire. This phase results in two case and control groups that allow making comparisons of various possible causes of food allergies.

Methods of the study

Approval of Lithuanian Bioethics Committee was given to conduct this biomedical research (2005-12-21, No. 60); Agreement of Department of Education, Culture and Sport of Vilnius city municipality administration was also got.

Special questionnaires were created and approved for this project by Institute of Food Research and were used in all participating countries. To ensure the integrity of study and data, standardized translation procedures, involving forward translation (from English into Lithuanian), backward translation (comparison and necessary editing) and local piloting, were done. The first one, a short screening questionnaire consisted of nine questions, providing basic insights to adverse reactions to food. The second one, a clinical case-control questionnaire was a comprehensive tool for interview and contained different groups of questions about ones childhood, family, home, environment, work, etc.

Study sample and power calculations were done by the coordinators of the project. Presuming there will be a noticeable part of non-responders, we followed a recommendation to increase minimum study sample size in screening phase from 3000 to 4000.

During the second (clinical, case-control) phase of the study we took blood samples for IgE, DNA and mRNA analysis. Collection of blood samples was performed at Allergy centre in Vilnius University Antakalnis Hospital. Samples were dispatched for analysis to Amsterdam Medical Centre and Munich Research Centre for Environment and Health.

In this work, we analysed a part of the data from Amsterdam Medical Centre with serum IgE levels to 25 foods that were measured using an ImmunoCAP system.

These 25 priority foods were assessed: hen's egg, cow's milk, soy, peanut, wheat, fish, sesame seed, buckwheat, corn, rice, hazelnut, tomato, walnut, carrot, celery, shrimp, poppy seed, lentil, mustard, sunflower, apple, kiwi, melon, banana, peach. Tests were positive if specific antibody level in serum was ≥ 0.35 kU_A/l.

Data collection and administration

Community based surveys were undertaken in the first (screening) phase. Children got the questionnaires at schools and gathered them at home to fill with parents. Adults were interrogated by making home visits. The second phases contained an interview and blood sampling.

All survey data were submitted through website to the EuroPrevall database. The coordinating centre conducted verification for queries. All data were encoded, blood samples were labelled with bar codes to ensure confidentiality. No identifiable data were put on questionnaires or samples. Participants were asked to sign consent form before starting blood sampling and interview.

Organizational aspects

There were 16 primary schools in Vilnius city at the outset of the study. 13 schools participated in the study with total number of 190 classes and 4333 schoolchildren in them. 4333 questionnaires were distributed and 3084 (response rate – 71.2%) were collected with responses in return. School administrations were informed in advance so that to give basic information and agree on time, organizational details and number of schoolchildren. Class teachers were provided with a sheet of information about the study, so that to inform children and their parents. At the same time, we also organised a survey on schools administration perception on awareness of food allergy. 128 persons participated in this survey, 118 questionnaires (92.2%) were applicable and used for further analysis.

The original manual of procedures provides rules to administer a postal questionnaire. We presumed that there will be an excessively large number of non-responders in Vilnius and ergo we chosen to conduct adult survey by visiting citizens at home. We could not use a random sample of the whole city and decided to take two large outpatient clinical centres (Antakalnis and Šeškinė) and make random samples from patients' lists of these centres. Final sample contained 3985 adults, 2634 (response rate – 66.1%) of them agreed to take part in the study.

Randomly selected participants from the first part were invited to take part in the second phase. The selection procedure followed the principals of composing case and control groups. Selected persons were contacted by phone to agree on subsequent meeting.

There were 814 children and 255 adults selected for the case-control study. 205 (31.3%) of children and 56 (22.0%) of adults agreed to take part, although after familiarising with information sheet and consent form, 19 parents of children refused to perform blood test for their child, 29 refused to be interviewed, 11 persons in the adults group refused to be interviewed.

It should be mentioned, that investigators did much effort to attract more participants, by offering suitable time. Still motivation of participants was poor by some clear reasons. Those, who are allergic already, know this fact, avoid particular food and use medications, so then why to repeat a painful procedure, especially for children, and waste a lot of time (going to and from clinic, performing an hour or hour and half interview with blood sampling). While on the other hand, those, that are not allergic, do not suffer from food, so then why to do that painful procedure and waste a lot of time. Participation in an European project that seeks for better understating of the disease and development of tools to prevent and manage food allergy was not a “hook” for our people. There are not many vast epidemiologic studies carried out in Lithuania, so people look with caution to such things. However, much the same problems were in other centres.

Prior to data collection, investigators attended a series of training seminars with the coordinating centres, during which the protocols were explained and the standardised techniques demonstrated. Subsequently, an extensive quality control procedure was implemented in the study, comprising weekly and monthly reports and checks, progress on data entries, site visits. Investigators participated in internal and external audits as well.

Data analysis

The prevalence of adverse reactions to food and food allergy was expressed as a point (percentage) and interval estimate (the 95 percent confidence intervals (95% CI) were chosen). For category data analysis chi-square and Fisher’s exact tests were used. The results were considered as statistically significant if p value was ≤ 0.05 .

Prevalence ratio (PR) and its 95% CI were counted to test possible associations. We also used Mantel test for trend.

Logistic regression was used to evaluate risk factors. Odds ratio (OR) and its 95% CI were counted to estimate association between risk factors and food allergy. Two-way contingency tables were used for categorical variable selection. All variables significant at the alpha level of 0.3 were entered into multiple logistic regression model. We used stepwise multiple logistic regression with backward elimination for model building in children group. The level of significance to eliminate covariates from the model was $p = 0.3$. To test overall fit of logistic regression model Hosmer and Lemeshow chi-square test of goodness of fit was used. Significance of coefficients β were evaluated by Wald test. Link test was used to identify specification error. Due to the small sample size of adults group, exact logistic regression was used.

Statistical data analysis was performed by statistical packages SPSS 17.0, Stata 10.1 and WinPEPI 11.0. Actual power was calculated with PS Power and Sample Size Calculations 3.0.

3. RESULTS

3.1. The prevalence of adverse reactions to food and food allergy

The prevalence of adverse reactions to food and food allergy among children

Parents of 4333 children of Vilnius city primary schools were asked to complete the EuroPrevall food allergy screening questionnaire, that was specially designed for this. 3084 questionnaires were got in return and used for further analysis. There were 1531 (49.6%) boys and 1553 (50.4%) girls out of them. The age of schoolchildren varied from 5 to 12 years (mean – 8.2 ± 1.2 years, median – 8 years). Distribution of children by age and gender is given in Table 1.

Table 1. Distribution of children by age and gender

Age (years)	Boys		Girls		Total	
	n	%	n	%	n	%
5	2	0.1	2	0.1	4	0.1
6	89	5.8	104	6.7	193	6.3
7	464	30.3	424	27.3	888	28.8
8	333	21.8	359	23.1	692	22.4
9	350	22.9	396	25.5	746	24.2
10	286	18.7	260	16.7	546	17.7
11	5	0.3	7	0.5	12	0.4
12	2	0.1	1	0.1	3	0.1
Total	1531	100	1553	100	3084	100

From this table we can clearly see that distribution of schoolchildren by gender was similar, and children were mostly of 7–10 years old. It is therefore primary classes (1st–4th) were included in this study (usually a child start 1st class in primary school at 7 and finish 4th class at 10, but there were some younger and older individuals).

Firstly, we evaluated which part of schoolchildren population report, that they have illness or trouble caused by eating a food or foods. 1445 (46.9%) stated, that they have ever had such problems, 1639 (53.1%) responded negatively. After analysing this data by gender, we determined, that boys and girls similarly reported adverse reactions to food (48.1% and 45.6% respectively) and there is no association between adverse reactions and gender (PR = 1.06; 95% CI [0.98–1.14], $p = 0.156$).

Before making analysis by age, we took in mind the fact that this is a primary school age, so that in analysis some younger and some older individuals were subjected to those of 6 years and younger and to those of 10 years and older. Distribution of children, who have had illness or trouble caused by eating a food or foods, by age is given in Table 2. We clearly see that part of schoolchildren that reports adverse reactions to food is increasing with age and this trend is statistically significant (χ^2 by Mantel test for trend was 26.51 (df = 1; $p < 0.001$)).

Table 2. Prevalence of adverse reactions to food by age among children

Age (years)	N	Have had an illness or a trouble, caused by eating a food or foods (n=1445)		Prevalence of illness or a trouble, caused by eating a food or foods	
		n	%	%	95% CI
≤6	197	72	4.9	36.5	30.1-43.5
7	888	375	26.0	42.2	39.0-45.5
8	692	321	22.2	46.4	42.7-50.1
9	746	387	26.8	51.9	48.3-55.4
≥10	561	290	20.1	51.7	47.6-55.8
Total	3084	1445	100	46.9	45.1-48.6

We also checked if food allergy was diagnosed by a doctor. Parents of 505 (16.4%; 95% CI [15.1–17.7]) children of Vilnius city primary schools responded, that their children had a diagnosed food allergy. We compared these data with the previous results about adverse reactions to food (Fig. 2). The majority of children (1608; 52.1%) did not suffer from adverse reactions to food and food allergy was not diagnosed to them.

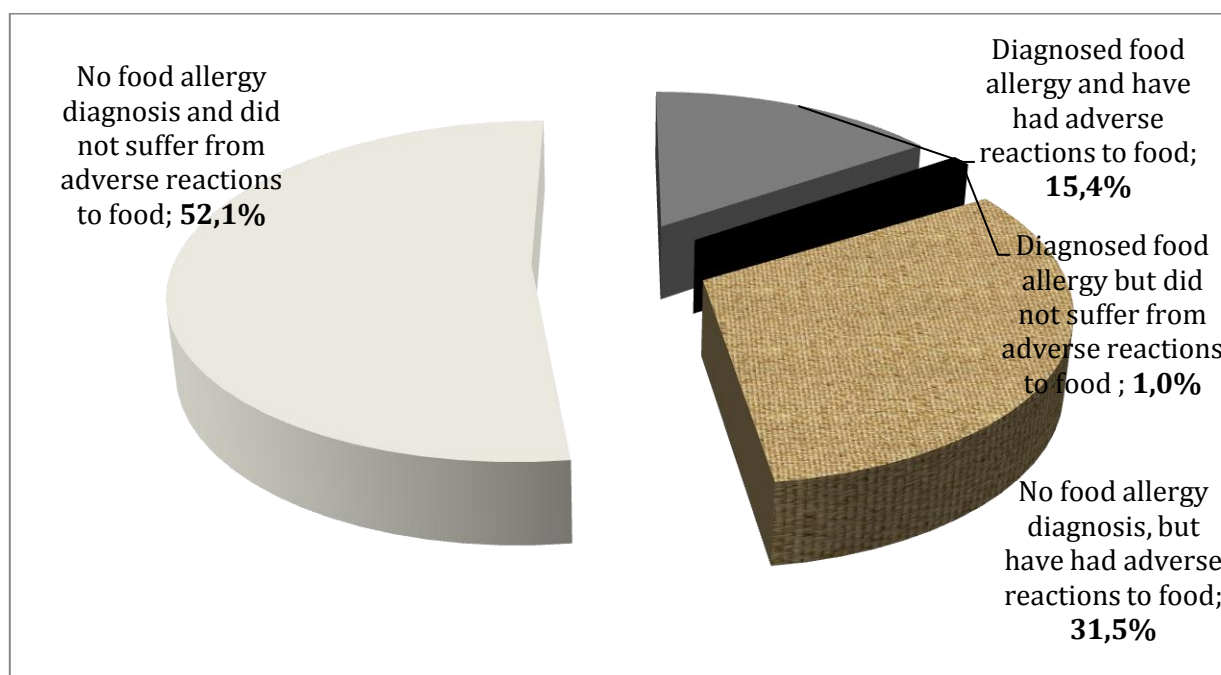


Figure 2. Distribution of food allergy diagnosis and adverse reactions to food in children

After analysis of children with diagnosed food allergy by gender, we determined, that food allergy was diagnosed to boys more frequently than to girls (18.1 and 14.8% respectively; $p = 0.014$) and that there was a link between gender (boys) and food allergy (PR = 1.22; 95% CI [1.04-1.44]).

Consequently, boys and girls suffer from adverse reactions to food similarly, but food allergy is diagnosed to boys more frequently.

The prevalence of adverse reactions to food and food allergy among adults

3985 adult citizens in Vilnius were visited for completion of the EuroPrevall food allergy screening questionnaire. 2634 answered the questions. There were 1288 (48.9%) men and 1364 (51.1%) women out of them. The age of responders varied from 19 to 57 years (mean – 36.1 ± 19.5 years, median – 36 years). Distribution of adults by age and gender is given in Table 3.

Table 3. Distribution of adult responders by age groups and gender

Age groups (years)	Men		Women		Total	
	n	%	n	%	n	%
≤24	161	12.5	185	13.7	346	13.1
25-34	435	33.8	429	31.9	864	32.8
35-44	406	31.5	397	29.5	803	30.5
45-54	278	21.6	332	24.7	610	23.2
55≤	8	0.6	3	0.2	11	0.4
Total	1288	100	1346	100	2634	100

From this table we can clearly see that distribution of adults by gender was similar, and the biggest part among the responders was in age groups of 25-44 years.

According to our objectives, we evaluated which part of adult population report, that they have illness or trouble caused by eating a food or foods. Only 51 (1.9%) stated, that they have ever had such problems, 2583 (98.1%) responded negatively. After analysing these data by gender, we determined, that women reported adverse reactions to food more frequent than men (2.9% and 0.9% respectively; $p < 0.001$), and females had a more than 3 times greater risk for adverse reactions to food than men (PR = 3.12; 95% CI [1,64–5,93]), while male gender had an inverse association (PR = 0.32; 95% CI [0.17-0.61]).

Distribution of adults, who have had illness or trouble caused by eating a food or foods, by age is given in Table 4. After analysing the trend we determined, that it is decreasing with age (χ^2 by Mantel test for trend was 28.12 (df = 1; $p < 0.001$)).

We also checked if food allergy was diagnosed by a doctor. Only 16 (0.6%; 95% CI [0.4–1.0]) adults responded, that they had a diagnosed food allergy. We compared these data with the previous results about adverse reactions to food (Fig. 3). The majority of adults (2582; 98.0%) did not suffer from adverse reactions to food and food allergy was not diagnosed to them.

Table 4. Prevalence of adverse reactions to food by age among adults

Age groups (years)	N	Have had an illness or a trouble, caused by eating a food or foods (n=51)		Prevalence of illness or a trouble, caused by eating a food or foods	
		n	%	%	95% CI
≤24	346	25	49.0	7.2	4.7-10.5
25-34	864	12	23.6	1.4	0.7-2.4
35-44	803	7	13.7	0.9	0.4-1.8
45-54	610	7	13.7	1.2	0.5-2.4
55≤	11	0	0	0	-
Total	2634	51	100	-	-

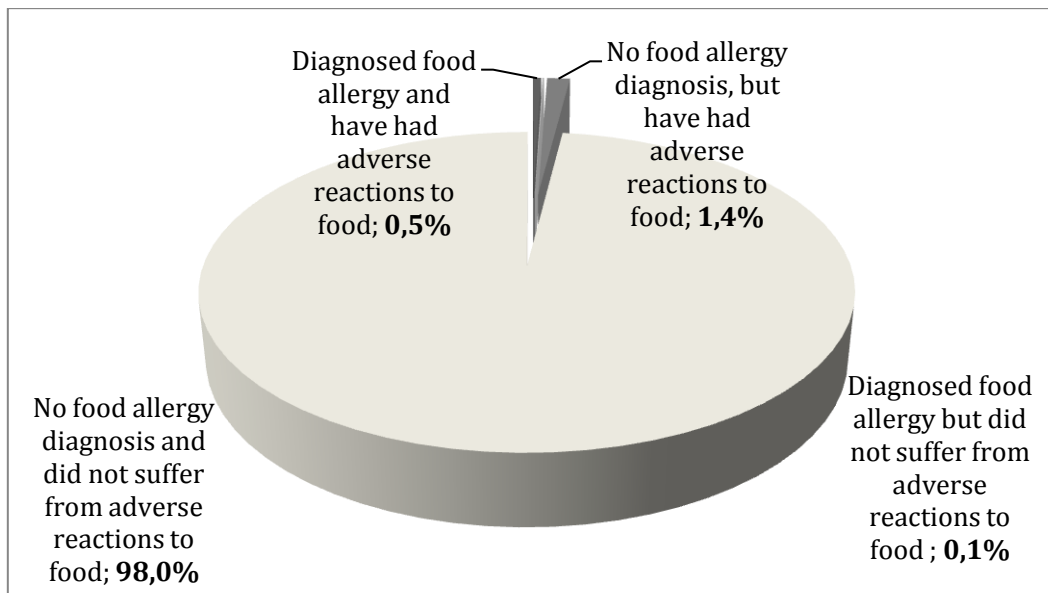


Figure 3. Distribution of food allergy diagnosis and adverse reactions to food in adults

After data analysis of adults with diagnosed food allergy by gender, we determined, that women have had a diagnosed food allergy more frequently than men (1.0 and 0.2% respectively; $p = 0.015$), besides, female gender has a more than 4 times greater risk for food allergy than men (PR = 4.16; 95% CI [1.19–14.56]). While male gender has a reverse association (PR = 0.24; 95% CI [0.07–0.84]).

Hence, more women suffer from adverse reactions to food and food allergy is more frequently diagnosed to them.

3.2. Main symptoms of adverse reactions to food and food allergy and foods that cause them

Main symptoms of food hypersensitivity and food allergy and foods that cause them in children

We analysed, which symptoms manifested to children, that have had problems or illness caused by eating a food or foods (Fig. 4). Diarrhoea or vomiting were the most common symptoms among schoolchildren (48.0%); a rash, urticarial rash or itchy skin were also frequent troubles (46.4% of children indicated this symptom).

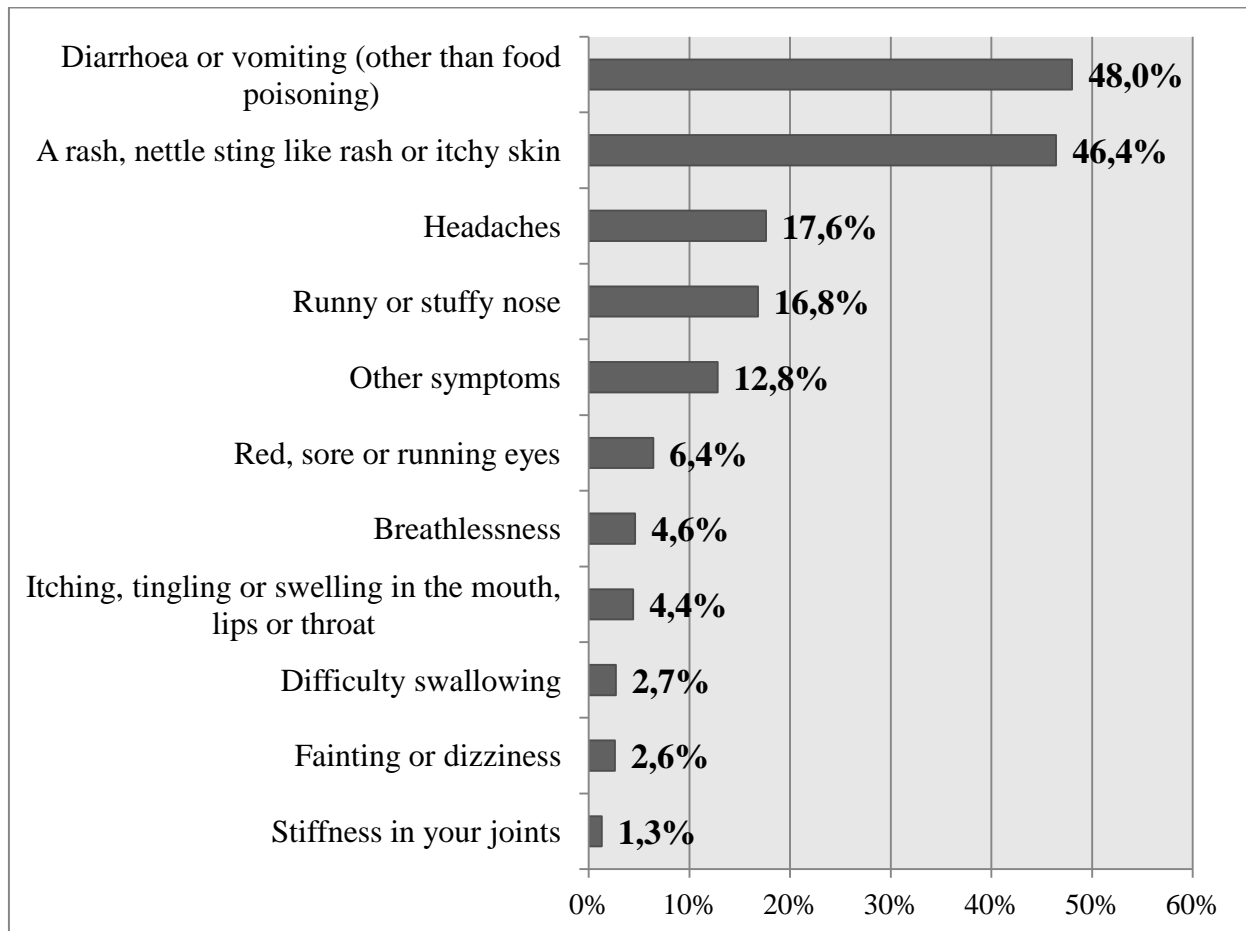


Figure 4. Distribution of symptoms among children that have had troubles from food

After analysing this data by gender, we determined, that there were no differences among boys and girls, except for the red, sore or running eyes, this was more common ($p < 0.001$) among boys (8.6%) than girls (4.1%).

We also asked to indicate, how many times did the troubles or illnesses happen. The majority of children (46.0%) answered that the symptoms happened only once. 32% pointed out that the symptoms manifested for 2–4 times and for 22% – more than 4 times. There were no significant differences by gender. There was a strong association

(PR = 4.4; 95% CI [3.4–5.7]; $p < 0,001$) between frequent manifestation of symptoms (more than 4 times) and food allergy diagnosis.

We asked to indicate up to three foods, that caused adverse reactions (if there were more than three, we asked to indicate the main three, that were the most problematic). The majority of children (79.6%) pointed out at least one food; 3.5% did not know and 16.9% did not indicate any. From those children who indicated at least one food, the majority (44.2%) indicated one, 32.1% indicated two and 23.7% indicated three foods, that caused adverse reactions.

We also asked to name the food that causes troubles or illnesses by eating them. The answers were very different. Some named food accurately (e.g., apple, hazelnut), others named only general groups, like fruits or nuts. We present answers, as they were, systematised in Table 5 and general picture of these data in Figure 5.

Table 5. Distribution of foods, that caused clinical symptoms to children

Food	Children, that have had a problem or illness caused by eating a food or foods (n=1445)		
	n	%	95% CI
Nuts	69	4.8	3.7-6.0
From them:			
Hazelnut	3	0.2	0.04-0.6
Peanut	2	0.1	0.02-0.5
Coconut	2	0.1	0.02-0.5
Almond	1	0.1	0.002-0.4
Vegetables	100	6.9	5.7-8.4
From them:			
Asparagus	1	0.1	0.002-0.4
Bean	5	0.4	0.1-0.8
Cabbage (cauliflower)	6	0.4	0.2-0.9
Carrot	19	1.3	0.8-2.1
Corn	8	0.6	0.2-1.1
Garlic	1	0.1	0.002-0.4
Onion	3	0.2	0.04-0.6
Peas	3	0.2	0.04-0.6
Paprika	7	0.5	0.2-1.0
Potato	9	0.6	0.3-1.2
Tomato	25	1.7	1.1-2.5
Fish	85	5.9	4.7-7.2
From them:			
Salmon	1	0.1	0.002-0.4
Tuna	2	0.1	0.02-0.5
Herring	7	0.5	0.2-1.0
Whitefish, cod, plaice	1	0.1	0.002-0.4
Fruits and berries:	355	24.6	22.4-26.9
From them:			

Food	Children, that have had a problem or illness caused by eating a food or foods (n=1445)		
	n	%	95% CI
Apples	19	1.3	0.8-2.1
Bananas	5	0.4	0.1-0.8
Cherries	6	0.4	0.2-0.9
Grape	12	0.8	0.4-1.5
Kiwi	18	1.3	0.7-2.0
Lemon	18	1.3	0.7-2.0
Melon	6	0.4	0.2-0.9
Orange (mandarin)	96	6.6	5.4-8.1
Peach	6	0.4	0.2-0.9
Pear	4	0.3	0.1-0.7
Raspberry (blackberry)	2	0.1	0.02-0.5
Strawberry (wild-strawberry)	39	2.7	1.9-3.7
Plum	3	0.2	0.04-0.6
Milk and dairy	280	19.4	17.4-21.5
From them:			
Cheese	3	0.2	0.04-0.6
Cow's milk	106	7.3	6.0-8.8
Yoghurt	18	1.3	0.7-2.0
Meat	24	1.7	1.1-2.5
From it:			
Beef	2	0.1	0.02-0.5
Pork	10	0.7	0.3-1.3
Poultry	10	0.7	0.3-1.3
Cereals	23	1.6	1.0-2.4
From them:			
Buckwheat	8	0.6	0.2-1.1
Rye	1	0.1	0.002-0.4
Wheat (flour)	13	0.9	0.5-1.5
Rice	1	0.1	0.002-0.4
Crustaceans	2	0.1	0.02-0.5
From them:			
Crab	2	0.1	0.02-0.5
Cacao	28	1.9	1.3-2.8
Chocolate	157	10.9	9.3-12.6
Egg	107	7.4	6.1-8.9
Spice, herbs, seeds	14	1.0	0.5-1.6
From them:			
Parsley	1	0.1	0.002-0.4
Sunflowers seed	3	0.2	0.04-0.6
Sesame seed	3	0.2	0.04-0.6
Yeast	2	0.1	0.02-0.5

Food	Children, that have had a problem or illness caused by eating a food or foods (n=1445)		
	n	%	95% CI
Soya	5	0.4	0.1-0.8
Others	819	56.7	54.1-59.3

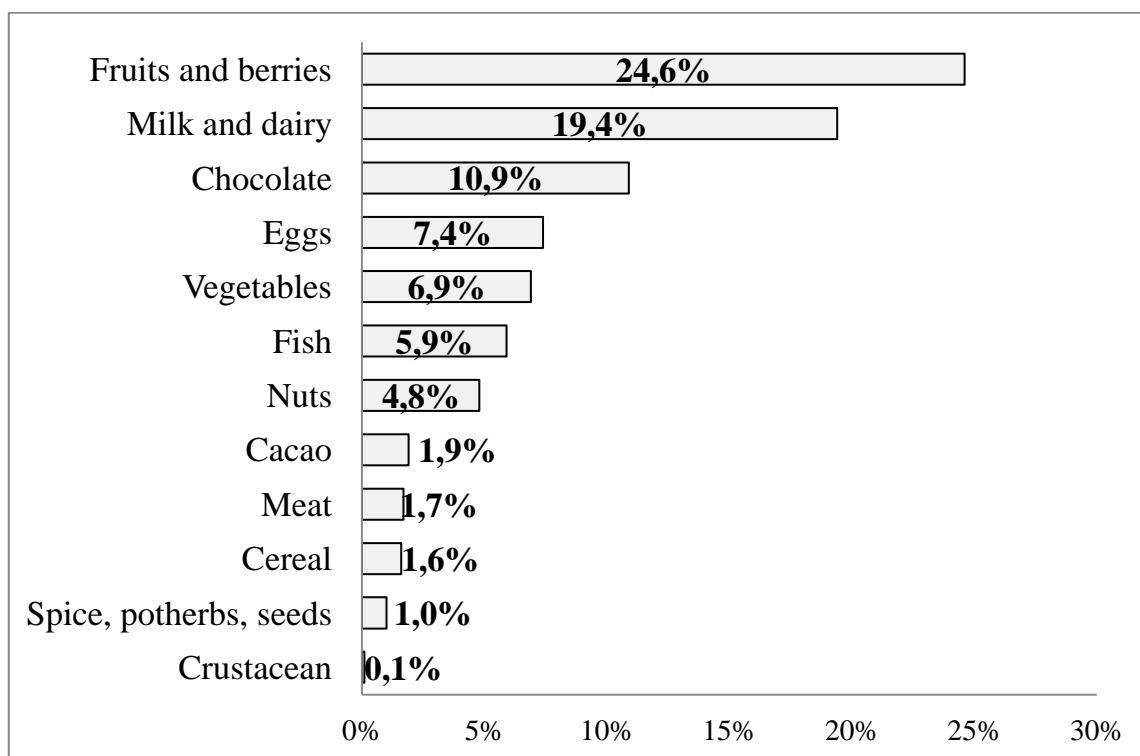


Figure 5. Distribution of food groups, that caused clinical symptoms to children

Consequently, we see that the most important and relevant foods for children are fruits and berries, also milk and dairy.

Main symptoms of adverse reactions to food and food allergy and foods that cause them in adults

We analysed, which symptoms manifested to adults, that have had problems or illness caused by eating a food or foods (Fig. 6). Rashes, urticarial rash or itchy skin (62.7%) were the most common symptoms among adults.

After analysing these data by gender, we determined that there were no differences among men and women.

We also asked to indicate, how many times did the troubles or illnesses happen. The majority of adults (41.2%) answered that the symptoms happened only once. 31.4% pointed out that the symptoms manifested for 2–4 times and for 27.5% – more than 4 times. There were no significant differences by gender. There was a strong association (PR = 5.7; 95% [CI 1.5–21.8]; p = 0.008) between frequent manifestation of symptoms (more than four times) and food allergy diagnosis.

We asked to indicate up to three foods, that caused adverse reactions (if there were more than three, we asked to indicate the main three, that were the most problematic). The majority of adults (74.5%) pointed out at least one; 2.0% did not know and 23.5% did not indicate any. From those adults who indicated at least one food, the majority (47.4%) indicated two, 42.1% indicated one and 10.5% indicated three foods, that caused adverse reactions.

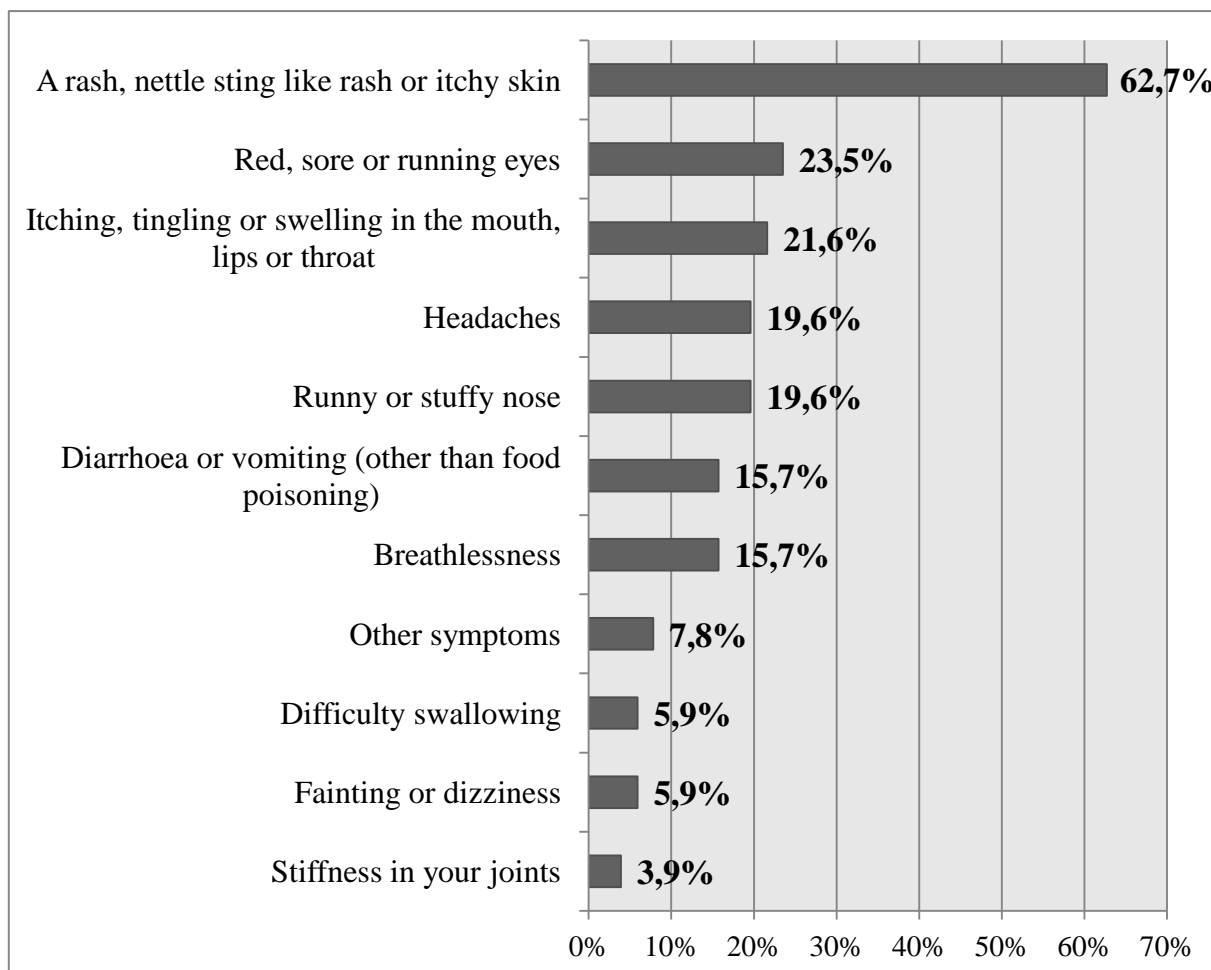


Figure 6. Distribution of symptoms among adults that have had troubles from food

We also asked to name the food that causes troubles or illnesses by eating them. We present answers, as they were, systematised in Table 6 and general picture of these data in Figure 7.

Table 6. Distribution of foods, that caused clinical symptoms to adults

Food	Adults, that have had a problem or illness caused by eating a food or foods (n=51)		
	n	%	95% CI
Nuts	10	19.6	9.8-33.1
From them:			
Hazelnuts	3	5.9	1.2-16.2

Food	Adults, that have had a problem or illness caused by eating a food or foods (n=51)		
	n	%	95% CI
Peanut	2	3.9	0.5-13.5
Vegetables	6	11.8	4.4-23.9
From them:			
Carrot	2	3.9	0.5-13.5
Potato	2	3.9	0.5-13.5
Tomato	1	2.0	0.1-10.5
Fish	1	2.0	0.1-10.5
From it:			
Whitefish, cod, plaice	1	2.0	0.1-10.5
Fruits and berries	17	33.3	20.8-47.9
From them:			
Apple	3	5.9	1.2-16.2
Kiwi	1	2.0	0.1-10.5
Lemon	1	2.0	0.1-10.5
Orange (mandarin)	5	9.8	3.3-21.4
Strawberry (wild-strawberry)	1	2.0	0.1-10.5
Milk and dairy	2	3.9	0.5-13.5
From it:			
Cow's milk	1	2.0	0.1-10.5
Meat	0	0	-
Cereals	1	2.0	0.1-10.5
From them:			
Buckwheat	1	2.0	0.1-10.5
Crustaceans	1	2.0	0.1-10.5
From them:			
Shrimp	1	2.0	0.1-10.5
Cacao	0	0	-
Chocolate	5	9.8	3.3-21.4
Egg	3	5.9	1.2-16.2
Spice, herbs, seeds	1	2.0	0.1-10.5
From them:			
Sunflowers' seed	1	2.0	0.1-10.5
Soya	0	0	-
Others	12	23.5	12.8-37.5

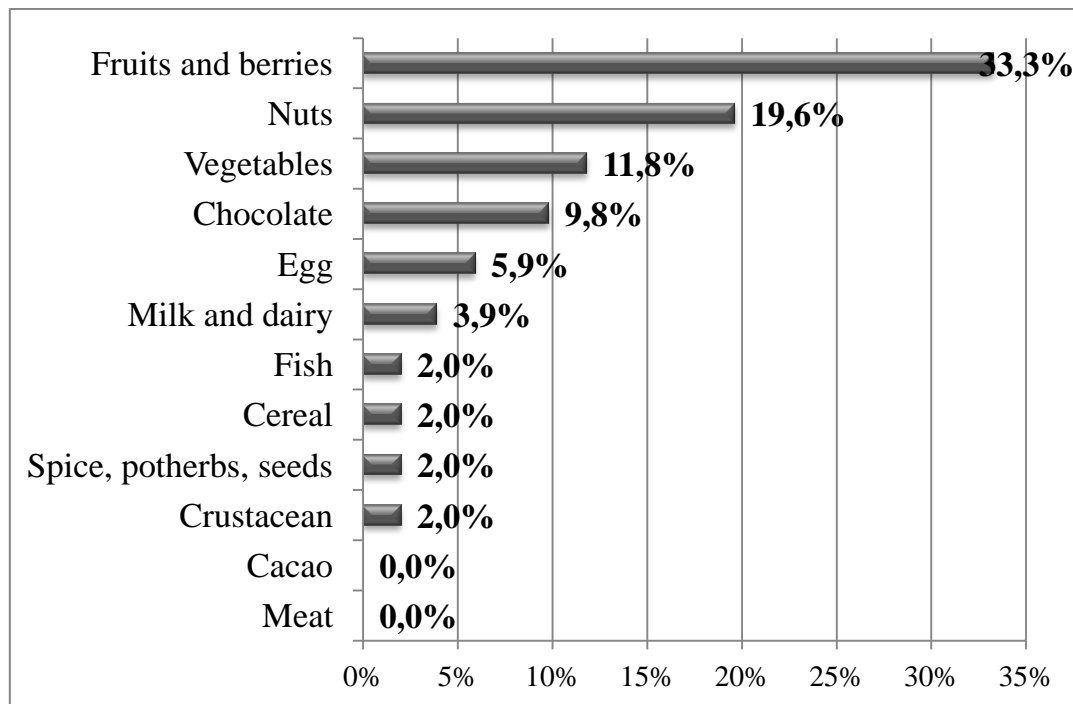


Figure 7. Distribution of food groups, that caused clinical symptoms to adults

Consequently, we see that the most important and relevant foods to adults are fruits and berries, also nuts.

3.3. Peculiarities of the prevalence of IgE mediated food allergy

Parents of 205 children and 56 adults agreed to take part in the second, case-control phase of the study, although after familiarising with information sheet and consent form, 19 parents of children refused to perform blood test, 29 refused to be interviewed, 11 in the adults study refused to be interviewed.

There were 92 (46.7%) boys and 105 (53.7%) girls, from 7 to 12 years age (average age – 9.3 ± 1.3 ; median – 9 years), in the children group. There were 21 (42.0%) men and 29 (58.0%) women, from 21 to 54 years age (average age – 38.0 ± 10.1 ; median – 38 years), in the adult group.

The main task in this part of the study was to determine the presence of IgE mediated food allergy by taking blood samples. After blood samples analysis, food allergy was identified to 42 children and 11 adults

We compared these results with those we got earlier from the first phase (Tables No. 7 and 8). We see, that for the majority (41.4%) of children IgE mediated food allergy was not identified, although they have had adverse reactions from food. For the majority of adults (73.2%) IgE mediated food allergy was not identified and they have not had adverse reactions to food.

Table 7. Distribution of children by identified IgE mediated food allergy and adverse reactions to food

Adverse reactions to food	IgE mediated food allergy		Total
	Was identified	Was not identified	
Have had	39 (21.0%)	77 (41.4%)	116 (62.4%)
Have not had	3 (1.6%)	67 (36.0%)	70 (37.6%)
Total	42 (22.6%)	144 (77.4%)	186 (100%)

Table 8. Distribution of adults by identified IgE mediated food allergy and adverse reactions to food

Adverse reactions to food	IgE mediated food allergy		Total
	Was identified	Was not identified	
Have had	4 (7.1%)	4 (7.1%)	8 (14.3%)
Have not had	7 (12.5%)	41 (73.2%)	48 (85.7%)
Total	11 (19.6%)	45 (80.4%)	56 (100%)

Thus, the “prognostic” prevalence of IgE mediated food allergy could be 21% (95% CI [15.4–27.5]), among children, who have trouble or illness caused by eating a food or food, and 1.6% (95% CI [0.03–4.6]) among those, who have not. While it could be 7.1% (95% CI [2.0–17.3]) in adults, that have trouble or illness caused by eating a food or food, and 12.5 (95% CI [5.2–24.1]) that have not.

After analysing these data by gender, we determined that IgE mediated food allergy was identified to boys more frequent than to girls (26.2 and 17.0% respectively), but the difference was not statistically significant ($p = 0.191$); $PR = 1.539$; 95% CI [0.87–2.73]. IgE mediated food allergy was also more frequent among men than women (23.8 and 13.8% respectively), but the difference was not statistically significant ($p = 0.464$); $PR = 1.726$; 95% CI [0.53–5.67].

We did analysis on how many foods one was allergic to (from 25 possible). Children were mostly (41.5%) allergic to one (average number of food – 5.5 ± 1.1 , median – 2); 63.4% of children were allergic to 1–3 food. Five (12.2%) children were allergic to more than 20 foods. 45.5% of adults were allergic to 1–3 foods; 2 (18.2%) – to more than 20 (average number – 8.8; median – 4).

Hereinafter we present the data on foods, to which our study participants were allergic to (Table 9). The most relevant foods for children with IgE mediated food allergy were cow’s milk (43.9%), hazelnut (41.5%), kiwi and celery (36.6%). The most relevant foods among adults were hazelnut, peach and kiwi (54.5%). There were no allergic to fish.

Table 9. Distribution of foods for which IgE mediated food allergy was identified

Foods	Children with identified IgE mediated food allergy (n=41*)			Adults with identified IgE mediated food allergy (n=11)		
	n	%	95% CI	n	%	95% CI
Nuts:	17	41,5	26.3-57.9	8	72.7	39.0-94.0
Hazelnut	17	41.5	26.3-57.9	6	54.5	23.4-83.3
Peanut	7	17.1	7.2-32.1	4	36.4	10.9-69.2
Walnut	6	14.6	5.6-29.2	3	27.3	6.02-61.0
Vegetables:	16	39.0	24.2-55.5	6	54.5	23.4-83.3
Celery	15	36.6	22.1-53.1	3	27.3	6.02-61.0
Carrot	13	31.7	18.1-48.1	4	36.4	10.9-69.2
Corn	7	17.1	7.2-32.1	4	36.4	10.9-69.2
Tomato	11	26.8	14.2-42.9	4	36.4	10.9-69.2
Lentil	7	17.1	7.2-32.1	3	27.3	6.02-61.0
Fish (cod)	2	4.9	0.6-16.5	0	0	0-28.5
Fruits:	25	61.0	44.5-75.8	10	90.9	58.7-99.9
Apple	12	29.3	16.1-45.5	3	27.3	6.02-61.0
Banana	12	29.3	16.1-45.5	4	36.4	10.9-69.2
Kiwi	15	36.6	22.1-53.1	6	54.5	23.4-83.3
Melon	6	14.6	5.6-29.2	4	36.4	10.9-69.2
Peach	13	31.7	18.1-48.1	6	54.5	23.4-83.3
Cow's milk	18	43.9	28.5-60.3	1	9.1	0.23-41.3
Cereals:	10	24.4	12.4-40.3	5	45.5	16.8-76.6
Buckwheat	7	17.1	7.2-32.1	5	45.5	16.8-76.6
Wheat (flour)	10	24.4	12.4-40.3	5	45.5	16.8-76.6
Rice	5	12.2	4.1-26.2	5	45.5	16.8-76.6
Crustaceans (shrimp)	1	2.4	0.1-12.9	1	9.1	0.23-41.3
Egg	7	17.1	7.2-32.1	1	9.1	0.23-41.3
Spice, herbs, seeds	10	24.4	12.4-40.3	6	54.5	23.4-83.3
Sunflower's seed	8	19.5	8.8-34.9	4	36.4	10.9-69.2
Sesame seed	8	19.5	8.8-34.9	5	45.5	16.8-76.6
Soy	7	17.1	7.2-32.1	3	27.3	6.02-61.0
Poppy seed	7	17.1	7.2-32.1	3	27.3	6.02-61.0
Mustard	6	14.6	5.6-29.2	3	27.3	6.02-61.0
* Allergen mix fx6 (wheat, corn, sesame, buckwheat, rice)	1					

We also asked to point which food gave one the worst problems. Milk and dairy were mentioned mostly both in the children (34.6%) and in the adults (33.3%) groups.

We checked which symptoms manifested to those, whom IgE mediated food allergy was identified. Rashes, urticarial rash or itchy skin were the most common symptoms among allergic children (31.0%) and adults (27.3%).

3.4. Potential risk factors for food allergy

In the second study phase, we also evaluated the potential risk factors for development of food allergy. The distribution of risk factors among those with identified food allergy and those with no food allergy is presented in Table 10 (children) and Table 11 (adults).

Table 10. Evaluation of risk factors and comparison in children by identified food allergy

Risk factors	Food allergy was identified		Food allergy was not identified		OR	95% CI	p (χ^2)
	n	%	n	%			
Gender:					1.73	0.81-3.82	0.136 (2.221)
- boys	22	57.9	62	44.3			
- girls	16	42.1	78	55.7			
Mother's smoking during pregnancy:					2.69	0.63-13.89	0.272*
- yes	2	6.3	3	2.4			
- no	30	93.8	121	97.6			
Mother's alcohol drinking during pregnancy					0.57	0.15-1.75	0.570*
- yes	3	9.4	19	15.3			
- no	29	90.6	105	84.7			
Infant birth-rate:					0.46	0.26-2.59	0.686*
- low (<2,5 kg)	1	3.1	8	6.5			
- normal	31	96.9	115	93.5			
Natural feeding:					0.66	0.28-1.55	0.327 (1.077)
≥5 months	14	43.8	67	54.0			
≤4 months	18	56.2	57	46.0			
Mother's asthma:					1.1	0.32-4.60	1.0*
- had	2	6.2	7	5.7			
- did not have	30	93.8	115	94.3			
Mother's food allergy:					1.76	0.63-4.40	0.238 (1.391)
- had	8	26.7	19	17.1			
- did not have	22	73.3	92	82.9			
Anyone was smoking in the family during first 2 years of life:					0.79	0.23-1.82	0.61 (0.261)
- yes	8	26.7	39	31.5			

Risk factors	Food allergy was identified		Food allergy was not identified		OR	95% CI	p (χ^2)
	n	%	n	%			
- no	22	73.3	85	68.5			
Treatment with antibiotics during firsts 2 years of life:					0.87	0.37-2.38	0.736 (0.113)
- yes	22	68.8	89	71.8			
- no	10	31.2	35	28.2			

* Fisher's exact test

Table 11. Evaluation of risk factors and comparison in adults by identified food allergy

Risk factors	Food allergy was identified		Food allergy was not identified		OR	95% CI	p
	n	%	n	%			
Gender:					0.512	0.09-2.49	0.464*
- female	4	44.4	25	61.0			
- male	5	55.6	16	39.0			
Smoking:					1.96	0.33-10.00	0.459*
- yes	5	62.5	17	45.9			
- no	3	37.5	20	54.1			
Asthma:					6.80	1.06-43.48	0.059*
- yes	3	37.5	3	8.1			
- no	5	62.5	34	91.9			
Nasal allergies:					4.50	0.79-25.51	0.095*
- yes	5	62.5	10	27.0			
- no	3	37.5	27	73.0			
Skin allergy:					1.62	0.32-9.30	0.672*
- yes	3	37.5	10	27.0			
- no	5	62.5	27	73.0			
Anyone in the family with asthma:					1.18	0.52-13.77	1
- yes	1	12.5	4	10.8			
- no	7	87.5	33	89.2			
Anyone in the family with other allergy:					0.62	0.17-3.53	0.699
- yes	2	25.0	13	35.1			
- no	6	75.0	24	64.9			
Mother's asthma:					0.81	0.7-0.92	1.0*
- yes	0	0.0	2	5.4			
- no	8	100	35	94.6			

Risk factors	Food allergy was identified		Food allergy was not identified		OR	95% CI	p
	n	%	n	%			
Mother's other allergy:					0.80	0.66-0.92	0.572*
- yes	0	0,0	6	16.2			
- no	8	100	31	83.8			
Father's asthma:					0.82	0.70-0.93	1.0*
- yes	0	0.0	1	2.7			
- no	8	100	36	97.3			
Father's other allergy:					1.18	0.51-14.60	1.0*
- yes	1	12.5	4	10.8			
- no	7	87.5	33	89.2			
Respiratory infection:					0.79	0.65-0.92	0.321*
- had	0	0.0	7	18.9			
- did not have	8	100	30	81.1			

* Fisher's exact test

As we see, there were no statistically significant results in analysis for association of food allergy and potential risk factors. This was mostly influenced by small number of observations. The actual study power was also low and was likely to be influenced by systemic self-selection error.

After evaluation of risk factors in children group by stepwise multivariate logistic regression, we designed a statistically significant model with these variables – child gender and mother's food allergy (Table 12).

Table 12. Evaluation of the model for risk factors "child gender and mother's food allergy"

Risk factor	OR _C	OR _A	95% CI
Gender (boy)	2.24	3.36	1.17-9.63
Mother had food allergy	1.92	5.44	1.19-24.97

OR_C – crude odds ratio; OR_A – adjusted odds ratio

Likelihood-ratio $\chi^2 = 8.12$; df = 3; n = 126

Model's p = 0.0436

Gender (male) (OR = 3.36) and mother's food allergy (OR = 5.44) are prognostic factors directly associated with child's food allergy. But on the presence of those both two factors (gender + mother's allergy), risk for having food allergy increases particularly. According to the designed model, prognostic association between these variables and child's food allergy is very strong – OR = 18.3; 95% CI [2.02–166.04] (Table 13).

Table 13. Evaluation of the model for risk factors “child gender + mother’s food allergy”

Factor	OR	SE	z	p	95% CI
Gender (male) + mother’s food allergy	18.31	20.60	2.58	0.010	2.01-166.07

Due to the small sample size of adults group, exact logistic regression was used. We designed a statistically significant model with these variables – asthma and nasal allergies (Table 14).

Table 14. Evaluation of the model for risk factors “asthma and nasal allergies”

Factor	β coef.	p	OR	95% CI
Asthma	1.45	0.268	4.26	0.40-43.47
Nasal allergies	1.13	0.200	3.09	0.43-24.94

n = 45; model score = 8.810; p = 0.034

As we see, we cannot state that there is a strong association between food allergy and asthma (OR = 4.26; 95% CI [0.40–43.47]; p = 0.268) or nasal allergies (OR = 3.09; 95% CI [0.43–24.94]; p = 0.200).

3.5. School administrations perception of food allergy

128 participants from staff of the school administrations in Vilnius were involved in the study. 118 (92.2%) of questionnaires were used for further analysis. 72 (61.0%) of participants were health care professionals (school nurses or public health professionals), 32 (27.1%) were teachers and 14 (11.9%) other personnel (headmaster, deputy, psychologists, social pedagogue).

We asked if a responder was aware of any child with food allergy in the last 3 years. The majority of them (55.1%) answered, that there were no children with food allergy in their school. Other responses varied from 1 to 28, but mostly 1. The majority (61.9%) knew exactly which children are with any chronic condition or need special medical care. 56.2% responded, that it is possible to get information about children with food allergy. This information is mostly provided with child health check-up forms, filled every year by general practitioners or family doctors. Information provided by parents was also important. 15.3% indicated that their school has a separate list of children with food allergy.

We also asked if a responder knows, to what kind of food a child or children were allergic, if there any child. The most frequently mentioned foods were milk and dairy (45.8%), citrus fruits (43.8%), fish (27.1%), chocolate (25.0%) and egg (22.9%).

The schools staff was also asked, if they knew any symptoms of food allergy. 91 (77.0%) answered positively. Skin symptoms were mentioned most frequently (even 96.7% of responders mentioned them). Respiratory symptoms were mentioned by 37.4% and gastrointestinal tract symptoms – by 18.7%. 45.1% of responders also mentioned other symptoms.

Only 26.3% indicated that they were educated in food allergy in the last 3 years. Only 11.9% responded to have a “no-sharing” policy for food in the schools.

We were interested if a school has a plan of action to manage food allergy. The majority of responders (51.7 %) indicated that there is a general plan on how to deal with health issues, although 16.9% indicated, that it includes actions if a severe episode of food allergy happens (Fig. 8).

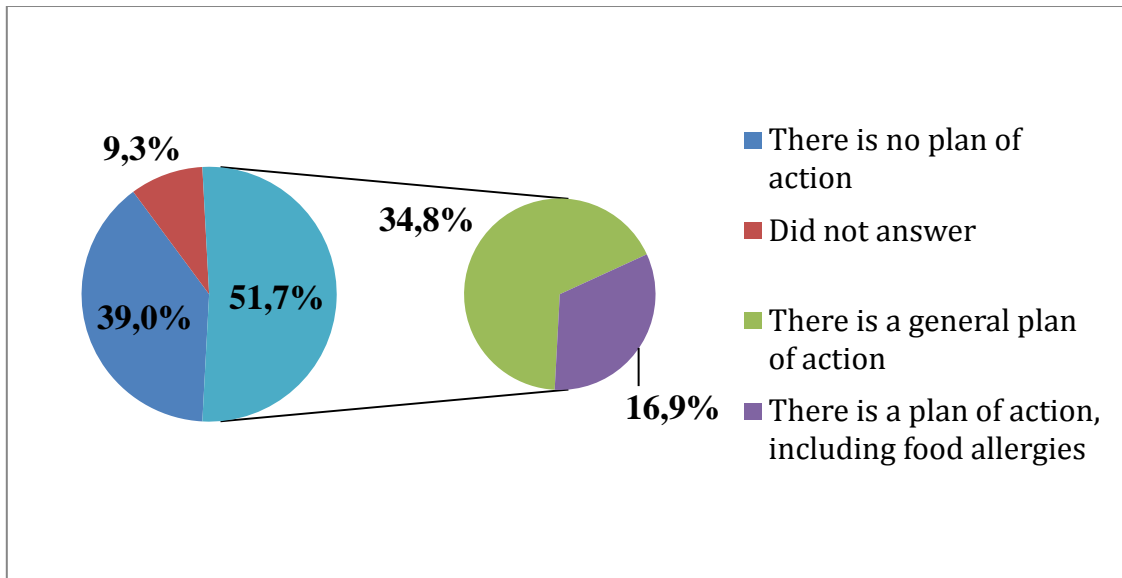


Figure 8. The presence of action plan, covering health issues, at schools

In case of severe episode of food allergy, the majority of schools staff (58.5%) would call emergency, only 7.6% would inject epinephrine (Fig. 9).

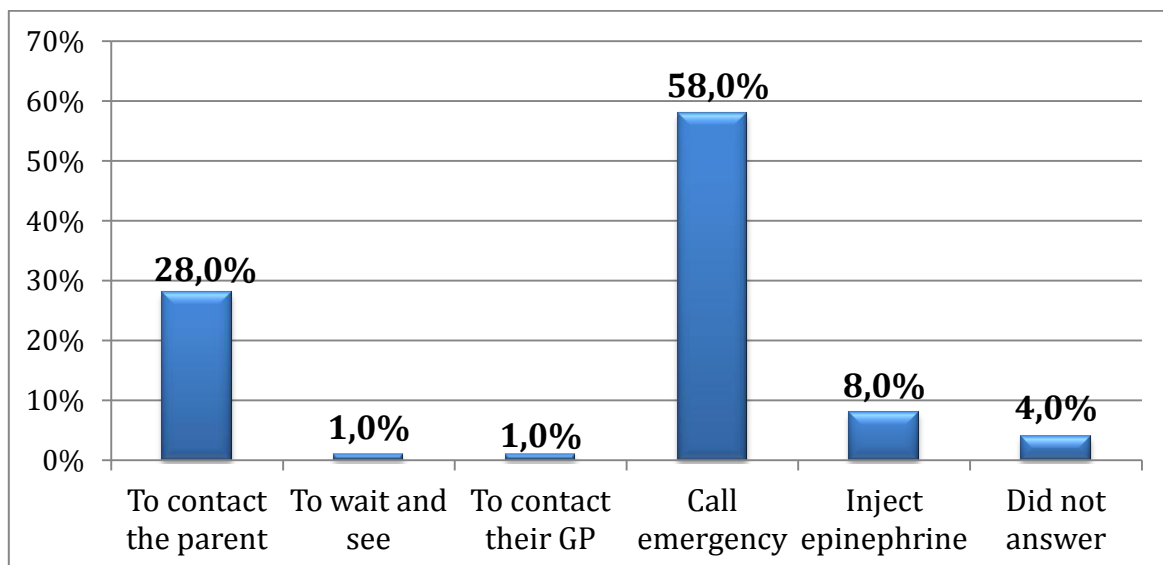


Figure 9. Priority action in case of severe food allergy episode in the school

The preference of priority actions significantly differs among responders in different position ($p = 0.002$). Teachers would mostly contact the parent while health care professionals would call emergency.

17.8% of responders indicated, that epinephrine is available at the school. In all cases, it is stored in health care room. Even 52.4% did not know for what purpose it could be used.

The majority of responders (82.2%) were not aware of any charity whose main aim was to increase awareness of food allergy.

The participants of the study we asked to evaluate the degree of concern on food allergy in the school on a scale from 0 to 100: 49.2% evaluated one's degree as low (0–30) and explained this, as there are not many children with food allergy, children do not eat the foods they are allergic to, there was not any accident of food allergy, there are many more important things, there is a lack of resources to pay attention for separate menu or staff education, parents and GP provide only limited information, health issues in the school are managed by health professional only. 8.5% of responders evaluated this degree as high (70–100) and explained that the number of children with food allergy is increasing, the number of ill children is increasing, and youth's nutrition is often unhealthy. By the opinion of majority (61.9%) food allergy is of less relevance in comparison to other health issues.

Results of our study corresponds to that of many others – a substantial proportion of the population reports adverse reactions to food, while, relatively, few of these complaints represent true IgE-mediated responses. However, IgE-mediated food allergy is just one part of the food hypersensitivity or adverse reactions. In addition, this problem will not lose its relevance, as, according to other studies, numbers in prevalence and incidence with its social and economic aspects and burden, are increasing.

According to the EuroPrevall results from Lodz (Poland), a part of children, that have had adverse reactions to food, is similarly large as ours (41.6 and 46.9% respectively). But the results in adults group differ (28.9% in Lodz and 1.9% in Vilnius). In our opinion, parents overestimated the problems of their children, when answering children questionnaire, while adults underestimated their own problems.

Our results also corresponds to others, analysing gender differences, stating that food allergy is more prevalent in boys and then later on in women.

We can find as many similarities as dissimilarities when looking the foods that cause adverse reactions. It is closely connected to culture, traditions, nutritional habits, climate, and etc. Globalization and immigration-emigration also affects the distribution of foods.

Our findings on risk factors to child food allergy also correspond to other studies. Hereditary is often stated as a strong risk factors for allergies. Prevalence of asthma and other allergic diseases is often higher among boys up 10 years old, but later on, it increases among girls and women.

Management of acute health disorders at schools is complicated, as availability of epinephrine is scarce. The possibility to use EpiPens should be studied.

4. CONCLUSIONS

1. The prevalence of adverse reactions to food differs significantly among children and adults: it reaches even 46.9% among children and only 1.9% among adults. Food allergy was diagnosed by a doctor to 16.4% of children and 0.6% of adults.
2. Boys and girls similarly suffered from adverse reactions to food (48.1 and 45.6% respectively), but food allergy was diagnosed to boys more frequent than girls (18.1 and 14.8 respectively). In adults group, women suffered from adverse reactions to food more frequent than men and food allergy was also diagnosed more frequent to them.
3. The prevalence of adverse reactions to food is associated with child age and it increases from 6 to 10 years. It is also associated with adult's age and it has a decreasing trend.
4. The most common symptoms from adverse reactions to food among children were diarrhoea or vomiting and a rash, urticarial rash or itchy skin. These were also the most common symptom among adults.
5. Fruits and berries (24.6%), milk and dairy (19.4%) were the most relevant foods to cause symptoms. Fruits and berries, nuts and vegetables were the most relevant foods among adults. The most relevant foods for children with IgE mediated food allergy were cow's milk (43.9%), hazelnut (41.5%), kiwi and celery (36.6%). The most relevant foods to adults with IgE mediated food allergy were hazelnut, peach and kiwi (54.5%).
6. Gender (male) (OR = 3.36) and mother's food allergy (OR = 5.44) are prognostic factors directly associated with child's food allergy. But on the presence of those both two factors (gender + mother's allergy), risk for food allergy increases in particular. According to the designed model, prognostic association between these variables and child food allergy is very strong – OR = 18.3; 95% CI [2.02–166.04].
7. Schools administration has some knowledge regarding food allergy. However, it is not enough. There was lack of written school policies to deal with food allergy and it was difficult to get EpiPens in schools. That is why it is important to give more attention to schools staff education about food allergy.

5. RECOMENDATIONS

1. Food allergies seriously affect the health of patients, their relatives, and their daily activities; it is a significant financial burden to the state as well. Therefore, management of these diseases, which consists of education, prevention and treatment of acute reactions, must be continuously developed in order to determine the most effective ways to reduce the burden of disease

- on patients and society. Knowledge of extent of the problem is the first step in the way to solve it.
2. Not only the medical society should involve in the process, but also purposefully shaped public health policy, actively pursued patient and public education is important. It is a need to find more optimal options for allergy diagnosis for the patient to minimize confusion and dispatching to the specialists. It is important to create favourable conditions for food-allergic persons, helping them to fully adapt to life by reduction of emotional and social damage, caused by disease. This can be achieved through such tools as improvement of food labelling system, introduction of more strict requirements for labelling and food composition, as well as by searching of other food market safety related activities. Such actions should be taken at both international and national context.
 3. As food allergies are increasing among children worldwide, inevitably there will come more of such to schools. Therefore, schools have to be ready. It is recommended:
 - to have a list of children with food allergy;
 - to have a plan of action in case of severe food allergy episode;
 - to educate schools' staff and children how to read food labels.
 4. We propose to analyse more the aspects of emergency health care at schools, especially in case of severe reactions and the possibility to use EpiPens.
 5. Our results could be used for further studies and implementation of national scientific programs. In Lithuania, it is essential to conduct educational activities and to teach not only the patients and their family members, but also the general society, highlighting both the concept of allergy and its patterns, the risk factors of this disease. This knowledge should be constantly updated, so it is necessary to continue research in food allergy.

List of publications

- Kavaliūnas A, Šurkienė G, Dubakienė R, Stukas R. [Prevalence of hypersensitivity to food among Vilnius citizens]. *Visuomenės sveikata (Public Health)*. 2011;3(54):70-77.
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Submitted papers:

- Rūta Dubakienė, Andrius Kavaliūnas, Genė Šurkienė, Rimantas Stukas, Kęstutis Žagminas. Jurgita Šaulytė, Clare Mills, Peter G. J. Burney, Ischa Kummeling. Prevalence of food allergies among Vilnius city primary schools children (*Medicina Journal*).
- Andrius Kavaliūnas, Genė Šurkienė, Rūta Dubakienė, Rimantas Stukas. [Prevalence and pattern of ailments caused by hypersensitivity to food among Vilnius citizens] (*Medicinos teorija ir praktika [Theory and Practice in Medicine] Juornal*).
- Andrius Kavaliūnas, Genė Šurkienė, Rūta Dubakienė, Kęstutis Žagminas, Rimantas Stukas. Prevalence of food allergy among Vilnius city primary schools children (*Biologija [Biology] Juornal*).

Oral presentations:

- A. Kavaliūnas “Prevalence of food allergy among Vilnius city primary schools children“ at the III (65th) International Congress of medical students and young scientists “Actual Problems of Modern Medicine“ 12–14 of October, Kiev, Ukraine, organized by Ministry of Public Health of Ukraine, National O.O. Bohomolets Medical University, O.A. Kysil Students Scientific Society, Young Scientists and Specialists Society (1st place in the public health, social medicine and history of medicine section).
- A. Kavaliūnas “Prevalence of self-reported adverse reactions to food among Vilnius city primary schools children“ at the “1st International Health Science Conference“, 26–28 of May, 2011, in Kaunas, Lithuania, organized by Lithuanian University of Health Sciences (2nd place in the public health section).
- A. Kavaliūnas, G. Šurkienė, R. Dubakienė, R. Stukas “Prevalence of self-reported adverse reactions to food among Vilnius city primary schools children“ at the 5th international scientific conference „The Vital Nature Sign“, 19–21 of May, 2011, in Birštonas and Kaunas, Lithuania, organized by Vytautas Magnus University.
- A. Kavaliūnas “Prevalence of food allergies among Vilnius city primary schools children” at the international conference of young scientists “Young people in science – 2011” (Международная конференция молодых ученых «Молодежь в науке – 2011»), 25–29 of April, Minsk, Belarus, organized by National Academy of Sciences of the Republic of Belarus (2nd place in the medical sciences section).
- A. Kavaliūnas [Prevalence of food allergies among Vilnius city inhabitants] at the 4th national scientific conference of doctoral students [Science – to Health], 7th of April, 2011, in Kaunas, Lithuania, organized by Lithuanian University of Health Sciences.

- A. Kavaliūnas [Prevalence of food allergies among Vilnius city primary schools children] at the 3rd national scientific conference of doctoral students [Science – to Human Health], 7th of April, 2010, in Kaunas, Lithuania, organized by Kaunas University of Medicine.
- A. Kavaliūnas, R. Dubakienė “Epidemiology of food allergy among children in Vilnius (Lithuania)” at the 7th EuroPrevall Congress, 14-17 of May, Berlin, Germany.
- A. Kavaliūnas, R. Dubakienė “Epidemiology of food allergy: progress in Vilnius (Lithuania)” at the 6th EuroPrevall Congress, 16-19 of October, Warsaw, Poland.
- A. Kavaliūnas, R. Dubakienė “EuroPrevall Epidemiology Study – Vilnius Report” at the EuroPrevall WP 1.2 meeting, 2nd of October, 2007, Amsterdam, The Netherlands.

Poster presentations:

- A. Kavaliūnas, R. Dubakienė, G. Šurkienė, R. Stukas “Prevalence of self-reported adverse reactions to food among Vilnius city primary schools children” at the “Baltic Public Health Conference 2010 – Accomplishments and Challenges”, 23–25 of September, 2010, in Tartu, Estonia, organized by Tartu University, Estonian National Institute for Health Development, Estonian Ministry for Social Affairs (Best Poster Award).
- Poster presentation by A. Kavaliūnas, G. Šurkienė, R. Dubakienė, R. Stukas “Prevalence of food allergy among Vilnius city primary schools children” is accepted to European Public Health Conference “Public Health and Welfare – Welfare development and health”, 9–12 of November, 2011, in Copenhagen, Denmark.

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REZIUMĖ

Tiriamoji problema

Paskutiniais dešimtmečiais didėja sergamumas alerginėmis ligomis, taip pat ir alergija maistui. Tai tampa svarbia sveikatos problema. Pagrindiniai rizikos veiksniai, didinantys alerginių ligų paplitimą, yra įvairūs: genetinis polinkis, alergenų gausa, aplinkos teršalai, sumažėjęs imuninės sistemos atsakas kritiniais individo vystymosi periodais. Todėl alergijos gali būti traktuojamos kaip moderniosios civilizacijos ligos ir joms siūloma taikyti bendro sveikatos sutrikimo sąvoką.

Maistas – integrali kiekvieno žmogaus gyvenimo dalis, tačiau alergija maistui ir jo natūralioms ar dirbtinėms sudedamosioms dalims gali būti pavojinga ar net mirtina ir ypač vaikams sukelia daug varginančių fizinių ar net psichologinių negalavimų. Alergija maistui tampa labai rimta problema ne vien tik daugeliui vaikų bei tėvų, tačiau taip pat visam medicinos personalui bei gyventojų bendruomenei. Alergija maistui paliečia įvairaus amžiaus žmonių grupes. Kadangi nustatyto maisto produkto nevertojimas yra pagrindinis ir efektyviausias šios ligos gydymo būdas, todėl tokių pacientų gyvenimo kokybė ypač nukenčia – alergiški žmonės turi priprasti prie papildomo diskomforto, nes nuolatos turi kontroliuoti tai, ką valgo, dėl to iškyla papildomų sunkumų socialiniame gyvenime. Pacientų (arba alergiškų vaikų tėvų) nerimas dėl galimų sunkių reakcijų gali sąlygoti socialinę izoliaciją ar net psichinės sveikatos problemas. Prie problemos aktualumo prisideda ir faktas, kad nors alergijos maistui diagnostikos ir gydymo būdai medikams turėtų būti gerai žinomi, moksliniais tyrimais nustatyta, kad specialistų žinios nėra pakankamos; alergija maistui dažnai diagnozuojama arba netinkamai gydoma; pacientai net po anafilaksinio šoko išrašomi iš liginės be tolimesnės alergologo konsultacijos ar recepto adrenalinui, tuo pačiu su nebūtiniais mitybos suvaržymais.

Finansinė ir socialinė našta, susijusi su šia liga, vis didėja, todėl mokslininkai aktyviai įsitraukia į galimų sprendimų būdų paiešką, siekdami išsiaiškinti, kaip galima būtų palengvinti tokių pacientų ir jų artimųjų gyvenimą bei sumažinti našta valstybei. Šios problemos valdymui svarbūs tokie veiksniai kaip teisingas gydytojo santykis su pacientu, diagnozės tikslumas ir detalumas, pacientų bei jų artimųjų mokymas ir teisingas (detalus) maisto produktų ženklavimas. Daugeliu atvejų šią problemą palengvinti gali ne vien tik medicinos personalas ar pats ligonis, bet taip pat priimami kryptingi politiniai sprendimai, arba atitinkama privataus sektoriaus veikla, pvz., tam tikro maisto produkto gamintojo apsisprendimas ryškiais užrašais ženklinti savo produktų pakuotėse informaciją apie specifinių alergenų buvimą arba nebuvimą juose.

Darbo aktualumas

Manoma, kad maisto produktų, galinčių sukelti alergines reakcijas, skaičius didėja, sunkių alerginių reakcijų gausėja, tačiau patikimos informacijos, nusakančios tikslų šios problemos mastą, trūksta. Alergijos maistui paplitimas tarp vaikų, ypač jaunesnio amžiaus, pradinukų, taip pat kelia didelį susidomėjimą, kadangi atliktų tyrimų duomenimis jis yra didesnis nei tarp suaugusiųjų. Kartu su visomis socialinėmis ir

ekonominėmis pasekmėmis bei poveikiu visuomenės sveikatai, alerginių reakcijų maisto produktams prevencija ir gydymas tampa didžiu iššūkiu mokslininkams, medikams, politikams, visuomenei.

Tyrimai, atlikti buvusiose Rytų ir Vakarų Vokietijose parodė, kad yra nemažai skirtumų tarp Vakarų Europos ir Rytų Europos, ypač postkomunistinių jos šalių, gyventojų sergamumo alerginėmis ligomis. Senosiose Europos Sąjungos šalyse jos vargina apie 35,0 proc. žmonių. Vartojama vis naujų maisto produktų, medikamentų, pramonėje ir aplinkoje vis daugiau cheminių medžiagų. Tokiomis sąlygomis atsiranda naujų alergenų, be to, kinta jau žinomi.

Apklausų duomenys rodo, kad nuo 3 iki 35 proc. suaugusiųjų mano, jog jie ar jų vaikai kenčia nuo alergijos maistui, tačiau atliktų tyrimų duomenimis, maistui alergiški 6–8 proc. mažų vaikų (iki 3 m.), 3–5 proc. vyresnių vaikų ir 1,5–3 proc. suaugusiųjų. Visgi, įvertinti tikslų alergijos maistui paplitimą sunku, nes įvairiose šalyse atliktų epidemiologinių tyrimų duomenys skiriasi metodais ir ištirtų asmenų amžiumi. Pažymėtina, kad alergija maistui dažniau nustatoma žmonėms, sergantiems kitomis atopinėmis ligomis: alergija maistui diagnozuojama 33–40 proc. vaikų ir jaunuolių, sergančių vidutinio sunkumo ir sunkiu atopiniu dermatitu, ir apie 6–17 proc. vaikų, sergančių astma. Taigi skirtingas šių alerginių ligų paplitimas ne tik įvairiose amžiaus grupėse, bet ir atskirose šalyse, naujų alergenų gausa sąlygoja būtinumą toliau gilintis į šią visuomenės sveikatos problemą.

Mokslinis darbo naujumas

Lietuvoje tyrimų alerginių ligų dėsningumams nustatyti trūksta, o alergija maistui dažniausiai tyrinėjama asmens sveikatos aspektu (diagnostikos ir gydymo principai).

Šiuo tyrimu pirmą kartą Lietuvoje ištirtas padidėjusio jautrumo maistui ir alergijos maistui paplitimas tarp vaikų ir suaugusiųjų. Nustatyta alergijos maistui struktūra, įvertinti alergijas sukeliantys maisto produktai, išnagrinėti maisto alergijų simptomai, išanalizuotas mokyklų darbuotojų vaidmuo, taikomos priemonės ir pagalba mokyklose.

Darbe, siekiant metodologinio vieningumo, panaudota bendra EuroPrevall projekto metodika, specialiai šio projekto tikslams sukurti klausimynai. Tiriant maisto alergijų paplitimą iš karto atlikti keli tyrimai skirtingose populiacijos amžiaus grupėse – tarp vaikų ir tarp suaugusiųjų – iš viso daugiau nei 8000 tyrimo dalyvių. Tyrimo tikslams pasiekti organizuoti du skirtingo tipo epidemiologiniai tyrimai, papildantys vienas kitą – paplitimo ir atvejo-kontrolės, kurio metu atlikti objektyvūs laboratoriniai kraujo tyrimai alergijos maistui diagnozės nustatymui. Lietuvoje tai vienas didžiausių tokio masto tyrimų (EuroPrevall – didžiausio masto mokslinis alergijos maistui tyrimas Europoje). Be to, surinkti Vilniaus gyventojų kraujo mėginiai bus naudojami tolesnei DNR, iRNR analizei ir genetiniams tyrimams bei padės sudaryti rizikos veiksnių bendrą Europos duomenų bazę.

Praktinė darbo reikšmė

Šiame darbe panaudoti Europos Sąjungos (ES) finansuojamo projekto EuroPrevall (angl. *The Prevalence, Costs, and Basis of Food Allergy across Europe*) įgyvendinimo Lietuvoje metu surinkti duomenys.

Projekte dalyvavo 67 partneriai iš 24 šalių: 17 ES šalių, Šveicarijos, Islandijos, o taip pat Ganos, Naujosios Zelandijos, Australijos, Rusijos, Kinijos ir Indijos. Geografinė įvairovė suteikė šiam projektui įvairų kultūros, mitybos įpročių ir aplinkos, klimatinė bei geografinių veiksnių spektrą. Šio projekto išdavoje Lietuva, kaip šalis narė, taip pat atsirado atliktų epidemiologinių tyrimų žemėlapiuose, kartu su Lenkija reprezentuojanti Rytų Europos regioną su jam būdingais paminėtais kultūriniais, socialiniais aspektais, įtakančiais ir mitybos įpročius, ir maisto alergijų epidemiologinę situaciją šalyje, kartu atskleidžiant ir leidžiant daryti palyginimus apie nagrinėjamą problemą tarptautiniu kontekstu. Tyrimas, atliktas Lietuvoje, kaip sudėtinė bendro projekto dalis, pasitarnavo kuriant EuroPrevall kraujo duomenų banką ir alergenu žinyną.

Tyrimo metu gauti duomenys bus panaudoti tolimesnėms studijoms ir efektyvių priemonių maisto alergijų valdymui paieškai, taip pat vykdomoms nacionalinėms mokslo programoms, skirtoms sutelkti Lietuvos mokslinį potencialą bei finansinius išteklius ir inicijuoti apibrėžtai problemai spręsti būtinus mokslinius tyrimus, „Sveikas ir saugus maistas“, „Lėtinės neinfekcinės ligos“. Gauti duomenys bus naudingi ateityje, lyginant juos su būsimų tyrimų rezultatais, vertinant paplitimo pokyčius, nagrinėjant šios ligos etiopatogenezę.

Lietuvių vaikams ir suaugusiems alergijos maistui sukeliama negalavimai, juos sukeliantys dažniausi produktai gali pasitarnauti gydytojų praktikoje, įtariant, diagnozuojant ir gydant šią ligą. Specialistams padės geriau suprasti šios ligos dėsningumus, jų svarbą.

Darbo tikslas

Nustatyti padidėjusio jautrumo maisto produktams ir alergijos maistui paplitimą bei pobūdį tarp Vilniaus miesto pradinių mokyklų mokinių ir suaugusiųjų gyventojų bei mokyklų administracijos darbuotojų požiūrį į alergiją maistui.

Darbo uždaviniai

1. Nustatyti padidėjusio jautrumo maisto produktams ir alergijos maistui paplitimą pagal lytį ir atskirose pradinių mokyklų mokinių ir 19-57 m. suaugusiųjų amžiaus grupėse
2. Išsiaiškinti pagrindinius padidėjusio jautrumo maistui ir alergijos maistui simptomus ir juos sukeliančius maisto produktus atskirose pradinių mokyklų mokinių ir 19-57 m. amžiaus suaugusiųjų grupėse
3. Nustatyti alergijos maistui sąsajas su motinos žalingais įpročiais (rūkymu ir alkoholio vartojimo nėštumo metu), kūdikių mažu gimimo svoriu ir žindymo trukme, lytimi, gydymu antibiotikais per pirmuosius dvejus gyvenimo metus
4. Įvertinti Vilniaus apskrities mokyklų administracijos darbuotojų požiūrį į alergiją maistui.

Metodika

Šiame darbe panaudoti Europos Sąjungos (ES) finansuojamo projekto EuroPrevall (angl. *The Prevalence, Costs, and Basis of Food Allergy across Europe*), kuriuo siekiama ištirti sąveikas tarp maisto patekimo į organizmą, jo metabolizmo, imuninės sistemos veiklos, genetinio fono ir socioekonominių veiksnių bei nustatyti esminius rizikos veiksnius maisto sąlygotoms ligoms ir alergijoms atsirasti ir sudaryti rizikos veiksnių bendrą Europos duomenų bazę, įgyvendinimo Lietuvoje metu surinkti duomenys. Šiame projekte dalyvavo Vilniaus universitetas, kartu su daugeliu kitų mokslinių tyrimų centrų Europoje. Įgyvendinant šį projektą siekiama integruoti gautus duomenis įvairių priemonių, reikalingų mokslininkams, sveikatos specialistams, politikams, įstatymų kūrėjams, gydytojams ir pacientams, vartotojams, taip pat maisto pramonei ir biotechnologijoms, kūrimui, kurios padėtų efektyviau valdyti maisto alergijas bei jas sukeliančius alergenų.

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Šio darbo tikslui ir uždaviniams pasiekti atlikti du skirtingi savo principais tyrimai – paplitimo (momentinis) ir atvejo-kontrolės. Pirmiausia atliktas paplitimo tyrimas, siekiant nustatyti, kiek tyrimo populiacijoje yra žmonių, kada nors sirgusių ar turėjusių negalavimų nuo suvalgyto maisto. Vėliau, norint patvirtinti ar atmesti alergijos maistui diagnozę, tyrimo dalyviai buvo kviečiami atlikti laboratorinius kraujo tyrimus, kartu interviu metodu apklausiant ir užpildant išsamų klausimyną apie vaikystę, šeimą, namų aplinką, darbą ir pan. Tokiu būdu sudarytos dvi (atvejo – laboratoriškai patvirtinta alergija maistui – ir kontrolės) grupės, leidžiančios daryti įvairius palyginimus apie galimas alergijos maistui priežastis.

Išvados:

1. Padidėjusio jautrumo maisto produktams paplitimas tarp vaikų ir suaugusiųjų žymiai skiriasi: jis siekė net 46,9 proc. tarp pradinių klasių mokinių ir tik 1,9 proc. tarp suaugusiųjų. 16,4 proc. visų vaikų ir 0,6 proc. suaugusiųjų alergija maistui buvo diagnozuota gydytojo.
2. Sirgusių ar negalavusių dėl suvalgyto maisto berniukų buvo beveik tiek pat, kiek mergaičių (48,1 ir 45,6 proc. atitinkamai), tačiau berniukams alergija maistui buvo diagnozuota dažniau nei mergaitėms (18,1 ir 14,8 proc. atitinkamai). Tarp suaugusiųjų daugiau moterų nei vyrų yra turėjusios negalavimų dėl suvalgyto maisto, taip pat joms dažniau buvo diagnozuota alergija maistui.
3. Padidėjusio jautrumo maisto produktams paplitimas yra susijęs su vaikų amžiumi ir didėja nuo 36,5 proc. tarp 6 m. mažiaus vaikų iki 51,7 proc. tarp 10 m. amžiaus ir vyresnių vaikų. Didėjant suaugusiųjų amžiui padidėjusio

- jautrumo maisto produktams paplitimas mažėja nuo 7,5 proc. tarp 24 m. ir jaunesnių amžiaus grupėje iki 0,0 proc. tarp 55 ir vyresnių amžiaus grupėje.
4. Dažniausi maisto produktų sukelti simptomai tarp vaikų buvo viduriavimas ar vėmimas (kitas nei apsinuodijimas maistu) bei bėrimas, tinimas ar niežulys odoje. Pastarasis simptomas buvo pats dažniausias ir tarp suaugusiųjų. Padidėjusio jautrumo maisto produktams sukeltų simptomų pobūdis ir paplitimas buvo panašus, lyginant rezultatus pagal lytį, tik paraudusios, skausmingos ar ašarojančios akys daugiau pasitaikė tarp berniukų nei mergaičių.
 5. Daugiausia sveikatos sutrikimus vaikams sukelia vaisiai ir uogos (24,6 proc.), nemažai – pienas ir jo produktai (19,4 proc.). Vaikams dažniausiai nustatyta alergija karvės pienui, lazdyno riešutams ir kivi. Dažniausi maisto produktai, sukeltantys sveikatos sutrikimus suaugusiesiems, buvo vaisiai ir uogos, riešutai, daržovės. Dažniausiai suaugusiesiems nustatyta alergija lazdyno riešutams, kivi ir persikams.
 6. Nustatyta, kad vyriška vaiko lytis (OR = 3,36) ir motinos sirgimas maisto alergija (OR = 5,44) yra prognostiniai veiksniai, tiesiogiai susiję su vaiko alergija maistui, o esant šių abiejų veiksnių kombinacijai, rizika susirgti alergija maistui ypač padidėja (OR = 18,3 95% PI [2,02-166,04]).
 7. Vilniaus apskrities mokyklų slaugytojai ir administracija turi tam tikrų žinių apie maisto alergijomis sergančius vaikus, tačiau tik 16,9 proc. mokyklų turi tvarkos aprašą, nurodantį, kaip reikėtų elgtis kilus maisto alergijos priepuoliui. Dažniausiai informacija apie vaikus, sergančius maisto alergijomis, gaunama iš vaikų sveikatos pažymėjimų. 26,3 proc. mokyklų buvo įgyvendinami kokie nors apmokymai, susiję su maisto alergijomis. Daugumoje mokyklų mokiniai nėra apsaugoti nuo atsitiktinio alergeno suvalgymo.