

EuroPrevall Survey on Prevalence and Pattern of Self-Reported Adverse Reactions to Food and Food Allergies Among Primary Schoolchildren in Vilnius, Lithuania

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Key words: food allergy; hypersensitivity; adverse reactions; prevalence; schoolchildren.

Summary. The aim of the research was to assess the prevalence and pattern of self-reported adverse reactions to food and food allergies among primary schoolchildren in Vilnius.

Material and Methods. Vilnius University was a partner in the EuroPrevall project. A total of 4333 schoolchildren from 13 primary schools participated in the study. Of all 4333 questionnaires distributed, 3084 were returned (response rate, 71.2%). This screening phase was followed by the second (clinical) part with an objective confirmative laboratory analysis of blood samples for the diagnosis of food allergy. For the research purposes, 186 blood samples for IgE were analyzed.

Results. Almost half of the children had an illness or a disorder caused by eating food. The prevalence of adverse reactions to food was found to be increasing with age from 6 to 10 years. Food allergy was diagnosed in 16.4% of children. Boys had food allergy more frequently than girls. Diarrhea or vomiting and a rash, urticarial rash, or itchy skin were the most commonly mentioned symptoms. Fruits, berries, and milk and dairy were found to be the most common foods to cause adverse reactions. The most relevant foods for children with IgE-mediated food allergy were cow's milk and hazelnuts.

Conclusions. The prevalence of self-reported food hypersensitivity among primary schoolchildren was observed in almost half of the studied population. Fruits, berries, and milk and dairy were the most common foods to cause adverse reactions among primary schoolchildren in Lithuania. The determined differences in the prevalence of food hypersensitivity and IgE-mediated food allergy and associations with gender and age need further scientific analysis for the development of prognostic and diagnostic tools.

Introduction

In recent decades, the prevalence of allergic diseases, including food allergy, has been increasing. This is becoming an important health problem (1). The main risk factors that contribute to this are as follows: genetic predisposition, allergen exposure, environmental pollution, and low immune response of the individual critical periods of development. Therefore, allergies can be treated as a disease of modern civilization, and it is proposed to apply the concept of common health disorder to them (2).

Food products can cause various reactions, i.e., hypersensitivity to food. One of these adverse reactions is allergy to food. The European Academy of Allergy and Clinical Immunology (EAACI) proposed a new nomenclature for allergic diseases in 2001 according to which food allergies are attributed to hypersensitivity to food and may be immunoglobulin E (IgE)-mediated or non-IgE-mediated;

hypersensitivity also includes nonallergic hypersensitivity (previously known as food intolerance) (3).

Allergy to food and its natural or artificial ingredients cause many physical and psychological disorders. It is a very serious problem not only for many children and parents, but also for the entire medical staff and local communities. Financial and social burdens associated with this disease are increasing (4). It is thought that the number of foods that can cause allergic reactions is growing, and the number of serious allergic reactions is increasing, but reliable information on the precise magnitude of this problem is missing. The prevalence of food allergies in children, especially in younger age, at primary school, is also a major interest, since different studies show that it is higher than in adults. Along with all the social and economic implications for public health, the prevention and treatment of allergic reactions to food are becoming a challenge to scientists, doctors, politicians, and the public (5).

Survey data show that 5% to 35% of adults believe that they or their children suffer from food

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allergies, although accomplished studies on this particular issue report that 6% to 8% of young children (up to 3 years), 3% to 5% of older children, and 1.5% to 3% of adults are really allergic to food. However, it is difficult to assess the exact prevalence of food allergy because of the country and regional disparities, as well as differences in the epidemiological data and research methods (1, 6, 7).

There are not many studies done in Lithuania to determine a consistent pattern of allergies. Moreover, there is a lack of data about the prevalence of food allergies, symptoms, and problematic products. Taking into consideration the relevance of the problem and the fact that this disease is more frequent among children, it is very important to have data about the country, i.e., about the situation and what it is in comparison with other countries. This determined our aim and contingent of the research. Although the prevalence of allergies differs in the cities and towns of the same country, we explored the prevalence of food allergies among primary school-aged children in Vilnius city, the capital and the largest city in Lithuania, hosting diverse nationalities with a variety of lifestyles and nutritional habits.

The aim of this study was to assess the prevalence and pattern of self-reported hypersensitivity to food and food allergies among primary schoolchildren in Vilnius.

Material and Methods

Vilnius University was a partner in the EuroPrevall integrated project "The Prevalence, Cost and Basis of Food Allergy Across Europe," which is an EU-funded multidisciplinary research study. To ensure methodological integrity of the study, all participating centers followed the EuroPrevall Manual of Procedures and consolidated methodology. The first objective of the EuroPrevall epidemiological surveys was to obtain estimates on the prevalence of food allergies across different European regions (8). By implementing this project in Lithuania, a community-based survey was carried out among primary school-aged children. A survey with a specially composed questionnaire for self-reported food allergy was followed by an objective confirmative laboratory analysis of blood samples for the diagnosis of food allergy.

An approval of the Lithuanian Bioethics Committee was obtained to conduct this biomedical research (December 21, 2005; No. 60); an agreement of the Department of Education, Culture and Sports of Vilnius city municipality was also received. A special questionnaire, created and approved for this project by the Institute of Food Research (Norwich, UK), was used in all participating countries. To ensure the integrity of the study and data, standardized translation procedures, involving

forward translation (from English into Lithuanian), backward translation (comparison and necessary editing), and local piloting, were done. Children got the questionnaires at school and took them home to complete with parents, or the questionnaires were completed only by parents.

Of the 16 primary schools, 13 participated in the study with a total number of 190 classes and 4333 schoolchildren in them. Of the 4333 questionnaires distributed, 3084 (response rate, 71.2%) were collected in return with responses.

During the second (clinical) phase of the study, blood samples for IgE were taken. The study focused on IgE-mediated allergies to a number of foods most commonly reported to cause type 1 allergic reactions. The foods selected included many kinds, which have to be labeled in the EU, such as cow's milk, hen's egg, fish (cod), shrimp, peanuts, hazelnuts, walnuts, and celery. In addition, two stone fruits, apple and peach, were selected since these represent foods involved in cross-reactive allergies. Furthermore, sensitization to a panel of other foods, including soy, wheat, buckwheat, corn, carrot, tomato, melon, kiwifruit, banana, lentils, sesame seeds, mustard seeds, sunflower seeds, and poppy seeds was examined (8). The collection of blood samples was performed in the Allergy Center of Vilnius University Antakalnis Hospital. The parents of 205 children agreed to participate in this part of the study, although after familiarizing with the information sheet and consent form, 19 parents refused a blood test to be performed to their children and additionally 25 parents refused to be interviewed. All the data were encoded, and the blood samples were labeled with bar codes to ensure confidentiality. No identifiable data were put on the questionnaires or samples. The participants were asked to sign a consent form before starting blood sampling. The results of tests were considered positive if the specific antibody level in serum was ≥ 0.35 kU_A/L. A two-step approach was taken to reduce the number of tests required to assess sensitization to foods. First, the samples were screened using 5 food mixes to identify the samples with elevated specific IgE antibody levels. The samples testing positive to a mix were subsequently tested against the individual foods of that mix. The levels of serum IgE were measured using an ImmunoCAP 250 system in a central laboratory, Academic Medical Center in Amsterdam.

The prevalence of adverse reactions to food and food allergy was expressed as a point (percentage) and interval estimate (95% confidence intervals [95% CI]). For the analysis of categorical data, the chi-square test was used. The results were considered as statistically significant if a *P* value was ≤ 0.05 . The prevalence ratio (PR) and its 95% CI were cal-

culated to test possible associations. The Mantel test for trend was also employed. The statistical data analysis was performed using statistical packages SPSS 17.0 and WinPEPI 11.0.

Results

The parents of 4333 children of Vilnius city primary schools were asked to complete the EuroPrevall food allergy-screening questionnaire, specially designed for this project. In total, 3084 questionnaires were returned and used for further analysis. There were 1531 boys (49.6%) and 1553 girls (50.4%) surveyed. The age of schoolchildren varied from 5 to 12 years (mean age, 8.2 years; SD, 1.2; median age, 8 years). The distribution of the children by age and gender is given in Table 1. The distribution of the boys and girls by age groups was similar ($P=0.103$). The children were mostly 7 to 10 years old as the primary grades (first to fourth) were included in this study (usually a child starts the first grade in a primary school at 7 years and finishes the fourth grade at 10 years, but there were some younger and older individuals grouped in the 5–6- and 10–12-year age groups for the purposes of the analysis).

The main aim of this study was to evaluate which part of schoolchildren population reported as having an illness or a disorder caused by eating a food or foods. Nearly half of the children ($n=1445$; 46.9%) stated that they had such problems, and 1639 (53.1%) responded negatively. The distribution of the children who had an illness or a disorder caused by eating a food or foods by gender is shown in Table 2. The boys and girls similarly reported adverse

reactions to food (48.1% and 45.6%, respectively), and there was no association between hypersensitivity to food and gender (PR=1.06; 95% CI, 0.98–1.14; $P=0.156$).

The distribution of the children who had an illness or a disorder caused by eating a food or foods by age is given in Table 3. The proportion of schoolchildren that reported adverse reactions to food was increasing with age, and this increase was found to be statistically significant. The coefficient of simple linear regression was 3.99 ($P=0.003$); χ^2 by the Mantel test for trend was 26.51 ($df=1$; $P<0.001$).

It was also checked whether food allergy was diagnosed by a doctor. The parents of 505 children (16.4%) reported that their children had a diagnosed food allergy. Table 4 shows the distribution of the children with a diagnosed food allergy by gender. The boys had a diagnosed food allergy more frequently than the girls (18.1% and 14.8%, respectively; $P=0.014$), and there was an association between male gender and food allergy (PR=1.22; 95% CI, 1.04–1.44).

Ailments provoked by food in children (Fig. 1) and food products that caused them (Fig. 2) were also analysed. Diarrhea or vomiting was the most common symptom caused by food among schoolchildren (48.0%); a rash, urticarial rash, or itchy skin were also frequent disorders (46.4%). The most problematic foods to cause ailments were fruits and berries (24.6%) and milk and dairy (19.4%).

Table 1. Distribution of Children of Vilnius City Primary Schools by Age and Gender

Age, Years	Boys	Girls	Total
5–6	91 (3.0)	106 (3.4)	197 (6.4)
7	464 (15.0)	424 (13.8)	888 (28.8)
8	333 (10.8)	359 (11.6)	692 (22.4)
9	350 (11.3)	396 (12.9)	746 (24.2)
10–12	293 (9.5)	268 (8.7)	561 (18.2)
Total	1531 (49.6)	1553 (50.4)	3084 (100)

Values are number (percentage).

Table 2. Prevalence of an Illness or a Disorder Caused by Eating a Food or Foods by Gender among Primary School Children in Vilnius City

Had an Illness or a Disorder Caused by Eating a Food or Foods ($n=1445$)	Boys ($n=1531$)		Girls ($n=1553$)		PR (95% CI)	χ^2	P
	n (%)	95% CI	n (%)	95% CI			
	737 (48.1)	45.6–50.7	708 (45.6)	43.0–48.1	1.06 (0.98–1.14)	2.01	0.156

Table 4. Prevalence of Food Allergy Diagnosed by a Doctor by Gender Among Primary School Children in Vilnius City

Diagnosed Food Allergy ($n=505$)	Boys ($n=1531$)		Girls ($n=1553$)		PR (95% CI)	χ^2	P
	n (%)	95% CI	n (%)	95% CI			
	276 (18.1)	16.1–20.1	229 (14.8)	13.0–16.7	1.22 (1.04–1.44)	6.06	0.014

Table 3. Distribution of Children of Vilnius City Primary Schools that Had an Illness or a Disorder Caused by Eating a Food or Foods by Age

Age, Years	n	Had an Illness or a Disorder Caused by Eating a Food or Foods ($n=1445$)	Prevalence of an Illness or a Disorder Caused by Eating a Food or Foods	
		n (%)	%	95% CI
5–6	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
10–12	561	290 (20.1)	51.7	47.6–55.8
Total	3084	1445 (100)	46.9	45.1–48.6

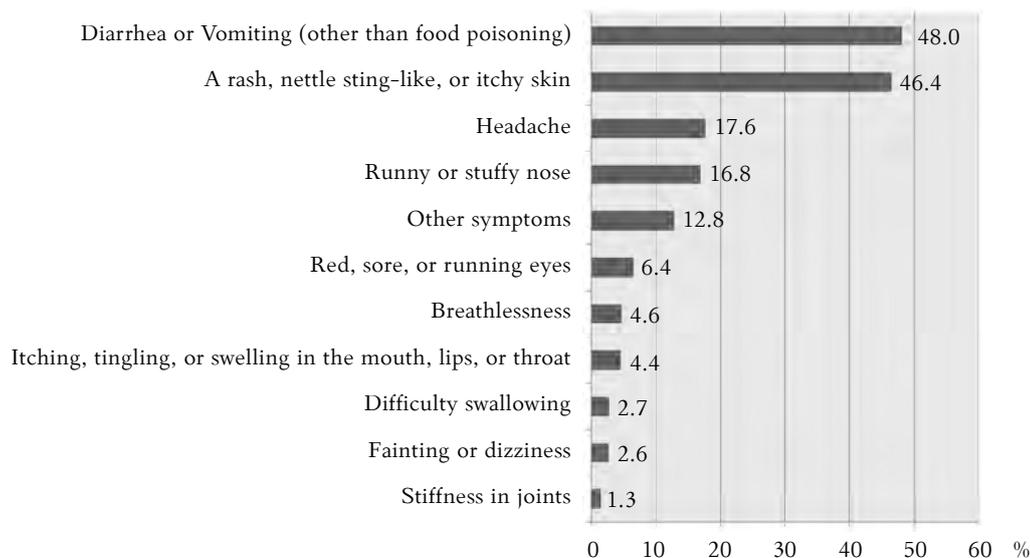


Fig. 1. Prevalence of symptoms among children of Vilnius city primary schools that had a disorder from food

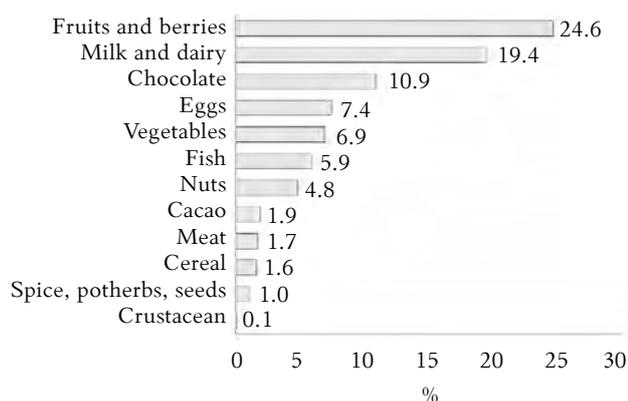


Fig. 2. Distribution of foods that caused clinical symptoms in children

Table 5. Distribution of Children by Identified IgE-Mediated Food Allergy and Adverse Reactions to Food

Adverse Reactions to Food	IgE-Mediated Food Allergy		Total
	Identified	Not Identified	
Present	39 (21.0)	77 (41.4)	116 (62.4)
Absent	3 (1.6)	67 (36.0)	70 (37.6)
Total	42 (22.6)	144 (77.4)	186 (100)

Values are number (percentage).

Table 6. Distribution of Children With IgE-Mediated Food Allergy by Gender

IgE-Mediated Food Allergy	Boys (n=84)		Girls (n=94)		PR (95% CI)	χ^2	P
	n (%)	95% CI	n (%)	95% CI			
Identified	22 (26.2)	17.2–36.9	16 (17.0)	10.0–26.2	1.54 (0.87–2.73)	1.709	0.191
Not identified	62 (73.8)	63.1–82.8	78 (83.0)	73.8–90.0			

The main task in the second (clinical) part of the study was to determine the presence of IgE-mediated food allergy. After the analysis of blood samples, food allergy was identified in 42 children. These results were compared with those from the first phase (Table 5). IgE-mediated food allergy was not identified in the majority (41.4%) of children, although they had adverse reactions from food. Thus, the prognostic prevalence of IgE-mediated food allergy could be 21% (95% CI, 15.4–27.5) among children who have a disorder or an illness caused by eating a food or foods and 1.6% (95% CI, 0.03–4.6) among those who do not have problems.

After analyzing these data by gender, it was determined that IgE-mediated food allergy was identified in the boys more frequently than in the girls (26.2% and 17.0%, respectively), but the difference was not statistically significant (PR=1.54; 95% CI, 0.87–2.73; $P=0.191$), as demonstrated in Table 6.

Table 7 summarizes the data on foods to which our study participants were allergic. The most relevant foods for children with IgE-mediated food allergy were cow's milk (43.9%), hazelnuts (41.5%), kiwifruit (36.6%), and celery (36.6%).

Table 7. Distribution of Children With IgE-Mediated Food Allergy Caused by Different Foods

Foods	Children With Identified IgE-Mediated Food Allergy (n=41*)	
	N (%)	95% CI
Nuts	17 (41.5)	26.3–57.9
Hazelnuts	17 (41.5)	26.3–57.9
Peanuts	7 (17.1)	7.2–32.1
Walnuts	6 (14.6)	5.6–29.2
Vegetables	16 (39.0)	24.2–55.5
Celery	15 (36.6)	22.1–53.1
Carrot	13 (31.7)	18.1–48.1
Corn	7 (17.1)	7.2–32.1
Tomato	11 (26.8)	14.2–42.9
Lentils	7 (17.1)	7.2–32.1
Fish (cod)	2 (4.9)	0.6–16.5
Fruits	25 (61.0)	44.5–75.8
Apple	12 (29.3)	16.1–45.5
Banana	12 (29.3)	16.1–45.5
Kiwifruit	15 (36.6)	22.1–53.1
Melon	6 (14.6)	5.6–29.2
Peach	13 (31.7)	18.1–48.1
Cow's milk	18 (43.9)	28.5–60.3
Cereal	10 (24.4)	12.4–40.3
Buckwheat	7 (17.1)	7.2–32.1
Wheat (flour)	10 (24.4)	12.4–40.3
Rice	5 (12.2)	4.1–26.2
Crustaceans (shrimp)	1 (2.4)	0.1–12.9
Egg	7 (17.1)	7.2–32.1
Spice, herbs, seeds	10 (24.4)	12.4–40.3
Sunflower's seeds	8 (19.5)	8.8–34.9
Sesame seeds	8 (19.5)	8.8–34.9
Soy	7 (17.1)	7.2–32.1
Poppy seeds	7 (17.1)	7.2–32.1
Mustard	6 (14.6)	5.6–29.2

*One child was allergic to allergen mix fx6 (wheat, corn, sesame, buckwheat, rice).

It was also checked which symptoms were present in those children who had IgE-mediated food allergy identified. A rash, urticarial rash, or itchy skin were the most common symptoms among allergic children (31.0%).

Discussion

Adverse reactions to food and food allergy are a serious problem among primary school children, and the present study revealed that almost half of the children of Vilnius city primary schools had an illness or a disorder caused by eating a food or foods. These disorders are perceived as self-reported adverse reactions to food. By implementing an analogous EuroPrevall screening study in the neighboring country Poland (Lodz city), the researchers reported that the percentage of children with adverse reactions to food was also great (41.6%) and similar to the Lithuanian data (9). Other studies showed the prevalence of hypersensitivity to food among children to be lower, e.g., 10.5% in Italy (10) and 8% in the United Arab Emirates (11). Scientists agree that due to different conceptions of food allergy and adverse reactions to food and their constant con-

fusion with food intolerance and food intoxication, the general population usually tends to overestimate this problem (12). This fact undoubtedly influenced the results of the present study, and we support this opinion. Meanwhile, it is evident that quite a small proportion (16.4%) of the children had a food allergy diagnosed by a doctor. In Poland, this proportion was greater, namely 27.7% (9).

The prevalence of food allergy depends on age and significantly differs between children and adults. Food allergy is often the first clinical appearance of allergy and the first link of the so-called "march of atopy" (1). However, it changes as a child grows, and 85% of children later outgrow their allergy to such products as milk and eggs, 50% to soy, but only 20% to peanuts (13–16). Therefore, it is often a health problem of children and young adults. The present study has revealed that the prevalence of hypersensitivity to food is related to age and has an increasing trend; moreover, there was an association between male gender and food allergy. After summarizing the results of other studies that were designed to explore the link between other allergies, especially asthma, and gender, our study showed the same results, i.e., the boys tended to have ailments more frequently. It is still unclear which factors are predominating; but it is supposed that it is associated with airways that are narrower in boys and their increased tonus, as well as an increased IgE level in serum, but these differences disappear later, and 10-year-old boys report symptoms of allergic diseases as frequently as girls (17, 18). The increased prevalence of symptoms and diagnoses of bronchial asthma, allergic rhinitis, and atopic dermatitis among boys was also identified by Lithuanian scientists (19). Other study performed in Lithuania reported that the prevalence of allergy to food was lower (12.8%) among older (fifth–ninth grades) schoolchildren (20). This suggests that the prevalence of adverse reactions to food might be increasing until age 10 years and then starting to diminish, as children outgrow it.

Adverse reactions to food and food allergy cause various symptoms and ailments, usually affecting the gastrointestinal tract, the respiratory system, and the skin (21, 22). In the present study, diarrhea or vomiting, a rash, urticarial rash, or itchy skin were the most frequent symptoms among children. There are many similarities between the results of the present research and other studies (9, 20, 23, 24).

There is heterogeneity in the prevalence of IgE-mediated food allergy and adverse reactions to food groups and different sort of foods. The list of the most common food allergens is different in various countries and regions. It is closely connected with cultural and nutritional habits and traditions; globalization and industrialization has a very great impact on that. Therefore, we can find as many differ-

ences as similarities while observing this, e.g., fruits, berries, and milk and dairy were the most common foods to cause adverse reactions among children in the present study, while fish is a more common food allergen in Scandinavia; soy, in Japan; peanuts, in the United States and the United Kingdom; tropic fruits, in Southeastern Asia; and sea food, in Mediterranean countries (1).

A substantial proportion of the population in Europe reports adverse reactions to foods. In the centers included in the European Community Respiratory Health Survey (ECRHS), 19% of the population reported an illness or a disorder caused by eating particular foods, and 12.2% reported that they nearly always experienced that illness following the ingestion of particular foods. There were significant differences in the prevalence of a food-related illness among different countries ranging from 4.6% in Spain to 18% in Sweden and 19.1% in Australia. Most likely, a few of these complaints represent true IgE-mediated responses (8, 25, 26). The results of the second part of our study correspond to those of others, e.g., according to the data of German scientists, the perception of food-related symptoms is common among children and adolescents from the general population. Self-reports could be confirmed in around 1 of 10 individuals, still resulting in 4.2% of proven clinical symptoms (27). Dutch researchers compared the results of food hypersensitivity and the diagnosis of food allergy and found that only 0.8% of people had food allergy, while 12.4% had complaints and reported to have hypersensitivity (28). People tend to overestimate the extent of food allergies: the rates of the perception of food allergies are often up to 4 times greater than the rates of true food allergies because people confuse allergy with intolerance or even with cases of mild food poisoning (12). Self-reported reactions to food have the

prevalence several times higher as compared with hypersensitivity diagnosed following the well-established evidence-based diagnostic guidelines. In children, allergic food reactions are more common compared with nonallergic food hypersensitivity reactions, and 90% of them are caused by only 8 food allergens: cow's milk, soya, egg, fish, shellfish, peanuts, tree nuts, and gluten. The diagnosis should be based on challenge tests with the potentially offending food allergens. Concerning other, more conservative diagnostic procedures, the negative results of serologic and skin prick tests can exclude IgE-mediated food allergy, but the positive results of tests, due to a high rate of false-positive reactions, are not sufficient for the diagnosis (29).

Conclusions

The prevalence of self-reported food hypersensitivity among primary schoolchildren was observed in almost half of the studied population (46.9%). Fruits and berries (24.6%) as well as milk and dairy (19.4%) were the most common foods to cause adverse reactions among primary schoolchildren in Lithuania. The determined differences in the prevalence of food hypersensitivity and IgE-mediated food allergy and associations with gender and age need further scientific analysis for the development of prognostic and diagnostic tools.

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Statement of Conflict of Interest

The authors state no conflict of interest.

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