

Food hypersensitivity among Finnish university students: association with atopic diseases

L. Mattila, M. Kilpeläinen*, E. O. Terho*, M. Koskenvuo†, H. Helenius‡ and K. Kalimo§

*The Finnish Student Health Service, *Department of Pulmonary Diseases and Clinical Allergology, University of Turku, †Department of Public Health, University of Turku, ‡Department of Biostatistics, University of Turku and §Department of Dermatology, University of Turku, Turku, Finland*

Summary

Background Food hypersensitivity (FH) is commonly suspected, especially among adults with atopic diseases. Symptoms of FH vary from oral allergy syndrome (OAS) to gastrointestinal, respiratory and systemic reactions. More data are needed regarding patient groups at risk for FH, and symptoms and foods responsible for the reactions.

Methods FH was studied in 286 Finnish university students. Four study groups were selected: subjects (i) with current atopic dermatitis (AD) with or without allergic rhinoconjunctivitis (ARC) or asthma ($n=41$); (ii) with past AD with or without ARC or asthma ($n=89$); (iii) with ARC or asthma ($n=69$); (iv) without clinically confirmed atopic disease ($n=87$). A thorough clinical examination was performed with a questionnaire specifying adverse events to foods. In addition, IgE specific to five foods, and skin prick tests to four foods were determined.

Results FH was reported by 172 subjects (60.1%), more often by females (66.3%) than by males (47.9%) ($P=0.003$). FH was most frequent among subjects with AD, among those with current AD in 73.2%, with past AD in 66.3%, and with ARC or asthma in 63.8%; 44.8% of subjects without any atopic disease reported FH. Kiwi fruit caused symptoms most frequently (38.4%), followed by milk (32.6%), apple (29.1%), tomato (27.9%), citrus fruits (25.0%), tree nuts (23.3%), and peanut (17.4%). A total of 720 separate symptoms to 25 food items were reported. OAS was most common (51.2%), followed by gastrointestinal symptoms (23.5%), worsening of AD (11.4%), urticaria (4.2%), rhinitis or conjunctivitis (5.7%) and asthma (4.0%). Severe reactions occurred in 3.5% (25/720). Negative IgE and skin prick test to foods predicted well negative history, but the value of positive test results was limited.

Conclusions FH was reported most often by students with current AD and multiple atopic diseases. Severe reactions occurred especially in patients with ARC and asthma. After excluding lactose intolerance, milk hypersensitivity was frequently reported.

Keywords adult, allergic rhinoconjunctivitis, asthma, atopic dermatitis, food allergy, food hypersensitivity

Submitted 29 April 2002; revised 17 August 2002; accepted 26 January 2003

Introduction

Food hypersensitivity (FH) is commonly suspected not only among children but also among adults. The frequency of self-reported FH in adults has shown a wide variation, from 4.6% up to 33% [1, 2]. These differences in reported FH between different countries depend on dietary habits, educational level and knowledge of the patients, and health care system of the country, as well as formulation of the questionnaires, and the study population.

In clinical practice concern regarding FH is a daily problem. In connection with a large population-based study 'Allergy 95' [3] we had an opportunity to examine the occurrence of FH in a sample of first-year Finnish university students. The goal of our

study was to find out how often FH was reported, by which food and with which kinds of symptoms. In addition we wanted to find out which patient groups most often reported FH.

In addition to clinical examination we used a structured questionnaire specifying the foods and different symptoms caused by foods. The history was correlated with skin prick test (SPT) and food-specific IgE results.

Study population and methods

In 1995 a postal questionnaire study 'Allergy 1995' [3] on occurrence, severity, possible risk factors of atopic diseases and especially asthma was carried out among all Finnish first-year university students ($n=14202$) studying in 22 universities situated in different parts of the country. Later detailed clinical examinations including questionnaire, skin prick tests and IgE determinations were carried out to selected students based on

Correspondence: Leena Mattila, The Finnish Student Health Service, Kirkkotie 13, PL 28, FIN-20541 Turku, Finland. E-mail: leena.mattila@yths.fi

this material. In all, 413 university students, 195 subjects with history of asthma or wheezing, and 218 subjects without these symptoms, were asked to participate in the study. A total of 296/413 students (72%) took part in the final examinations, 152 with a history of asthma or wheezing and 144 without. Complete examinations were carried out in 286 students, of whom 190 (66%) were women, and 96 (34%) men. The mean age of the students was 21.5 years (range 18.7 to 26.6 years).

Structured interview and clinical examination was carried out by the dermatologist (LM) and the pulmonary disease specialist (MKI). AD was confirmed by using the criteria of Hanifin and Rajka [4]. ARC was diagnosed if the subject had had symptoms of ARC during the past year at doctor's interview and SPT or serum IgE showed sensitization to allergens. Asthma was diagnosed if the subject had had asthmatic symptoms during the past year at doctor's interview and displayed a positive methacholine challenge or obstructive ventilation defect in spirometry [3].

Four different study groups were formed: (i) subjects with current AD (including those with simultaneous ARC and/or asthma); (ii) subjects with past AD (subjects with a history of AD, but not present symptoms, including those with ARC and/or asthma); (iii) subjects with ARC and/or asthma (with no past or current AD); and (iv) subjects without any atopic disease in clinical examination.

The structured questionnaire specified 25 food items and the following symptoms: (a) itching or swelling of the mouth, lips or throat, 'oral allergy syndrome' (OAS); (b) urticaria; (c) worsening of AD; (d) gastrointestinal symptoms (e.g. diarrhoea or pain); (e) rhinitis and/or conjunctivitis; and (f) asthma. In case of multiple symptoms, a combination of the identifying letters was used. In addition, other possible causes of FH were asked about. Diagnosis of lactose intolerance and coeliac disease was considered.

Skin prick testing (SPT) and specific IgE

The SPT panel included standardized allergens with the potency of 10 HEP (histamine equivalent in prick testing). The allergens were birch, timothy and mugwort pollens, *Cladosporium herbarum*, *Aspergillus fumigatus*, cat, dog and horse epithelia, house dust mite (*D. pteronyssinus*) (Soluprick[®], ALK-Abelló, Hørsholm, Denmark) and natural rubber latex (Stallergenes[®], Antony, France). Food allergens included fresh egg ovalbumin, kiwi and celery root tested as prick-prick tests, and wheat as 10% w/v solution in saline [5]. Histaminedihydrochloride 10 mg/mL was used as a positive and the diluent as a negative control. The tests were carried out in duplicate on the volar aspects of both forearms. The mean diameter of the two wheals was calculated, and the test was considered as positive if the mean diameter after subtracting the negative control wheal was at least 3 mm [6].

For specific IgE determinations Phadiatop[®] including cat, dog, horse, birch, timothy grass, mugwort, *D. pteronyssinus*, *Cladosporium* and Fx5 for food allergens, consisting of milk, egg ovalbumin, wheat, soy bean, codfish and peanut (Pharmacia-Upjohn, Uppsala, Sweden) were performed. A positive test was defined as a specific IgE level of 0.7 kU/L (RAST class 2 or more).

Statistical analysis

The occurrence of reported FH and specific sensitization was calculated by dividing the test positives by the number of

subjects with complete test results ($n = 286$), without adjustment for sampling. The four groups – current AD and past AD (with or without asthma or ARC), ARC or asthma and those without any atopic disease – did not overlap. Multiple logistic regression was carried out to compare subjects with current AD, past AD, and subjects with ARC or asthma alone with those without any atopic disease. Moreover, comparisons were made between subjects with current AD and ARC or asthma. Adjustment was carried out for sex. Results were expressed as odds ratios (OR) with 95% confidence intervals (CI). Confidence intervals not including 1.00 were regarded as significant.

Results

Complete results from clinical examination were obtained from 286 subjects, of whom 41 (14.3%) had current AD, 89 (31.1%) past AD, and 69 (24.1%) had ARC or asthma. A total of 87 subjects (30.4%) had no clinical atopic disease. In all, 27% of students with current AD had AD alone, 39% AD in combination with ARC and 34% AD with current asthma. Of students with ARC or asthma, 51% had asthma at clinical examination. Twenty-one per cent of subjects with past AD, 20% with current AD, 48% with ARC or asthma, and 41% of those with no atopic disease, were men.

Food hypersensitivity according to the questionnaire

FH was reported by 60.1% (172/286) of participants, significantly more by females than males, 66.3% (126/190) vs. 47.9% (46/96) ($P = 0.003$). The occurrence of symptoms related to 25 food items in 172 students are shown in Table 1. In general, kiwi fruit caused symptoms most frequently, in 38.4%, followed by milk in 32.6%, apple in 29.1%, tomato in 27.9%, citrus fruits in 25.0%, tree nuts in 23.3% and peanuts in 17.4%. Cereals, egg, avocado, celery, melons and seeds caused symptoms occasionally. Lactose intolerance was coded and reported by 6.3% (18/286). One subject had coeliac disease.

Altogether 720 separate symptoms from 25 food items were recorded. In general, the students reported involvement of two or more organs by the same food (Table 1). The commonest reaction pattern was OAS (a) reported by 51.2% (369/720). It was the only symptom in 37.6% (271/720). Kiwi fruit, shellfish, tree nut, peanut, peach, banana, avocado and celery nearly always caused OAS. Urticaria (b) was reported in 4.2% (30/720) of occasions, most often from shellfish and fish. Worsening of AD (c) was recorded in 11.4% (82/720), in 6.8% as the only symptom, especially from chocolate and citrus fruits. Gastrointestinal symptoms (d) appeared in 23.5% (169/720), in 20.4% as the only symptom, and were most often suspected from milk, cereals, wine/beer, paprika and egg. Rhinitis (e) was reported by 5.7% (41/720) and asthma by 4.0% (29/720), most commonly from fish and shellfish. Severe hypersensitivity reactions occurred in 3.5% (25/720) (Table 2). The reported causes were tree nuts (5), peanuts (5), fish (5), shellfish (3) and in a single case kiwi fruit, apple, peach, plum, pea, celery and almond. Thirteen of these 25 reactions were among subjects with ARC or asthma. The three most severe reactions were caused by tree nuts, peanut and fish.

Table 1. Occurrence of reported food hypersensitivity; 172 students reported 720 different symptoms, one could report several symptoms to one food

Occurrence of different reported symptoms against separate food items														
Food	Occurrence of reported food hypersensitivity (n = 172)		Oral allergy OAS		Urticaria		Worsening of aptopic dermatitis		Gastrointestinal symptoms		Rhinitis or conjunctivitis		Asthma	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Kiwi fruit	66	38.4	62	93.9	0		7	10.6	4	6.1	2	3.0	1	1.5
Milk	56	32.6	1	1.8	0		2	3.6	54	96.4	0		0	
Apple	50	29.1	37	74.0	0		4	8.0	13	26.0	5	10.0	1	2.0
Tomato	48	27.9	40	83.3	1	2.1	6	12.5	2	4.2	0		0	
Citrus fruits	43	25.0	18	41.9	2	4.6	18	41.9	4	9.3	6	13.9	0	
Tree nuts	40	23.3	35	87.5	4	10.0	3	7.5	7	17.5	3	7.5	6	15.0
Peanut	30	17.4	27	90.0	4	13.3	2	6.7	5	16.7	2	6.7	5	16.7
Paprika	24	14.0	9	37.5	0		3	12.5	14	58.3	0		0	
Chocolate	24	14.0	4	16.7	2	8.3	11	45.8	7	29.2	1	4.2	0	
Pea	23	13.4	19	82.6	0		2	8.7	5	21.7	4	17.4	1	4.3
Carrot	22	12.8	18	81.8	1	4.5	2	9.1	3	13.6	3	13.6	0	
Plum	22	12.8	18	81.8	0		0		5	4.4	2	9.1	1	4.5
Peach	21	12.2	18	85.7	0		3	14.3	2	9.5	3	14.3	1	4.8
Fish	21	12.2	12	57.1	8	38.1	7	33.3	4	19.0	2	9.5	8	38.1
Banana	20	11.6	16	80.0	0		0		4	20.0	1	5.0	0	
Wine/beer	18	10.5	2	11.1	3	16.7	2	11.1	13	72.2	2	11.1	0	
Spices	12	7.0	4	33.3	0		3	25.0	6	50.0	3	25.0	0	
Shellfish	12	7.0	10	83.3	5	41.7	1	8.3	2	16.7	0		3	25.0
Cereals	10	5.8	0		0		3	30.0	8	80.0	0		0	
Egg	9	5.2	4	44.4	0		1	11.9	5	55.6	0		0	
Avocado	6	3.5	5	83.3	0		1	16.7	0		1	16.7	0	
Celery	4	2.3	4	100.0	0		0		1	25.0	1	25.0	1	25.0
Seeds	4	2.3	3	75.0	0		0		1	25.0	0		1	25.0
Melons	4	2.3	3	75.0	0		1	25.0	0		0		0	
Mushrooms	0	0	0		0		0		0		0		0	
Total n	589 (with 720 different symptoms)		369	51.2%	30	4.2%	82	11.4%	169	23.5%	41	5.7%	29	4.0%

Subjects with atopic diseases reported FH significantly more often than those without ($P=0.004$). FH was reported by 73.2% (24/33 females and 6/8 males) with current AD (in 83.3% with simultaneous ARC or asthma), by 66.3% (50/70 of females and 9/19 of males) with past AD and by 63.8% (27/36 of females and 17/33 of males) of those with ARC or asthma. Of subjects without clinical atopic disease, 44.8% (25/51 of females and 14/36 of males) reported FH.

Subjects with current AD reported most often OAS (59.8%) and worsening of AD (16.6%). Subjects with past AD reported most often OAS (47.8%), gastrointestinal symptoms (24.4%) and worsening of AD (13.6%). Of those with ARC or asthma, 52.4% reported OAS, 26.2% gastrointestinal symptoms and 11.0% asthma. In subjects without clinical atopic diseases, gastrointestinal symptoms (48.7%) and OAS (38.2%) were most often suspected.

Compared with subjects without atopic disease, subjects with current AD reported FH to tree nuts, peanut, plum, citrus fruits, paprika, tomato, apple, chocolate, carrot and kiwi fruit significantly more often (Table 3). Among those with past AD, the risks were less frequent and lower. Subjects with ARC or asthma reported significantly more often FH to tree nuts, peanuts,

plum, banana, tomato and apple (Table 3). When comparisons were made between subjects with current AD and ARC or asthma alone, those with current AD reported significantly more often FH to citrus fruits, tree nuts, peanut, paprika and chocolate (data not shown). FH from milk was frequently reported in all groups, especially in students with ARC and asthma, but the differences were not significant (Table 3).

Skin prick test to kiwi fruit and celery was positive in 9.8% and RAST (≥ 2) to peanut in 9.1%. All subjects sensitized to celery were sensitized to birch or mugwort. Twelve of 286 subjects (4.2%) had positive RAST for soy (Table 4). Ten of these reported symptoms from tree nuts or peanut, and two had no FH symptoms at all. Compared with subjects without atopic disease, those with current AD displayed more often sensitization to kiwi fruit (SPT) and to peanut (RAST). Also wheat SPT was often positive, whereas wheat RAST was negative, and the students had no history of wheat FH. Subjects with past AD and ARC or asthma showed lower numbers of positive test results. However, the same foods, kiwi, peanut and wheat, gave most often positive results (Table 4).

Positive history of FH correlated poorly with positive test, except celery with four/four history/test positives. Among

Table 2. Reported severe allergic reactions from foods among subjects with current atopic dermatitis, past atopic dermatitis, allergic rhinoconjunctivitis or asthma, and among subjects without any atopic disease on clinical examination

Food	Number of subjects with symptoms	Type of reported symptoms (n)	Atopic disease			
			Current atopic dermatitis (n = 41)	Past atopic dermatitis (n = 89)	Allergic rhinoconjunctivitis / asthma (n = 69)	No atopic disease (n = 87)
Tree nuts	40	ABDEF (1)	1			
		ABDF (2)		1	1	
		AF (2)			2	
Peanut	30	ABDEF (1)	1			
		ABDF (2)		1	1	
		AF (2)	1	1		
Fish	21	ABCEF (1)		1		
		ABDF (2)		1	1	
		ABF (2)		1	1	
Shellfish	12	ABDF (2)		1	1	
		ABF (1)		1		
Almond	1	ABDF (1)	1			
Kiwi fruit	66	AF (1)			1	
Apple	50	AF (1)			1	
Peach	21	AF (1)			1	
Plum (fresh)	22	AF (1)			1	
Pea	23	AF (1)			1	
Celery	4	AF (1)			1	

Reported symptoms coded as follows (A) oral allergy syndrome, (B) urticaria, (C) worsening of atopic dermatitis, (D) gastrointestinal symptoms, (E) rhinitis or conjunctivitis, (F) asthma.

subjects with positive tests the history of FH was often negative. The only exception was fish, 10/11 subjects with positive RAST to fish reported symptoms. Among subjects with a negative history of FH, the tests were nearly always negative. Among test-negative subjects the history of FH was often negative, except for those who suspected milk FH. Of these students, 96.4% had experienced gastrointestinal symptoms.

Discussion

In the present study, FH was reported by 60.1% of the students, of whom two-thirds had atopic disease or asthma. Due to our patient selection favouring subjects with asthma, this figure is higher than reported earlier in population-based questionnaire studies, 20% in the United Kingdom [7], 21% in Germany [8], 17% in Australia [9], 12% in Holland [10] and 4% in France [11].

A general increase in pollen sensitization has occurred [12] and reports of increasing prevalence of hypersensitivity to several fruits and vegetables in pollen-sensitive individuals have been published [8, 11, 13]. Similarly, according to earlier reports women [7–11] and subjects with atopic diseases, 28 vs. 15% [7], 57 vs. 17% [11], and subjects with wheezing [9] had more reported FH than the general population. In our study, 66.8% of subjects with clinically confirmed atopic diseases reported FH, compared with 44.8% of non-atopic subjects. Also in the present study, women reported significantly more often FH than men.

Schäfer et al. [8] found the highest risk for food allergy among subjects with hay fever, e.g., compared with AD patients, 73% vs. 10%. However, overlapping of atopic diseases is common.

In the present study, 73% of subjects with current AD had simultaneous ARC or asthma. According to our results 73.2% of subjects with current AD (83% of those with ARC and asthma), 66.3% with past AD, 63.8% of subjects with ARC or asthma and 44.8% of subjects without any atopic disease reported FH. Thus according to our results students with active AD had the greatest risk of developing FH.

Of different foods, kiwi fruit caused symptoms most commonly, followed by milk, apple, tomato, citrus fruits, tree nuts and peanut. In earlier reports from France [11], Germany [8] and Australia [1], hypersensitivity to fruits has appeared to be the most common FH. In contrast, in the United Kingdom less than 5% [7] and in the Netherlands only 2% [10] suspected fruit hypersensitivity. In Nordic countries, allergy to birch pollen is frequent. Cross-sensitivity between birch pollens and fruits, vegetables or hazel nuts is reported, and according to the European Community Respiratory Health Survey (ECRHS) residence in Northern Europe has been regarded as a risk factor for FH [1]. Our high figures for FH give support to these associations.

Milk hypersensitivity has been thought to be rare in adults. In our study milk hypersensitivity was reported by 19.6% of all the study participants, and by 32.6% of subjects with FH. It was reported most frequently among students with ARC and asthma, but there was no significant difference when compared with other patient groups or non-atopic subjects. The present figures are higher than reported in most other studies, 10% in Australian young adults [9], 4% in the ECRHS study [1], 8% in France [11], and 3% in the United Kingdom [7] as well as in Germany [8]. In the present study almost all (96.4%) symptoms reported from milk were gastrointestinal compared with 40 to

Table 3. Occurrence and odds ratios for reported food hypersensitivity (FH) among subjects with current atopic dermatitis (AD), past AD and allergic rhinoconjunctivitis (ARC) or asthma compared with subjects without any atopic disease on clinical examination ($n = 286$). Significant associations (AORs) marked by bold numbers

		Occurrence (%) and adjusted odds ratio (AOR) for reported food hypersensitivity in study groups									
Food	Students with FH ($n = 286$)	Current AD* ($N = 41$)			Past AD* ($n = 89$)			ARC or asthma† ($n = 69$)			No atopic disease (reference) ($n = 87$) %
		%	AOR‡	95% CI	%	AOR‡	95% CI	%	AOR‡	95% CI	
Kiwi fruit	66	39.0	3.6	1.5–8.6	25.8	1.9	0.9–4.2	21.7	1.8	0.8–4.2	13.8
Milk	56	14.6	0.8	0.3–2.2	20.2	1.1	0.5–2.5	26.1	2.0	0.9–4.4	16.1
Apple	50	31.7	5.7	2.0–16.6	21.4	3.3	1.3–8.3	17.4	2.9	1.0–8.4	6.9
Tomato	48	39.0	7.4	2.6–21.2	15.7	2.1	0.8–5.9	17.4	3.1	1.1–9.0	6.9
Citrus fruits	43	36.6	10.2	3.1–33.9	19.1	4.1	1.3–12.9	10.1	2.6	0.7–9.2	4.6
Tree nuts	40	34.2	39.9	5.0–319.2	19.1	18.2	2.4–140.8	11.6	11.9	1.4–97.8	1.2
Peanut	30	29.3	33.7	4.2–272.5	11.2	10.3	1.3–83.2	10.1	9.9	1.2–82.6	1.2
Paprika	24	17.7	7.6	1.5–31.8	15.7	6.9	1.5–31.8	1.5	0.7	0.1–7.4	2.3
Chocolate	24	22.0	5.3	1.5–18.8	7.9	1.6	0.4–5.8	5.8	1.3	0.3–5.4	4.6
Pea	23	9.8	8.9	0.9–83.9	13.5	13.0	1.6–103.1	8.7	8.2	0.9–70.6	1.2
Carrot	22	17.1	4.9	1.2–20.4	10.1	2.7	0.7–10.5	4.3	1.4	0.3–6.9	3.4
Plum	22	14.6	12.4	1.4–107.9	10.1	8.2	1.0–67.0	8.7	8.8	1.0–76.1	1.2
Peach	21	19.5	-	-	10.1	-	-	5.8	-	-	0
Fish	21	12.2	-	-	10.1	-	-	10.1	-	-	0
Banana	20	9.8	8.3	0.9–77.3	10.1	8.7	1.1–70.8	8.7	8.6	1.0–73.2	1.2
Wine/beer	18	0	-	-	7.9	0.8	0.3–2.3	4.4	0.5	0.11–1.8	9.2
Spices	12	9.8	4.5	0.8–26.4	5.6	2.5	0.5–13.5	1.5	0.60	0.1–7.1	2.3
Shellfish	12	5.6	-	-	9.8	-	-	4.4	-	-	0
Cereals	10	2.4	1.7	0.10–28.4	5.6	4.2	0.5–36.9	4.4	4.2	0.4–42.5	1.2
Egg	9	4.9	4.6	0.4–54.1	4.5	4.2	0.4–39.6	2.9	2.5	0.2–28.6	1.2
Avocado	6	0	-	-	6.7	-	-	0	-	-	0
Celery	4	0	-	-	3.4	-	-	1.4	-	-	0
Melons	4	4.9	-	-	2.2	-	-	0	-	-	0
Seeds	4	0	-	-	0	-	-	2.9	-	-	0
Mushroom	0	0	-	-	0	-	-	0	-	-	0

*Concomitant ARC or asthma allowed. †No past or current AD. ‡Adjustment made for sex.

Table 4. Sensitisation to food allergens (skin prick test ≥ 3 mm and RAST ≥ 2) among all tested subjects and subjects with current atopic dermatitis (AD), past atopic dermatitis, allergic rhinoconjunctivitis (ARC) or asthma, and with no atopic disease on clinical examination. Subjects with no atopic disease regarded as a reference group. Adjustment made for sex

Prevalence of sensitisation and odds ratios for sensitisation								
Allergen	All tested subjects ($n = 286$)	Current AD ($n = 41$)		Past AD ($n = 89$)		ARC or asthma ($n = 69$)		No atopic disease (reference) ($n = 87$)
	% (n)	% (n)	Adjusted OR (95% CI)	% (n)	Adjusted OR (95% CI)	% (n)	Adjusted OR (95% CI)	% (n)
Skin prick test ≥ 3 mm								
Egg	0.7 (2)	2.4 (1)	-	0	-	1.4 (1)	-	0
Kiwi fruit	9.8 (28)	17.1 (7)	17.4 (2.0–147.7)	12.4 (11)	11.9 (1.5–95.0)	13.0 (9)	13.0 (1.6–105.3)	1.1 (1)
Celery	9.8 (28)	21.9 (9)	-	13.5 (12)	-	10.1 (7)	-	0
Wheat	2.8 (8)	9.8 (4)	10.8 (1.1–104.3)	2.2 (2)	2.2 (0.19–26.0)	1.4 (1)	1.2 (0.1–2.6)	1.1 (1)
RAST ≥ 2								
Egg	2.1 (6)	2.4 (1)	-	2.2 (2)	-	4.3 (3)	-	0
Peanut	9.1 (26)	14.6 (6)	8.5 (1.6–45.4)	14.6 (13)	8.4 (1.8–39.3)	7.2 (5)	3.2 (0.6–17.1)	2.3 (2)
Soy	4.2 (12)	7.3 (3)	-	6.7 (6)	-	1.4 (1)	-	2.3 (2)
Milk	2.1 (6)	4.9 (2)	-	3.4 (3)	-	1.4 (1)	-	0
Fish	3.8 (11)	7.3 (3)	-	5.6 (5)	-	4.3 (3)	-	0
Wheat	5.6 (16)	7.3 (3)	3.6 (0.6–22.6)	10.1 (9)	5.0 (1.0–24.5)	2.9 (2)	1.2 (0.2–9.1)	2.3 (2)

Significant associations marked by bold numbers.

50% in other studies [1, 8, 9]. Confirmed lactose intolerance was reported by 6.3%, which is in accordance with recent Finnish surveys among young adults [14, 15]. In the study by Peltto et al. [16], milk-intolerant patients without lactose intolerance showed a significantly higher specific leucocyte activating capacity during oral challenge compared with controls or patients with lactose intolerance. On the other hand, milk-specific serum IgE antibodies were rarely detected [16], as in our study. Ten participants in the present study reported both milk hypersensitivity and lactose intolerance, suggesting misclassification. Nevertheless, the number of subjects with milk hypersensitivity was considerable, supporting the earlier observation that hypersensitivity to milk may be a key factor in non-specific gastrointestinal disorders [15, 16].

Products with peanut are widespread in catering and cooking. Sensitization to peanut is increasing also in countries with reported quite low and steady consumption, as for example in Sweden [17]. Peanut allergy is established early in life, often without a known exposure by ingestion [17, 18] and is a frequent cause of severe reactions [17, 19], as was also in our study. In the present study 9.8% of the subjects had positive RAST to peanut, which is in line with Schäfer et al. [8], with 11% SPT positive. Peanut allergy is strongly associated with atopy, asthma and other food allergies, especially tree nut allergy [18], and is connected with systemic reactions [20].

Another hidden allergen is celery, also capable of inducing generalized reactions. Both raw and cooked celery can give rise to IgE-mediated allergy [21]. In Switzerland, celery root has been regarded as the most important food allergen, and cause for severe anaphylaxis [21]. In our study only four out of 28 subjects with positive SPT to celery suspected allergy, one had experienced a severe reaction. Especially celery root is widely used in many Finnish national dishes but few students recognize celery, which may influence the scarce reporting of symptoms.

The most common symptom among students was OAS (51.2%), appearing as the only symptom in 37.6%, which is parallel with figures by Wütrich [13] and Schäfer [8]. However, much lower occurrence, only 6 to 7%, has been reported in older populations [10, 11]. Gastrointestinal symptoms were also frequently reported (23.5%), followed by worsening of dermatitis in 11.4%. Life-threatening reactions from food may occur more frequently than commonly assumed, and among documented reactions, food has been the most frequent cause of anaphylaxis [20]. Peanut, tree nuts and seafood have accounted for the vast majority of these reactions [20], as also in the present study, in which severe reactions were reported in 3.5% of all reactions.

To establish a diagnosis of FH poses problems. The spectrum of symptoms caused by various foods is wide, and a clear discrepancy between self-reported FH, results of skin tests and food-specific IgE has been found when compared with results obtained by challenge [10, 19, 22]. In general, both SPT and RAST have shown poor positive predictability in diagnosing FH, whereas negative predictive value has generally appeared better depending on the product [22, 23]. In our study RAST for fish was negative in 99.6%, and similarly RAST for peanut in 95.3% of subjects with a negative history. All subjects with a negative history to celery were prick test negative. However, SPT for kiwi was positive in only 23% and RAST for peanut in 48% among those who reported symptoms.

FH was frequently suspected by the students. To obtain reliable data, a structured questionnaire was developed in which

food items, as well as symptoms were specified in detail. In several cases this personal history gave valuable information on health risks and helped to give practical information on how to avoid them. It was a useful tool for focusing on essential things and limiting unnecessary examinations and it helped to avoid unjustified dietary exclusions [24]. The use of the questionnaire has become a daily routine in clinical practice in student health care.

Acknowledgements

The authors thank Anne Kaljonen for the data processing. The study was supported by the National Insurance Institute, Finland, the Finnish Society for Allergy and Immunology, and the Finnish Student Health Service.

References

- 1 Woods RK, Abramson M, Bailey M, Walters EH. International prevalences of reported food allergies and intolerances. Comparisons arising from the European Community Respiratory Health Survey (ECRHS) 1991–94. *Eur J Clin Nutr* 2001; 55:298–304.
- 2 Bender A, Matthews D. Adverse reactions to food. *Br J Nutr* 1981; 46:403–7.
- 3 Kilpeläinen M, Terho EO, Helenius H, Koskenvuo M. Validation of a new questionnaire on asthma, allergic rhinitis, and conjunctivitis among young adults. *Allergy* 2001; 56:377–84.
- 4 Hanifin JM, Rajka G. Diagnostic features of atopic dermatitis. *Acta Derm Venereol* 1980; 92:44–7.
- 5 Varjonen E, Vainio E, Kalimo K, Juntunen-Backman K, Savolainen J. Skin prick test and RAST responses to cereals in children with atopic dermatitis. Characterization of IgE-binding components of wheat and oats by immunoblotting method. *Clin Exp Allergy* 1995; 25:1100–7.
- 6 Dreborg S, Frew A. Position Paper. Allergen standardisation and skin test. *Allergy* 1993; 48 (Suppl. 14):49–82.
- 7 Young E, Stoneham MD, Petrukevitch A, Barton J, Rona R. A population study of food intolerance. *Lancet* 1994; 343:1127–30.
- 8 Schäfer T, Böhler E, Ruhdorfer S et al. Epidemiology of food allergy/food intolerance in adults: associations with other manifestations of atopy. *Allergy* 2001; 56:1172–9.
- 9 Woods RK, Abramson M, Raven JM, Bailey W, Weiner JM, Walters EH. Reported food intolerance and respiratory symptoms in young adults. *Eur Respir J* 1998; 11:151–5.
- 10 Niejstijl-Jansen JJ, Alwine F, Kardinaal M et al. Prevalence of food allergy and intolerance in the adult Dutch population. *J Allergy Clin Immunol* 1994; 93:446–56.
- 11 Kanny G, Moneret-Vautrin DA, Flabbee J, Beaudouin E, Morisset T. Population study of food allergy in France. *J Allergy Clin Immunol* 2001; 108:133–40.
- 12 Linneberg A, Nielsen NH, Madsen F, Frolund L, Dirksen A, Jorgensen T. Increasing prevalence of specific IgE to aeroallergens in an adult population: two cross-sectional surveys 8 years apart: the Copenhagen Allergy Study. *J Allergy Clin Immunol* 2000; 106:247–52.
- 13 Wütrich B. Food induced cutaneous adverse reactions. *Allergy* 1998; 53 (Suppl. 46):131–5.
- 14 Kunttu K, Huttunen T. Student Health Survey 2000: a National Survey Among Finnish University Students. Social Security and Health Reports 45. Helsinki: The Social Insurance Institution, 2001.
- 15 Peltto L, Impivaara O, Salminen S, Poussa T, Seppänen R, Liliius E-M. Milk hypersensitivity in adults. *Eur J Clin Nutr* 1999; 53:620–4.

- 16 Pelto L, Salminen S, Lilius E-M, Nuutila J, Isolauri E. Milk hypersensitivity: key to poorly defined gastrointestinal symptoms in adults. *Allergy* 1998; 53:307–10.
- 17 Van Odijk J, Ahlstedt S, Bengtsson U, Hulthen L, Borres MP. Specific IgE antibodies to peanut in western Sweden. Has the occurrence of peanut allergy increased without an increase in consumption? *Allergy* 2001; 56:573–7.
- 18 Emmett SE, Angus FJ, Fry JS, Lee PN. Perceived prevalence of peanut allergy in Great Britain and its association with other atopic conditions and with peanut allergy in other household members. *Allergy* 1999; 54:380–5.
- 19 Pucar F, Kagan R, Lim H, Clarke AE. Peanut challenge: a retrospective study of 140 patients. *Clin Exp Allergy* 2001; 31:40–6.
- 20 Sampson HA. Food anaphylaxis. *Br Med Bull* 2000; 56:925–35.
- 21 Wütrich B, Stäger J, Johansson SGO. Celery allergy associated with birch and mugwort pollinosis. *Allergy* 1990; 45:566–71.
- 22 Sampson HA, Albergo R. Comparison of results of skin tests, RAST, and double-blind, placebo-controlled food challenges in children with atopic dermatitis. *J Allergy Clin Immunol* 1984; 74:26–33.
- 23 Anhøj C, Backer V, Nolte H. Diagnostic evaluation of grass- and birch-allergic patients with oral allergy syndrome. *Allergy* 2001; 56:548–52.
- 24 Robertson DA, Ayres RC, Smith CL, Wright S. Adverse consequences arising from misdiagnosing of food allergy. *Br Med J* 1989; 298:32–3.