

REGULAR ARTICLE

Food hypersensitivity is common in Swedish schoolchildren, especially oral reactions to fruit and gastrointestinal reactions to milk

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ABSTRACT

Aim: This study examined the prevalence, symptom expression and risk factors for food hypersensitivity among Swedish schoolchildren.

Methods: Parents of 2585 (96% of invited) children aged 7–8 years completed a questionnaire regarding food hypersensitivity and allergic diseases. A random sample of 1700 children (90% of invited) also participated in skin prick testing with ten airborne allergens.

Results: The overall prevalence of reported food hypersensitivity to milk, egg, fish, wheat, soya, fruits and, or, nuts was 21%, with symptoms caused by milk (9%) being the most common. The most frequently reported symptoms were oral symptoms (47.4%), mainly caused by fruit, and gastrointestinal symptoms (45.7%), mainly caused by milk. Factors associated with any food hypersensitivity were female sex, allergic heredity and a positive skin prick test. Eczema was consistently associated with symptoms caused by milk, egg, fish, wheat, soya, fruits and nuts. Rhinitis was associated to the same foods, except milk.

Conclusion: Reported food hypersensitivity was common among Swedish schoolchildren. The most frequent symptom expressions were oral symptoms triggered by fruits and gastrointestinal symptoms triggered by milk. The high prevalence of reported symptoms should be validated by clinical examinations to provide a diagnosis.

INTRODUCTION

Food hypersensitivity (FHS) among children is common (1–3), and symptoms may affect single or multiple organ systems. Symptoms are most frequently localised in the skin as urticaria, angioedema or eczema, the respiratory, or gastrointestinal tract and in the mucus membranes of the mouth (1,4,5). Some food-induced symptoms, like itching of the mouth, can indicate either a mild disease, such as oral allergy syndrome (OAS), which is related to sensitisation to birch pollen, or a first symptom of a more severe reaction to food (5–7). Knowledge about intake of different foods and their relation to clinical symptoms is essential in diagnosing FHS and assessing affected children in need of thorough clinical examinations.

The term FHS includes both immunological and nonimmunological reactions and when IgE-antibodies are involved in the reaction, the term IgE-mediated food allergy is appropriate (8). In general, the prevalence of FHS

assessed by clinical examinations and food provocations yields lower estimates compared to self-reported data (1,5,9). Comparisons between studies are challenging due to the different numbers of foods investigated, age of the study population, study methods used and variations in the definition of FHS. A meta-analysis of studies among infants, children and adults concluded that the prevalence of reported food allergy varied from 3 to 35%, while challenge proven food allergy varied from 1 to 11% (10).

Food hypersensitivity, asthma, rhinitis and eczema often co-exist and may also share the same risk factors, such as allergic heredity and allergic sensitisation (1,9,11). The association between FHS and atopic diseases is complex.

Key notes

- Reported food hypersensitivity was common among schoolchildren aged 7–8 years, 21% of the children expressed symptoms caused by foods.
- Food hypersensitivity to milk showed different patterns regarding symptom expression and risk factors compared to food hypersensitivity to other foods.
- The high prevalence of reported symptoms should be validated by clinical examinations to provide a diagnosis

Abbreviations

CI, Confidence interval; FHS, Food hypersensitivity; IgE, Immunoglobulin E; ISAAC, International Study of Allergy and Asthma in Childhood; OAS, Oral allergy syndrome; OLIN, The Obstructive Lung Disease in Northern Sweden; OR, Odds ratio; SPT, Skin prick test.

For example, eczema is a common symptom of FHS, but FHS is also a risk factor for eczema, asthma and rhinitis (1). Studies show an inconsistent association between FHS and sex (12). Some studies report similar prevalence of reported FHS among girls and boys (9), while others report a higher prevalence among women than men (13). The association between FHS and age is also inconsistent. An increase in the prevalence of FHS by increasing age is seen in some studies (1) while others report an opposite pattern (11). Also, the severity of FHS has been associated with older age (14). The effect of dietary exposures during the prenatal and the early postnatal period, including the timing of introduction of complementary foods in relation to FHS development, is unclear (15).

While studies about IgE-mediated food allergy are common, the knowledge about reported FHS and associated risk factors is still limited. Because eliminating food may affect nutrient status (16) and quality of life (13), it is important to acquire knowledge about the prevalence of reported FHS in the population. The aim of this study was to investigate the prevalence and symptom expression of reported FHS in a large population-based cohort of children aged 7–8 years. The associations between food hypersensitivity and asthma, rhinitis, eczema and potential risk factors were also studied.

PATIENTS AND METHODS

Study population

This study forms part of the Obstructive Lung Disease in Northern Sweden (OLIN) research programme and focuses on a cohort recruited in 2006. The cohort comprised all schoolchildren in the first and second grades, who were 7 and 8 years old, in three municipalities in Northern Sweden (17,18). The parents were invited to complete a questionnaire and 2585 (96%) participated. The final sample contained 48% girls and 52% boys. Children in two of the areas were also invited to skin prick testing (STP) with ten common airborne allergens and 1700 (90%) participated. The study was approved by the regional ethical review board at Umeå University, Sweden.

Questionnaire

The parental questionnaire, which has been used in a previous longitudinal cohort study since 1996, included the International Study of Allergy and Asthma in Childhood (ISAAC) questionnaire (19), substantially expanded with questions regarding physician diagnosis, symptoms and medications of asthma, rhinitis, eczema and a broad screening for possible risk factors (17,20). For the current cohort recruited in 2006, questions about food hypersensitivity were added. The questions were 'Is your child allergic to any food?' and 'Has your child had any reactions to the following foods?'. The latter question included reactions to milk, egg, fish, wheat, soya, fruits and nuts and types of symptoms caused by the specific foods. The following alternatives were given for symptoms: itching in the mouth, respiratory problems, vomiting/diarrhoea/stomach pain or

itchy rash. The questionnaires were distributed by the schoolteachers and answered by the parents at home.

Skin prick test (SPT)

The SPT procedure followed the European Academy of Allergology and Clinical Immunology recommendations (21). SPT was performed between February and April at the child's school. The allergens included in the test were birch, timothy, mugwort, dog, cat, horse, *Dermatophagoides farinae*, *Dermatophagoides pteronyssinus*, *Claudiosporium* and *Alternaria* (Soluprick; ALK, Horsholm, Denmark). Histamine 10 g/mL and glycerol were used as positive and negative controls, respectively. A positive reaction was defined as a mean wheal diameter of ≥ 3 mm. The tests were performed at the schools, and no tests for foods were included in the panel due to safety reasons.

Definitions

Food hypersensitivity (FHS) was defined based on parental reports of symptoms related to the ingestion of certain foods. The symptoms were sorted according to localisation into oral, respiratory, gastrointestinal and skin symptoms, respectively. Different groups of food hypersensitivity were created as follows:

FHS essential foods: Symptoms caused by milk, egg, fish, wheat and/or soy.

FHS essential foods excluding milk: Symptoms caused by egg, fish, wheat and/or soy.

FHS milk: Symptoms caused by milk.

FHS fruits: Symptoms caused by kiwi fruits, oranges, apples, raw carrots and/or bananas.

FHS nuts: Symptoms caused by tree nuts, peanuts and/or almonds.

FHS fruits or nuts: Symptoms caused by kiwi fruits, oranges, apples, raw carrots, bananas, nuts, peanuts and/or almonds.

Any FHS: Symptoms caused by essential foods, fruits and/or nuts.

Asthma/rhinitis/eczema: Positive response to the question: 'Has the child been diagnosed by a physician as having asthma/rhinitis/eczema?'

Any positive STP: Positive reaction to any of the tested airborne allergens.

Positive SPT animal: Positive reaction to cat, dog or horse.

Positive SPT pollen: Positive skin prick test to birch, timothy or mugwort.

Allergic heredity: Reported parental history of asthma, rhinitis or eczema.

Statistical analysis

Statistical analyses were performed using the Statistical Package of Social Science Software version 19 (SPSS Inc, Chicago, IL, USA). Differences in prevalence between the groups were tested using the chi-square test, and a p-value <0.05 was considered statistically significant. Factors that

were significantly associated with FHS in bi-variate analyses were included in multiple logistic regression models and expressed as odds ratios (OR) with 95% confidence intervals (95%CI). Dependent variables were *Any FHS*, *FHS essential foods excluding milk*, *FHS milk* and *FHS fruits or nuts*. The regression analyses were performed among the whole cohort and also among the children who participated in the skin prick testing.

RESULTS

Prevalence of FHS to different foods

The prevalence of any FHS was 21.3%, FHS essential foods were 10.9% and FHS fruits or nuts were 14.6%. The most common essential food to trigger symptoms was milk, which was reported by 9.0%. The most common fruit to trigger symptoms was kiwi fruit, which was reported by 8.0%, and the prevalence of FHS to other fruits and nuts varied between 0.7 and 4.5%. The prevalence of FHS to egg, fish, wheat or soy was low, at 0.6–1.4% (Table 1).

The prevalence of any FHS was higher among girls than in boys (24.7% vs. 18.1%, $p < 0.001$). For specific foods, a higher reported prevalence among girls than boys was seen for FHS to milk (11.0% vs. 7.0%, $p < 0.001$), kiwi fruits (10.0% vs. 6.2%, $p < 0.001$) and oranges (5.8% vs. 3.3%, $p = 0.002$). There were no differences between girls and boys regarding FHS to other specific foods (Table 1).

Of the children with any FHS, 303 children (55%) reported FHS to one single food, 23.2% to two foods, 9.8% to three foods and 12.2% to four foods or more. Among the 303 children with FHS to only one food, milk was the most frequently reported food (46.2%), followed by kiwi fruits (26.4%) and oranges (11.6%).

Risk factors for FHS

In bi-variate analyses, any FHS, FHS essential foods and FHS fruits or nuts were significantly associated with any positive SPT, positive SPT to pollen and animal and with asthma, rhinitis, eczema and allergic heredity. FHS milk was significantly associated with eczema and allergic heredity. The prevalence of FHS fruits or nuts was lowest among those living in a house compared to children living in an apartment. The prevalence of Any FHS, FHS essential foods and FHS milk was highest in Luleå compared to the other areas (Table 2). No associations were found between any of the FHS groups and breastfeeding at <3 months, parental smoking or having older siblings.

In the multiple logistic regression analysis, Any FHS remained significantly associated with female sex (OR 1.71, 95% CI 1.34–2.19), allergic heredity (OR 1.86, 95% CI 1.43–2.42), any positive SPT (OR 1.49, 95% CI 1.13–1.96), rhinitis (OR 2.82, 95% CI 1.86–4.28) and eczema (OR 2.44, 95% CI 1.80–3.29). FHS to essential foods excluding milk was significantly associated with rhinitis (OR 2.05, 95% CI 1.00–4.20) and eczema (OR 4.93, 95% CI 2.76–8.78). FHS milk was significantly associated with female sex (OR 1.66, 95% CI 1.18–2.33), allergic heredity (OR 1.57, 95% CI 1.09–2.24), eczema (OR 1.54, 95% CI 1.01–2.36) and living in Luleå compared to living in Kiruna (OR 1.95, 95% CI 1.27–2.99). FHS fruits and nuts were significantly associated with female sex (OR 1.58, 95% CI 1.18–2.11), allergic heredity (OR 2.16, 95% CI 1.56–2.98), any positive SPT (OR 2.04, 95% CI 1.49–2.80), rhinitis (OR 3.26, 95% CI 2.17–5.01) and eczema (OR 2.53, 95% CI 1.81–3.52) (Table 3). The results were similar when the analyses were performed in the whole cohort, and the SPT variable was excluded.

Table 1 Prevalence (%) of food hypersensitivity (FHS) to different foods among all children and among boys and girls, respectively, at the age of 7–8 years

	All % (n)	Boys % (n)	Girls % (n)	Difference by sex p-value
Essential foods				
Milk	9.0 (232)	7.0 (94)	11.0 (138)	<0.001
Egg	1.4 (36)	1.2 (16)	1.6 (20)	0.384
Fish	1.2 (32)	1.3 (18)	1.1 (14)	0.600
Wheat	1.0 (26)	1.1 (15)	0.9 (11)	0.535
Soy	0.6 (15)	0.6 (8)	0.6 (7)	0.896
Any essential foods	10.9 (283)	9.1 (122)	12.9 (161)	0.002
Any essential foods, milk excluded	3.5 (90)	3.6 (48)	3.4 (42)	0.744
Fruits and nuts				
Kiwi	8.0 (208)	6.2 (83)	10.0 (125)	<0.001
Orange	4.5 (117)	3.3 (44)	5.8 (73)	0.002
Apple	3.9 (100)	4.1 (55)	3.6 (45)	0.493
Raw carrots	1.4 (36)	1.7 (23)	1.0 (13)	0.139
Banana	0.7 (18)	0.7 (9)	0.7 (9)	0.889
Tree nuts	3.6 (93)	4.1 (55)	3.0 (38)	0.141
Peanuts	3.2 (84)	3.7 (50)	2.7 (34)	0.142
Almonds	2.0 (51)	2.3 (31)	1.6 (20)	0.187
Any fruits or nuts	14.6 (377)	12.7 (169)	16.6 (208)	0.004
Any of the above foods (Any FHS)	21.3 (551)	18.1 (242)	24.7 (309)	<0.001

Table 2 Prevalence (%) of food hypersensitivity (FHS) to different foods in relation to allergic sensitization, asthma, rhinitis, eczema, allergic heredity, and living conditions

		Any FHS		FHS essential foods		FHS essential foods milk excluded		FHS milk		FHS fruits or nuts	
			p-value		p-value		p-value		p-value		p-value
Any positive SPT	No	18.0	<0.001	10.1	<0.001	2.1	<0.001	9.3	0.367	10.2	<0.001
	Yes	34.0		15.8		7.3		10.1		27.9	
Positive SPT pollen	No	19.1	<0.001	10.2	<0.001	2.4	<0.001	8.9	0.085	11.6	<0.001
	Yes	39.7		19.0		9.2		12.1		33.1	
Positive SPT animal	No	18.5	<0.001	10.3	<0.001	2.1	<0.001	9.5	0.956	10.8	<0.001
	Yes	37.0		16.8		8.9		9.4		31.1	
Asthma	No	20.1	<0.001	10.4	0.002	2.9	<0.001	8.9	0.625	13.3	<0.001
	Yes	36.6		17.8		11.0		9.9		30.4	
Rhinitis	No	18.8	<0.001	10.0	<0.001	2.7	<0.001	8.7	0.078	12.0	<0.001
	Yes	50.5		22.3		12.4		12.4		45.5	
Eczema	No	17.6	<0.001	8.9	<0.001	1.9	<0.001	8.1	<0.001	11.2	<0.001
	Yes	42.1		22.3		12.2		14.0		33.5	
Allergic heredity	No	13.7	<0.001	7.6	<0.001	2.4	0.012	6.2	<0.001	8.1	<0.001
	Yes	26.8		13.4		4.3		11.0		19.2	
Current living	House	20.3	0.080	10.9	0.801	3.2	0.496	9.1	0.507	13.5	0.024
	Apartment	24.0		10.5		4.2		8.0		17.7	
	Both	27.3		13.0		2.6		11.7		19.5	
Area	Piteå	18.0		8.8		2.6		7.7		12.7	
	Kiruna	21.4	0.030	10.4	0.048	5.7	0.008	6.1	0.003	15.5	0.225
	Luleå	23.0		12.3		3.1		10.7		15.3	

Table 3 Risk factors for food hypersensitivity, analysed by multiple logistic regression analysis and expressed as odds ratios with 95% confidence intervals

		Any FHS		FHS essential foods milk excluded		FHS milk		FHS fruits or nuts	
		OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Sex	Girl	1.71	1.34–2.19	1.34	0.79–2.37	1.66	1.18–2.33	1.58	1.18–2.11
Allergic heredity	Yes	1.86	1.43–2.42	1.16	0.62–2.14	1.57	1.09–2.24	2.16	1.56–2.98
Any positive SPT	Yes	1.49	1.13–1.96	1.63	0.88–3.05	0.84	0.56–1.26	2.04	1.49–2.80
Asthma	Yes	1.11	0.71–1.74	1.97	0.95–4.08	0.97	0.50–1.90	0.97	0.59–1.60
Rhinitis	Yes	2.82	1.86–4.28	2.05	1.00–4.20	1.66	0.91–3.02	3.26	2.17–5.01
Eczema	Yes	2.44	1.80–3.29	4.93	2.76–8.78	1.54	1.01–2.36	2.53	1.81–3.52
Current living	House	1		1		1		1	
	Apartment	1.07	0.81–1.41	0.84	0.45–1.60	0.70	0.46–1.05	1.27	0.92–1.74
	Both	1.21	0.65–2.23	0.44	0.06–3.45	0.95	0.40–2.27	1.43	0.72–2.86
Area	Kiruna	1		1		1		1	
	Luleå	1.28	0.97–1.69	0.67	0.38–1.17	1.95	1.27–2.99	1.16	0.84–1.61

Prevalence of specific symptoms among children with FHS

Among children with any FHS, 47.4% reported oral symptoms, 45.7% gastrointestinal symptoms, 35.2% skin symptoms and 10.3% symptoms from the respiratory tract. Among children with FHS to milk, wheat and soy, symptoms from the gastrointestinal system were the most common, reported by 95.3%, 92.3% and 60.0%, respectively. Among children with FHS to egg and fish, skin symptoms were the most common, reported by 72.2% and 59.4%, respectively. Oral symptoms were the most frequently reported symptom among children with FHS to

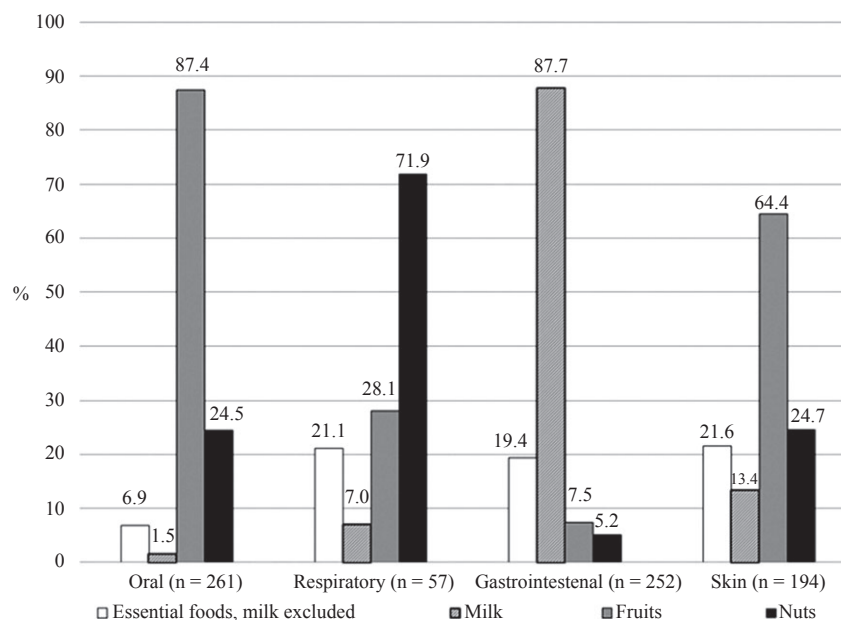
kiwi fruits, apples, carrots and bananas, reported by 67–80%. Among children with FHS to oranges, 70.9% reported skin symptoms. Among subjects with FHS to tree nuts, almonds and peanuts, oral symptoms were the most common, 55.9%, 60.8% and 52.4%, respectively (Table 4).

Triggering foods in relation to clinical symptoms

The prevalence of triggering foods among children with different symptoms of FHS is given in Figure 1. The most frequent trigger for oral symptom was fruits (87.4%), followed by nuts (24.5%). Among children with respiratory symptoms, nuts were the most common trigger (71.9%)

Table 4 Prevalence (%) of different clinical symptoms among children with food hypersensitivity (FHS) to different foods

	Type of clinical symptoms			
	Oral % (n)	Respiratory % (n)	Gastrointestinal % (n)	Skin % (n)
Essential foods				
Milk	1.7 (4)	1.7 (4)	95.3 (221)	11.2 (26)
Egg	22.2 (8)	13.9 (5)	41.7 (15)	72.2 (26)
Fish	25.0 (8)	15.6 (5)	25.0 (8)	59.4 (19)
Wheat	0.0 (0)	3.8 (1)	92.3 (24)	3.8 (1)
Soy	20.0 (3)	20.0 (3)	60.0 (9)	26.7 (4)
Essential foods	6.7 (19)	4.9 (14)	84.5 (239)	21.2 (60)
Essential foods, milk excluded	20.0 (18)	13.3 (12)	54.4 (49)	46.7 (42)
Fruits and nuts				
Kiwi	80.3 (167)	3.4 (7)	3.8 (8)	26.4 (55)
Orange	29.1 (34)	0.9 (1)	3.4 (4)	70.9 (83)
Apple	78.0 (78)	9.0 (9)	4.0 (4)	27.0 (27)
Raw carrots	66.7 (24)	8.3 (3)	5.6 (2)	36.1 (13)
Banana	72.2 (13)	0 (0)	33.3 (6)	0 (0)
Tree nuts	55.9 (52)	31.2 (29)	9.7 (9)	39.8 (37)
Peanuts	52.4 (44)	38.1 (32)	11.9 (10)	39.3 (33)
Almonds	60.8 (31)	35.3 (18)	7.8 (4)	35.3 (18)
Any fruits or nuts	68.2 (257)	13.3 (50)	7.2 (27)	42.2 (160)
Any of the above foods (Any FHS)	47.4 (261)	10.3 (57)	45.7 (252)	35.2 (194)

**Figure 1** Prevalence (%) of triggering foods among children with different clinical symptoms.

followed by fruits (28.1%). The most frequent trigger for gastrointestinal symptoms was milk (87.7%). Among children with skin symptoms, fruits were the most frequent trigger (64.4%).

DISCUSSION

In this large population-based cohort of children aged 7–8 years, the prevalence of reported hypersensitivity to any

food was high (21%) and more common among girls. The most common food to trigger symptoms was milk, reported by 9%. Milk was also the dominating trigger reported by children with FHS to one food only. Among clinical manifestations, oral and gastrointestinal symptoms were the most common, and they were mainly triggered by fruits or nuts and milk.

The prevalence of reported FHS in our study was similar to the findings in previous Scandinavian studies. In Finland,

the reported prevalence of FHS among children aged 1–4 years was 21% (2), and in Norway, the corresponding prevalence among 1-year-old children was 19% (3). In a Swedish study, 26% reported FHS at any time during the first 8 years of life, while 13% had current FHS at 8 years of age (1). As expected, food hypersensitivity was associated with asthma, rhinitis and eczema in our study, results also found by others (1,22). Interestingly, different types of FHS associated differently with various atopic diseases and risk factors. Eczema was consistently associated with all types of FHS, while rhinitis was strongly associated with FHS to fruits and nuts. These findings support the view that the term FHS includes several different conditions probably caused by different pathophysiological mechanisms (8).

The first organs exposed to foods are the mouth followed by the gastrointestinal tract. In line with other studies, we found that oral and gastrointestinal symptoms were common manifestations of FHS (5,23). As expected, oral symptoms were mainly triggered by fruits and nuts, and FHS to fruits and nuts was significantly associated with rhinitis and allergic sensitisation to pollen. These symptoms could at least partly be explained by oral allergy syndrome due to birch pollen sensitisation as IgE-antibodies to birch can cross-react with a number of birch-like proteins in vegetables and fruits (6). Kiwi fruit was the most common fruit to trigger oral symptoms. FHS to kiwi fruit can be caused by cross-reactivity with birch pollen, causing mild-to-moderate symptoms. However, severe symptoms such as anaphylactic reactions to kiwi fruit have also been described (24). Among children with skin symptoms, the major triggers were fruits, with orange being the most common. Studies confirming the clinical relevance of orange allergy are limited. In a Spanish study, only half of the subjects with IgE-antibodies to orange reacted during oral provocations (25).

The prevalence of reported FHS to milk in our study was higher than expected. Even though FHS to milk is common during the first years of life, a majority develops tolerance before school age (26). FHS to milk showed different patterns regarding symptom expression and risk factors compared to FHS to other foods. Milk was the major trigger of gastrointestinal symptoms, and milk was also the most common food trigger among children who reported FHS to one food only. The lack of association between FHS to milk and allergic sensitisation or rhinitis indicates that other mechanisms than IgE-mediated allergy might explain the high prevalence of reported FHS to milk. Lactose intolerance cause milk-induced gastrointestinal symptoms. However, the true lactose intolerance is too rare among Swedish schoolchildren to explain the high prevalence of reported symptoms caused by milk in our study (27). Other diseases, such as irritable bowel syndrome (28) and coeliac disease (23), could also contribute to the milk-related symptoms. Feelings of stress during leisure or school time, loneliness, conflicts with the family or friends may also cause gastrointestinal symptoms but is usually not related to the food intake (29). The increase in supply of dairy-free products

and discussions in tabloid newspapers about possible harmful effects of milk may also have contributed to the high prevalence of reported FHS to milk.

Besides the associations with atopic diseases, we also found FHS to be associated with allergic heredity (11). However, bias may exist as parents with a history of asthma, rhinitis or eczema may be more observant regarding their children's reactions and more prone to exclude foods from their child's diet. Regarding sex differences, in our study, female sex was associated with FHS. This is in contrast with many studies of IgE-mediated food allergy reporting a higher prevalence of food allergy among boys compared to girls (30). In our study, the sex difference in FHS was mainly due to a higher prevalence of reported FHS to milk, kiwi fruit and orange among girls, while there were no significant sex differences regarding FHS to specific foods typically related to IgE allergy.

The effect of socio-economic status on FHS is not thoroughly studied. In our study, we were lacking detailed information about the socio-economic status of the family. Living in a house compared to an apartment could be a marker of a higher socio-economic status. Our results showed no differences in the prevalence of reported FHS according to the type of residence. This is in line with a study from the United States investigating parentally reported FHS among children, where no association was found between the severity of the condition and maternal education or poverty status (14). However, socio-economic status and educational level may influence what foods the children consume during the introduction of foods in early life and also later in childhood, factors that may affect the development of FHS later in life (15).

A major strength of our study is the use of a large unselected cohort with a very high participation rate. The cross-sectional study design has, however, limitations regarding causality of the associations found between FHS and the other atopic diseases. The validity of the results is supported by the similar prevalence of FHS reported by other studies in neighbouring countries (1–3). A limitation of our study is that the results were based on self-reported questionnaire data without any clinical validation of FHS. A further limitation is the lack of information regarding the severity of FHS symptoms. However, as perceived FHS has impact on the quality of life (13) and avoidance of foods may affect the nutritional intake (16), knowledge about the reported prevalence of FHS and its symptom expressions is important from a public health perspective.

In conclusion, one-fifth of the children in this large population-based cohort reported hypersensitivity to any food, and milk was the most common food to cause symptoms. Oral and gastrointestinal symptoms were the most frequently reported food-induced manifestations. Hypersensitivity to milk showed different patterns of symptom expression and associated factors compared to FHS to other foods. As avoidance of food might have negative effects on daily life and nutrition status, the high prevalence of reported symptoms should be validated by clinical examinations to provide a correct diagnosis.

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