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Original Article

Parents' estimate of food allergy prevalence and management in Italian school-aged children

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Abstract ***Background***: Despite the increasing prevalence of food allergy, few studies have assessed the prevalence of perceived food-induced symptoms among school-aged children. There is also a paucity of data on how children with food reactions are managed. We investigated the frequency and characteristics of perceived food reactions in school-aged children.
Methods: Children aged 5–14 years were included in this cross-sectional study. A standardized self-administered questionnaire on food reactions was handed out to 900 parents.
Results: We achieved a response rate of 69%. The lifetime prevalence of parental perceived allergic reactions to food was 10.5%; the point prevalence was 1.6%. Medical care included a call to a general practitioner in 54% of cases, self-management in 37%, an emergency call in 6%, and hospitalization in 3%. Antihistamines were administered in 45% of food reactions, topical steroids in 24%, oral or parenteral steroids in 16%, and epinephrine in 1.5%. In children who reported food reactions, skin prick tests for foods were performed in 54% of cases; the oral food challenge test was performed in 7.5%.
Conclusion: Parent perception of food allergic disorders is common in school-aged children. Few children have undergone diagnostic tests to ascertain clinical food hypersensitivity. This is warranted to avoid unnecessarily restricted diets. Efforts should be made to train primary care physicians to manage food-allergic children.

Key words food allergy, health services, parental perception, school-age, skin prick test.

The number of children with food allergy is increasing.[1] In school-aged children, sparse and dissimilar data on the prevalence of self-reported food allergy morbidity have been described.[2–4] In a British cohort of 757 11-year-old children, a point prevalence of 11.6% in children aged 11 years and 12.4% in those aged 15 years was found.[2] A French questionnaire-based survey estimated a current prevalence of 6.8% in children aged 6–11 years and of 3.4% in those aged 11–14 years.[3] The lifetime prevalence of perceived food allergy has been reported to vary from 2%[4] to 12.4%.[2]

It has been shown that parent-reported prevalence of food reactions may overestimate the true prevalence.[5,6] The management of children with suspected food reactions includes a diagnosis of food allergy that is confirmed by screening for immunoglobulin (Ig)E sensitization[7] and an elimination diet followed by an oral food challenge.[8] Therefore, in epidemiological studies, each child should undergo a double-blind placebo-controlled food challenge that is the diagnostic gold standard,[8] with all food items to validate the diagnosis. This is unfeasible in practice.[9]

On the other hand, epidemiological data on parentally perceived food reactions are needed for predicting utilization of the public health-care service. Thus, the purpose of the present study was to determine the frequency and characteristics of food reactions considered to be caused by allergy in school-aged children based on data provided by the parents in self-administered questionnaires. Furthermore, we have assessed how children with parentally reported food reactions are managed.

Methods

This cross-sectional study was conducted in Italy. Our subjects were parents of a random sample of children aged 5–14 years. The population sample was enrolled from the municipality-approved summer day camps, called "Giocampus". A standardized self-administered questionnaire was designed and handed out to 900 parents through teachers.

The questionnaire included information regarding date of compilation, age, sex and family history of allergy. A simple question covered whether the child had ever had an allergic reaction to foods. If this was the case, the type of offending food,

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age of first reaction, and symptoms induced by the offending food were requested. Details of whether the reaction was elicited by ingestion, contact or inhalation and where it took place were also requested. Medical care was established by questioning whether they made an emergency call, were admitted to the hospital, were seen by their general practitioner or applied self-treatment at home. They were also asked which drugs (antihistamines, steroids, topical steroids, and adrenaline) were administered. Diagnostic investigations were established by asking whether the child underwent a skin prick test (SPT) for foods or oral food challenges. In Italy, it is obligatory to have a family pediatrician, who may prefer to carry out diagnostic tests (skin prick test or oral food challenge) or to recommend a referral to an allergist. Therefore, we chose to ask parents if their children had had allergy tests and not whether they had visited an allergist. The questionnaire was pre-tested on a pilot group of 16 parents with children with or without food allergy. The study was approved by the Medical School of Pediatrics, University of Parma, Parma, Italy.

Statistical analysis

A sample size was determined based on an estimated overall population proportion of 10%[2–4,10] within 2.5% of the true value with a 95%CI and using simple random sampling. A final sample size of at least 886 children was calculated after adjusting for an anticipated non-response rate of 35% for parents.

We used χ^2 analysis with continuity correction or Fisher's exact test to compare proportions on the analysis of the data and to study associations. Results were considered significant if $P < 0.05$. The OR and 95%CI were also calculated.

Results

The questionnaire was completed by 625 out of 900 parents, giving a response rate of 69%. There were 388 (62.08%) boys; and 237 (37.92%) girls with a mean age of 9.36 years (range 5–14 years). No difference was observed in age distribution between boys and girls. Responders and non-responders did not differ in age or sex. Atopic family history was positive in 233 (37.3%) children (144 [37.1%] boys; 89 [37.6%] girls [$P = 0.912$]).

The lifetime prevalence of self-reported allergic reactions to foods was 10.5% (66/625). Perceived food-induced symptoms were reported by 46 (9.9%) out of 463 children aged 5–10 years and by 20 (12.3%) out of 162 children aged 11–14 years ($P = 0.390$). There was no difference between boys ($n = 40$ [10.3%]) and girls ($n = 26$ [10.9%] [$P = 0.79$]). Reactions to the following foods were reported: cow's milk in 22 children (33.3%), egg in 15 (22.7%), tomato in 10 (15.1%), peanut in seven (10.6%), chocolate in six (9%), wheat in six (9%), kiwi in four (6%) and strawberry in four (6%). Other vegetables were reported in 16 (24.2%) children. All foods are listed in Table 1. Offending foods elicited cutaneous symptoms in 49 (74.2%) cases, intestinal symptoms in 30 (46.1%) and respiratory symptoms in 14 (21.2%) as detailed in Figure 1.

Mean age of food reaction onset was 3 years (range 1 month–9 years). In 76% of children, the first reaction to food occurred before 4 years of age. Twenty-two children had more than one reaction to the offending food. The reaction to foods was provoked by ingestion in 93% of children, and by skin contact in 12% of children. One child had a reaction after inhalation. The reactions occurred at home in 81% of cases, at school in 21%, and at restaurants in 7.5%. Children who reacted after ingestion of foods both at home and outside home were significantly more likely to have the following symptoms: conjunctivitis ($P = 0.016$), oral allergy syndrome ($P = 0.006$) or coexisting occurrence of cutaneous, respiratory and gastrointestinal symptoms ($P = 0.003$). There was no significant correlation with other symptoms. No association was found between any self-reported symptoms or combination of them and reactions following intake of foods only at home or only outside home. Ten (1.6%) children had current allergic food reactions: six (60%) boys and four (40%) girls with a mean age of 9.5 years (range 6–11 years). The foods inducing perceived symptoms were the following: cow's milk in three cases, egg in two cases, wheat in two cases, tomato, peanut, chocolate, kiwi, apple, soy, sesame, apricot, melon, apricot, and hazelnut in one case each.

Table 1 Number of children with parentally perceived adverse reactions to any single food

Offending foods	Number of children	%
Cow's milk	22	33.3
Egg	15	22.7
Tomato	10	15.5
Peanut	7	10.6
Wheat	6	9
Chocolate	6	9
Kiwi	4	6
Strawberry	4	6
Melon	3	4.5
Orange	2	3
Hazelnut	2	3
Sesame	2	3

In 1 case: pork, apple, soy, potato, carrot, apricot, pea, beans, additives, sugar.

Management

In cases of food reactions, medical care included a call to a general practitioner in 54% of cases, self-management in 37%, an emergency call in 6%, and hospitalization in 3%. Antihistamines were administered in 45% of food reactions, topical steroids in 24%, oral or parenteral steroids in 16%, and epinephrine in 1.5%. No drug was administered in 27% of cases. There was no difference in place of care or administration of antihistamines or steroids between children who had symptoms only at home, those who had them only outside of home and those who had them both at home and outside of home. The child who received adrenaline had reactions both at home and out of home. For diagnostic confirmation, SPT to foods were performed in 36/66 (54%) children who reported food reactions. Reported food-related symptoms were considered to be IgE-associated in children presenting positive SPT to food allergens. Children with reported food allergy had IgE-associated symptoms in 16/66 (24%) cases. In

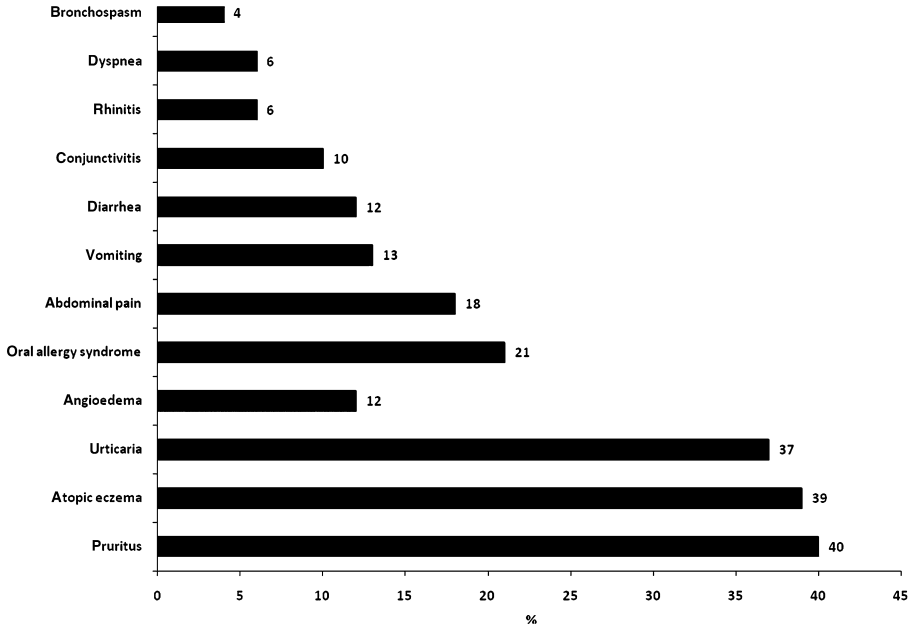

Fig. 1 Percentage of children with parentally reported symptoms of adverse reactions to food.

our population, overall prevalence of IgE-associated food allergy was 2.5%. There was no difference in sex between children who underwent SPT and those who did not. Children who underwent SPT were significantly younger than those who did not when they presented the first reaction (Table 2). In children with parentally reported food reaction, univariate analysis showed that among symptoms, only atopic eczema ($P < 0.05$) and oral allergy syndrome ($P = 0.01$) were associated with the prescription of an SPT (Table 2).

Among medical care, hospital admittance and emergency call ($P < 0.05$) were found to be associated with the prescription of an SPT (Table 3) but a consultation with a general practitioner or a pediatrician were not. There was a significant inverse association between reactions induced by foods only out of home and SPT to foods ($P = 0.03$). On the contrary, SPT to foods was significantly associated with reactions that occurred both at home and out of home ($P = 0.035$). Drug treatment was not associated with SPT (Table 3). Oral food challenge was performed in five (7.5%) children. All of them had positive SPT to foods. Food challenge was positive in two children.

Discussion

This survey provided by a written self-administered questionnaire for the first time as a useful description of perceived food

Table 2 Correlation between sex, age, atopic familiarity, symptoms and skin prick test to foods in children with self-reported food reaction

	Skin prick test		*P*-value
	Yes ($n = 36$)	No ($n = 30$)	
Characteristics *n* (%)			
Male/female	20/16	20/10	0.358
Atopic family history	24 (66%)	18 (60%)	0.575
Mean age at first reaction (months)	2.65	4.09	0.015
Symptoms *n* (%)			
Cutaneous reaction (pruritus, urticaria-angioedema, atopic eczema)	28 (77.8%)	21 (70%)	0.472
Pruritus	18 (50%)	9 (30%)	0.1
Atopic eczema	19 (52.8%)	7 (23.3%)	0.015
Urticaria-angioedema	13 (36.1%)	15 (50%)	0.256
Intestinal reaction (vomiting, abdominal pain, diarrhea, pruritus/swelling at mouth/palate)	19 (52.8%)	11 (36.7%)	0.191
Oral allergy syndrome	12 (33.3%)	2 (6.6%)	0.008
Abdominal pain	7 (19.4%)	5 (16.7%)	0.771
Vomiting	5 (13.9%)	4 (13.3%)	0.618
Diarrhea	4 (11.1%)	4 (13.3%)	0.537
Airway reaction (rhinitis, conjunctivitis, bronchospasm, dyspnea)	8 (22.2%)	6 (20%)	0.826
Conjunctivitis	5 (13.9%)	2 (6.7%)	0.296
Rhinitis	3 (8.3%)	1 (3.3%)	0.379
Dyspnea	3 (8.3%)	1 (3.3%)	0.379
Bronchospasm	1 (2.8%)	2 (6.7%)	0.431

Table 3 Correlation between place of reaction, medical care, treatment and skin prick test to foods in children with self-reported food reaction

	Skin prick test		*P*-value
	Yes (n = 36)	No (n = 30)	
Place of reaction *n* (%)			
At home	21 (58.3%)	16 (53.3%)	0.684
Only out of home (school, restaurant, other)	1 (2.8%)	6 (20%)	0.03
At home and out of home	13 (36.1%)	4 (13.3%)	0.035
Medical care *n* (%)			
General practitioner	20 (55.6%)	14 (46.7%)	0.472
Self treatment/no treatment	9 (25%)	12 (40%)	0.193
Emergency/hospital admittance	5 (13.9%)	0	0.042
Other	2 (5.6%)	4 (13.3%)	0.253
Treatment *n* (%)			
Antihistamine	18 (50%)	12 (40%)	0.417
Topical steroids	14 (38.9%)	2 (6.7%)	0.002
Parenteral steroids	7 (19.4%)	4 (13.3%)	0.507
Epinephrine	1 (2.8%)	0	0.545
No drugs	7 (19.4%)	11 (36.7%)	0.118
Other			

reactions in Italian children aged 5–14 years. In our population, we found that the lifetime prevalence of parentally perceived allergic reactions to food was 10.5%; and the point prevalence was 1.6%. Moreover, we observed that diagnostic tests, such as SPT or oral food challenge, were not routinely performed to ascertain food allergy even though there is evidence for their use in the case of suspected food reactions and diagnosis based on history is often inaccurate.[5]

Our questionnaire study had some limitations. As in any questionnaire study, the subjectivity of the answers may cause misclassification error. The questions covered a large span of the children's life. This could have led to a bias as a result of parental recall inaccuracy. However, in the present study the questionnaire was written and filled out by all parents themselves. Thus, a data bias is unlikely. To confirm food allergy and definitely avoid a selection bias, each child in the study population should have undergone an oral food challenge[8] with all foods.[9] This is practically and economically not feasible in epidemiological studies with a large unselected population. Moreover, it is ethically unjustified. Furthermore, we aimed to assess the burden caused by food reactions for the Health System. From this point of view, parental perception provides a better understanding of the prevalence of food reactions and of the demand for health-care services. Another important potential source of bias arises from non-responders. Nonetheless, our results seem to be valid and reliable since we had a high response rate. Furthermore we found no difference between responders and non-responders in sex and age.

Our findings are not consistent with contrasting data on lifetime prevalence of perceived food allergy in school-aged children reported by previous investigations.[2–4,10] Pereira *et al*.[2] sent a postal questionnaire to 11- and 15-year-old school children who were resident on the Isle of Wight. They found a 10–20% higher prevalence of perceived food allergy than that of our survey. However, they obtained low response rates of 47.4% and 50.2% for the 11- and 15-year-old cohorts, respectively. Therefore, it is possible that this could be a source of selection bias, as children without allergic diseases would be less likely to return the questionnaire. This and differences in population age may explain why we observed a lower prevalence of self-reported food allergy.

On the other hand, our results showed a lifetime prevalence of parentally perceived food reactions in school-aged children that were more prevalent than that previously reported.[3,4,10] The cumulative incidence of symptoms after food ingestion was 2.1% in 9–11-year-olds in France,[4] and 3% in children aged 5–11 years in the UK.[10] However, it is not easy to compare our findings with theirs, because of differences in age range of the populations and sampling methods. In another questionnaire study, Rance *et al*.[3] found that the cumulative prevalence of perceived food allergy was 1.5–3 times less frequent in French children than in children in our community. However, they surprisingly showed that lifetime prevalence did not increase with age. Children aged 11–14 had a lower prevalence than children aged 6–10. Therefore, their results must be cautiously read because of possible recall bias. Furthermore, they studied a population that was entirely urban. Differences in these factors may explain their discrepant findings.

We found point prevalence lower than that previously reported in France.[3,11] Kanny *et al*.[11] conducted a questionnaire study in a representative sample of the French population. They found that 2.8% of children aged 7–15 years were perceived as being food intolerant. However, the study design was too different for a comparison with our survey.

Finally, differences in prevalence of food reactions ascertained by an oral food challenge between countries have been observed in adults.[6] This might indicate that differences between our study estimates of self-reported food allergy and those reported in other countries[2–4,10,11] may be the result of a real difference between populations. We can speculate that such differences may be explained by cultural factors or dietary habits. Moreover, they may have a genetic explanation. Along this line, a marked heterogeneity in the level of serum IgE to foods between populations has been found.[12,13]

Consistently with previous surveys,[2–4,11] we showed that cow's milk, eggs and peanuts were the most common offending foods. At variance, we also observed that reactions to tomatoes were common. This may depend on the high rate of sensitization due to high consumption of tomatoes in Italy or on the popular belief of the high allergenicity of tomatoes.

We found that a low number (54%) of children with reported food reactions underwent SPT. These figures are similar to those (57.7%) observed by Rancè *et al*. in French children.[3] They are also comparable to that previously observed by a Web-based questionnaire that showed that 60.5% of patients with anaphylactic shock from food reaction underwent allergy testing.[14] Moreover, we observed that in our population, children with suspected food reactions rarely underwent an oral food challenge, which is the recognized gold standard for the diagnosis of food allergy. Likewise in France, only 21% of children with a history of food reaction underwent a food challenge.[3]

Some explanations may be offered in order to understand why specific diagnostic investigations are underperformed. First, the number of pediatric allergy services may be insufficient to perform all the needed oral challenges leading to inadequate management of children with self-reported allergies. Second, mistaken beliefs and misconceptions about food allergies are common and may be amplified by misinformation that is frequent in print media and on the Internet. So, an insufficient education can lead parents to the misguided management of their children. Third, our findings may reflect low awareness of food allergy by primary care physicians.[15] Along this line, neither parental choice to seek general practitioners or pediatricians for acute food reactions nor type of drug used for the reaction were associated with SPT. This highlights the importance of re-training doctors and health personnel on how to manage children with food reactions. Another possible explanation is that physicians may have ignored food reactions because they were often mild and self-limiting, and the majority were safely managed at home. Accordingly, we observed that few children had IgE-associated symptoms, which are considered more serious. We believe, however, that these symptoms should be effectively considered because they may be troublesome, and they may cause anxiety in parents leading to unnecessary diet restriction.

The issue also queries whether some factors may positively influence the decision of undergoing clinical tests for food reactions. The onset of food reaction both at home and out of home is associated with SPT. Younger children were more likely to perform SPT. This concurs with the fact that real food allergies often begin in infants and young children.[16] Among symptoms, predictors of SPT utilization were atopic eczema and oral allergy syndrome but not intestinal and respiratory symptoms. The use of topical steroids, which is the mainstay in the treatment of atopic eczema, also emerged as a predictor of performing SPT. Our findings suggest that physicians are aware that atopic eczema and symptoms at the mouth are associated with food reactions.[12] Hospital admittance and emergency calls also appeared as predictors of SPT use. This may be the result of an awareness of the inaccuracy of food reaction history in hospital physicians.

Although the cumulative prevalence of parentally perceived food allergy was high, few children had IgE-associated symptoms. This is in agreement with the result of Pereira, who performed SPT in 89 children aged 11 years with reported reaction to foods and found a rate of positive SPT to foods of 32%.[2]

Another issue identified was that children who had reactions both at home and outside home had potentially more serious symptoms, as these symptoms more frequently coexisted at three different sites (skin, intestine and lung) and these children were perhaps more likely to receive adrenaline. This indicates the need for not only parents but also child-care workers to be trained properly in order to recognize and respond appropriately to allergic reactions for ensuring the safety of children.

In conclusion, we observed a high frequency of perceived food reactions in school-aged children. An appropriate assessment to ascertain clinical food hypersensitivity is warranted in order to avoid unnecessarily restricted diets, as most of these children would tolerate the suspected foods.[11] However, in our population, few children underwent diagnostic tests after the occurrence of suspected food reactions. From a public health perspective, given the increasing frequency of food allergy, our findings indicate that efforts should be made for training primary care physicians[17] to manage food-allergic children. We therefore have published practical guidelines for pediatricians in our region[8] and have disseminated them through interactive meetings. Furthermore, a mass-media educational campaign directed at the community to make known information about food allergy has been initiated. This may change both patients' expectations and the practice of clinicians.

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