

Food-Allergic Reactions in Schools and Preschools

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Background: Food allergies may affect up to 6% of school-aged children.

Objectives: To conduct a telephone survey to characterize food-allergic reactions in children (defined as those aged 3-19 years in this study) with known food allergies in schools and preschools and to determine mechanisms that are in place to prevent and treat those reactions.

Design: The parents of food-allergic children were contacted by telephone and asked about their child's history of food-allergic reactions in school. The schools the children attended were contacted, and the person responsible for the treatment of allergic reactions completed a telephone survey.

Results: Of 132 children in the study, 58% reported food-allergic reactions in the past 2 years. Eighteen percent experienced 1 or more reactions in school. The offending food was identified in 34 of 41 reactions, milk being the causative food in 11 (32%); peanut in 10 (29%); egg in 6 (18%); tree nuts in 2 (6%); and soy, wheat, celery, mango, or garlic in 1 (3%) each. In 24 reactions (59%),

symptoms were limited to the skin; wheezing occurred in 13 (32%), vomiting and/or diarrhea in 4 (10%), and hypotension in 1 (2%). Also, 15 (36%) of the 41 reactions involved 2 or more organ systems, and 6 (15%) were treated with epinephrine. Fourteen percent of the children did not have a physician's orders for treatment, and 16% did not have any medications available. Of the 80 participating schools, 31 (39%) reported at least 1 food-allergic reaction within the past 2 years and 54 (67%) made at least 1 accommodation for children with a food allergy, such as peanut-free tables, a peanut ban from the classroom, or alternative meals.

Conclusions: It is common for food-allergic children to experience allergic reactions in schools and preschools, with 18% of children having had at least 1 school reaction within the past 2 years. Thirty-six percent of the reactions involved 2 or more organ systems, and 32% involved wheezing. Every effort should be made to prevent, recognize, and appropriately treat food-allergic reactions in schools.

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FOOD ALLERGIES may affect up to 6% of preschool- and school-aged children.¹ While the only available therapy for these children is strict avoidance of the offending foods, accidental reactions are common and occur in up to 50% of food-allergic children despite their best efforts to avoid the offending foods.² It is also known that up to 50% of anaphylactic reactions in children are due to food allergies and that some of these reactions occur in the school.^{3,4} However, to our knowledge, the incidence of food-allergic reactions in schools has not been previously described. We, therefore, conducted a telephone survey to determine the frequency, symptoms, treatments, and outcomes of food-allergic reactions in children (defined as those aged 3-19 years in

this study) with known food allergies in schools and preschools and the mechanisms that are in place in schools to prevent and treat these reactions.

RESULTS

PARENTAL SURVEY

One hundred sixty parents or patients responded to the survey. Four school-aged children were homeschooled, 2 because of food allergies. Twenty-four preschool-aged children were not enrolled in preschool, 15 (63%) because of a food allergy. One hundred thirty-two subjects completed the entire study questionnaire and were included in the final data analysis. In 89%, the person responding was the child's mother; in 9%, the child's father;

PATIENTS AND METHODS

One hundred sixty food-allergic children aged 3 to 19 years were recruited among the patients seen at The Johns Hopkins Hospital Pediatric Allergy Clinic, Baltimore, Md, from April 1, 1999, to April 30, 2000, and from private pediatric offices in the Baltimore metropolitan area and in Virginia. Twenty-eight children were not enrolled in school and, therefore, were not included in the analysis. Of the remaining 132 children, a diagnosis of food allergy in 106 examined at The Johns Hopkins Hospital Pediatric Allergy Clinic was based on a convincing history of food-related reactions, with supportive laboratory data such as positive prick skin test results to the suspected food allergen, food-specific IgE measured by immunoassay (CAP System FEIA; Pharmacia Diagnostics, Uppsala, Sweden) (>0.35 kU/L), and/or food challenge. In the remaining 26 patients, food allergies were reported by the parents, and 23 (88%) of these patients had undergone an examination by an allergist that included skin testing and/or serum IgE testing to the relevant foods.

The parents of these children were contacted by telephone by 1 of 2 trained interviewers (A.N.-W. or M.K.C.-W.) after informed consent was obtained by mail. The parents and teenaged patients answered a standardized questionnaire detailing food-allergic reactions in the past 2 years. The 2-year period was used as a cutoff for more reliable recall. The schools that the children attended were contacted by the same interviewers, and the person in charge of treating food-allergic reactions completed a structured questionnaire by telephone. The study was approved by the institutional review board of The Johns Hopkins University School of Medicine, Baltimore.

and in 2%, the patients themselves. Eighty-two were established patients in The Johns Hopkins Hospital Pediatric Allergy Clinic, 24 were new patients, and 26 were identified through private pediatricians. The characteristics of the 132 participants are provided in **Table 1**.

Fifty-eight percent of the children were reported to have had food-allergic reactions in the past 2 years. Parents recalled a total of 219 reactions in these children (median, 2 reactions; range, 1-12 reactions). As detailed in **Table 2**, 24 of these children experienced 1 or more reactions in school. A total of 41 reactions were reported in these 24 children (median, 1 reaction; range, 1-7 reactions). Twelve children had 19 reactions in schools, and 12 had 22 reactions in preschools. There were an additional 3 children with multiple food allergies who had frequent (>30) benign cutaneous reactions at school that were attributed to foods. However, the offending foods and detailed descriptions of the reactions were not available, and these patients were, therefore, not included in the reaction analysis.

Data presented in **Table 3** further characterize food-allergic reactions. The causative food was clearly identified in 34 of the 41 reactions. Milk was most commonly implicated, followed by peanut, egg, and tree nuts.

Table 1. Description of the 132 Study Participants

Characteristics	Value*
Age, y	
Median	6.6
Range	2.9-19.3
Sex	
Male	60
Female	40
Type of patient	
Established	62
New	18
Recruited from a private pediatric office	20
Attending	
Preschool	47
School	53
Food allergies†	
Peanut	75
Tree nuts	46
Milk	46
Egg	36
Soy	14
Wheat	12
Other	49
No. of foods allergic to	
1	25
2	21
3	20
≥ 4	34

*Data are given as the percentage of participants unless otherwise indicated.

†Percentages total more than 100 because most participants had more than 1 food allergy.

Most reactions took place in classrooms with eating areas, but regular classrooms were the second most common location.

In 59% of the reactions, symptoms were limited to the skin and mucous membranes. Wheezing was noted in 32%, and vomiting and/or diarrhea in 10%. Thirty-six percent of the reactions involved 2 or more organ systems. One child was treated immediately with an antihistamine on the ingestion of the incriminated food and developed no symptoms.

Sixty-five percent of the reactions were treated with oral antihistamines, while 15% were treated with epinephrine (6 episodes in 3 children) and 10% were treated with inhaled bronchodilators. In 1 child, the administration of epinephrine was attempted but was not successful, and by the time the ambulance arrived, her symptoms (wheezing and vomiting) had resolved. In 2 other children, 3 cutaneous reactions also resolved without treatment.

The treatment provided for the reactions is detailed in Table 3. Most reactions were treated by either a school nurse or a teacher. An ambulance was called for 3 reactions. In the reactions that were treated with medication, treatment was initiated within 10 minutes of the onset of symptoms in most cases.

Eighty-six percent of the children had a protocol for the treatment of food-allergic reactions in place at school, provided by an allergist in 60% and by a pediatrician in 40%. Fourteen percent of the children did not have a written protocol in place. Parents reported good adherence

Table 2. Food-Allergic Reactions in Schools and Preschools*

Identification No.	Age, y	Food Allergies	No. of Reactions in the Past 2 y	No. of Reactions in Preschools or Schools	Causative Food	Symptoms
Preschools						
10	3.8	M and E	1	1	M	Facial swelling
19	3.3	M	3	2	M	Vomiting and wheezing (twice)
43	5.5	M, E, W, and P	3	1	P	Hives
96	4.4	E and O	1	1	E	Rash
97	5.7	P and T	3	1	P	Hives
99	4.0	W, P, and T	6	1	W	Rash
105	5.6	P	1	1	P	Rash
114	3.3	M, E, P, T, and O	12	7	M and E	Hives
139	5.9	M, E, P, and T	7	3	M (once) and tree nuts (twice)	Hives, facial swelling, and abdominal pain
140	3.0	M, E, and O	2	1	M	Hives and wheezing
141	6.4	M and P	2	2	M (twice)	Oral pruritus and wheezing (once)
152	3.1	M and P	2	1	M	Oral pruritus
Schools						
4	7.8	M, E, P, and O	3	1	Unknown	Hives
8	6.6	P, T, and O	3	1	P	Hives
18	16.3	P, T, and O	3	1	Celery	Facial edema and abdominal pain
34	8.2	E, P, and S	3	2	E	Hives and wheezing (twice)
42	8.8	P, T, and Sh	4	1	P	Hives
49	9.7	S, P, and T	Multiple	1	S†	Oral pruritus
60	11.0	M, E, P, and T	8	2	Unknown	Rashes
90	7.7	P and T	4	4	P (3 times)	Hives, wheezing (twice) and low blood pressure
133	11.1	P and T	1	1	P	Lip swelling
135	8.9	Fruits	20	1	Mango	Hives and wheezing
146	7.4	Garlic	1	1	Garlic	Hives and wheezing
147	10.9	Sh and O	10	3	Unknown	Hives, facial swelling, and wheezing (3 times)

*M indicates milk; E, egg; W, wheat; P, peanut; O, other; T, tree nuts; S, soy; and Sh, shellfish.

†This patient also had experienced frequent (on average, once per month) episodes of oral pruritus, treated with antihistamine, that were attributed to foods, but the causative food could not be identified. These reactions were excluded from the final analysis.

to the protocol in 80% of the children who experienced reactions at school. Eighty-four percent of the parents provided medications to be used at school in case of an allergic reaction. Eighty-one percent provided at least 1 self-injectable epinephrine device, 64% provided oral antihistamines, and 20% provided inhaled bronchodilators. Medications were kept in a health room for 58% of the children, in the classroom for 28%, and in the front office for 18%. Seventeen percent of the children carried their medications with them. Five percent of the children also had medications in other locations, such as the cafeteria, the school bus, or with a coach. Nineteen percent of the children had medications in more than 1 location. Sixteen percent of the children did not have any medications at school for the treatment of food-allergic reactions.

Fifty-nine percent of the children were not allowed to eat any food at school or preschool not provided by their parents, 22% ate regular school food, and 19% were allowed to have some of the foods and snacks provided by the school. Most parents were proactive in approaching the issue of a food allergy at school. Ninety percent talked to teachers, 58% talked to the school nurse, and 47% talked to the school principal. Thirty-five percent of the parents distributed written educational materials, 21% talked with parents of other children in the classroom, 15% made a formal presentation for the school staff, and 14% showed a videotape from the Food Allergy Net-

work. Eight percent arranged for self-injectable epinephrine device training for school personnel, 4% asked their child's pediatrician or allergist to call the school, and 7% used other resources. Most (83%) applied more than 1 strategy to ensure their child's safety at school. Eighty-six percent of the parents rated school receptiveness toward food allergy as good to excellent, 9% deemed it satisfactory, and 5% thought that there was inadequate school receptiveness. Forty-one percent of the parents belonged to 1 support group, 10% belonged to 2 support groups, and 3% belonged to 3 or more support groups; 46% of the parents did not hold any support group membership. Fifty percent of the parents belonged to the Food Allergy Network, 8% belonged to the Asthma and Allergy Foundation of America, and 4% belonged to other support groups.

SCHOOL SURVEY

We attempted to contact 89 schools; 3 declined the interview, and in 6 we were unable to reach the school nurse or the director. Fifty-nine schools and 21 preschools participated in the survey. As shown in **Table 4**, most (90%) of the schools and preschools reported more than 1 allergic child among their students. Thirty-nine percent of the schools reported at least 1 food-allergic reaction within the past 2 years, including 71 reactions in 22 schools and 14 reactions in 9 preschools. Most of the schools had a

health professional; there was no health professional in 5%. None of the preschools had a nurse on the premises. In more than 90% of the schools, the nurse or health technician was responsible for the treatment of food-allergic reactions, while in the preschools, teachers and administrative staff were in charge of treatment. In 78% of the schools and in 62% of the preschools, there was at least 1 backup person trained in the use of the self-injectable epinephrine device.

In 97% of the schools, medications for the treatment of food-allergic reactions were kept in the health room, and 31% of the schools had medications available in more than 1 location. In 19% of the schools, students were allowed to carry epinephrine with them. In the preschools, medications were located in the classroom in 48%, in the front office in 43%, and in the kitchen in 14%, with 5% of the preschools having medications for the treatment of food-allergic reactions available in more than 1 location. Fifty-one percent of all schools used a special form for the orders for treatment of food-allergic reactions, and 49% used a standard medication form. Sixty-seven percent of all schools made at least 1 accommodation for children with a food allergy, such as peanut-free tables, a peanut ban from the classroom or from the entire school, separate eating areas, and alternative meals.

COMMENT

Although food allergies may affect up to 6% of school-aged children and are the most common reasons for nutritional modifications in school, little is known about food-allergic reactions in schools and preschools.^{1,5,6} The almost universal presence of the most common food allergens, such as milk, egg, soy, wheat, and peanuts, makes their avoidance extremely difficult.⁷ In fact, in one study² focusing specifically on peanut allergy, 50% of the children had experienced an accidental exposure in a 1-year period. This risk is especially important, because food-allergic reactions in children have the potential to be life threatening or even fatal.⁸⁻¹⁰ In case series^{3,4,11-13} of anaphylaxis, food allergy was the major identifiable trigger in 34% to 57% of the reactions. A time trend study¹⁴ of hospital admissions for acute anaphylaxis reported that food was a causative factor in 15%, and that in addition to an overall increase in anaphylaxis incidence there was an increase in the incidence of food-related anaphylaxis. In other studies,^{3,4} it was found that food allergy was the most common cause of anaphylaxis in children outside of the hospital setting and that 1% to 2% of all anaphylactic reactions occurred in schools.

The preferred approach to food-allergic reactions is prevention. Theoretically, it may be achieved by a high level of alertness and/or complete elimination of the offending food from the child's environment. In reality, however, food elimination is difficult, and in the case of basic foods, such as milk, egg, soy, and wheat, it is virtually impossible. In addition, even foods such as peanuts and tree nuts, which can be avoided without concern of compromising the child's nutrition, are also difficult to eliminate because of food contamination or hidden ingredients. Furthermore, a recent telephone survey¹⁵ among the

Table 3. Details of the 41 Food-Allergic Reactions in School

Reaction Description	No. (%) of the Reactions*
Causative food†	
Milk	11 (32)
Peanut	10 (29)
Egg	6 (18)
Tree nuts	2 (6)
Soy, wheat, celery, mango, or garlic	1 (3) each
Location	
Classroom with an eating area	19 (46)
Classroom without an eating area	15 (37)
Cafeteria	6 (15)
During a field trip	1 (2)
Symptoms‡	
Limited to the skin and mucous membranes	24 (59)
Hives	16 (39)
Rash	4 (10)
Facial angioedema	2 (5)
Oral pruritus	2 (5)
Wheezing	13 (32)
Vomiting and/or diarrhea	4 (10)
Hypotension	1 (2)
Immediate treatment, no symptoms	1 (2)
No. of organ systems involved	
1	26 (64)
2	14 (33)
3	1 (3)
Treatment	
Oral antihistamine	27 (65)
Epinephrine injection	6 (15)
Bronchodilators	4 (10)
None	4 (10)
Person providing treatment	
School nurse	14 (34)
Teacher	13 (32)
Parent	4 (10)
School administrator	3 (7)
Emergency medical services personnel	2 (5)
Emergency department personnel	1 (2)
None	4 (10)
Time from the onset of reaction to treatment	
≤10 min	29 (71)
≤30 min	3 (7)
≤1 h	2 (5)
No treatment	4 (10)
No details available	3 (7)

*Percentages may not total 100 because of rounding.

†Clearly identified in 34 reactions.

‡Some participants had more than 1 symptom.

registrants in the National Peanut and Tree Nut Allergy Registry found that in 25% of the cases, a reaction in school was the first indication of a peanut allergy. Our survey demonstrates that food-allergic reactions are common in schools and preschools, as almost 1 of 5 surveyed children experienced such a reaction in school in the past 2 years. It is possible that this is an overestimate of the true frequency of such reactions in the general population, because it represents a referral population with an inordinate number of children with multiple food allergies. However, it also represents a highly educated population, most of whom were making use of at least 1 support organization, which may have helped to reduce the chances of accidental exposures.

Table 4. Characteristics of Schools and Preschools Participating in the Survey*

Characteristics	Schools (n = 59)	Preschools (n = 21)	Total (N = 80)
School type			
Public	43 (73)	2 (10)	45 (56)
Private	16 (27)	19 (90)	35 (44)
Median class size			
No. of students	25	15	24
Median	600	160	500
Range	165-1200	70-500	70-1200
Person providing information			
Principal or teacher	11 (19)	21 (100)	32 (40)
Nurse or health technician	48 (81)	0	48 (60)
No. of students with food allergies			
Median	8	6	7
Range	0-30	2-20	0-30
Schools reporting more than one food-allergic child	51 (86)	21 (100)	72 (90)
Schools that reported food-allergic reactions in the past 2 y	22 (37)	9 (43)	31 (39)
Total No. of reactions	71	14	85
Median	2	2	2
Range	1-12	1-3	1-12
Person in charge of treating allergic reactions			
Nurse or health technician	54 (92)	0	54 (68)
Teacher	3 (5)	11 (52)	14 (17)
Director or administrator	2 (3)	10 (48)†	12 (15)
Health professional present			
FT nurse	40 (68)	0	40 (50)
PT nurse and FT health technician	10 (17)	0	10 (13)
PT nurse	4 (7)	0	4 (5)
FT health technician	2 (3)	0	2 (2)
None	3 (5)	21 (100)	24 (30)
Backup person for the treatment of food-allergic reactions			
1	20 (34)	7 (33)	27 (34)
≥2	26 (44)	6 (29)	32 (40)
0	13 (22)	8 (38)	21 (26)
Location of medications for the treatment of food-allergic reactions			
Health room	57 (97)	0	57 (71)
Front office	3 (5)	9 (43)	12 (15)
Classroom	11 (19)	10 (48)	21 (26)
Child's bag	11 (19)	0	11 (14)
Preschool kitchen	0	3 (14)	3 (4)
>1 location	18 (30)	1 (5)	19 (24)
Form used for physician orders for the treatment of food-allergic reactions			
Standard medication form	24 (41)	15 (71)	39 (49)
Special form for allergic reactions	35 (59)	6 (29)	41 (51)
Accommodations for children with food allergies			
Peanut-free tables	16 (27)	5 (24)	21 (26)
Peanuts restricted from the school or classroom	8 (14)	11 (52)	19 (24)
Separate eating areas	7 (12)	7 (33)	14 (18)
Alternative meals	10 (17)	2 (10)	12 (15)
Peanuts or tree nuts not served by the school	0	3 (14)	3 (4)
>1 Accommodation	8 (14)	1 (5)	9 (11)
None	23 (39)	3 (14)	26 (33)

*Data are given as the number (percentage) unless otherwise indicated. The percentages may not sum to 100 because, in many schools, medications were kept in several locations, and the schools were making >1 accommodation for children with food allergy. FT indicates full-time; PT, part-time.

†In one preschool, the director in charge of treatment of food-allergic reactions was uncomfortable with the use of the self-injectable epinephrine device.

Milk was the most commonly incriminated food in the preschool-aged children, whereas peanut was most common in school-aged children. Fortunately, there were no fatalities; however, 36% of the reactions involved 2 or more organ systems and 15% were treated with epinephrine (Table 3). However, 14% of the children did not have a written protocol in place for the treatment of food-allergic reactions in school and 16% did not have medications available at school for the treatment of food-allergic reactions.

Thirty-seven percent of the schools and 43% of the preschools reported at least 1 food-allergic reaction in the past 2 years (Table 4). All but 1 of the surveyed schools had a person responsible for the treatment of food-allergic reactions trained in the administration of epinephrine, although there was no backup person identified in 22% of the schools and in 38% of the preschools. Sixty-seven percent of all schools reported at least 1 modification directed at the prevention of food-allergic reactions (Table 4).

Our survey demonstrates that complete elimination of food-allergic reactions in schools is extremely difficult. In fact, 10 of the reactions occurred in schools that made special accommodations designed to prevent food-allergic reactions. Therefore, it is critical that schools are prepared to recognize and treat food-allergic reactions even when every effort is made to minimize the risk of reactions.¹⁶ Pediatricians and allergists have an extremely important role in the education of food-allergic children and their parents. Physicians should ensure that every food-allergic child has a clear emergency plan and medications available in school in case of a food-allergic reaction. They have to educate children and their parents about when and how to use self-injectable epinephrine devices. Children with a history of severe anaphylactic reactions to food may benefit from wearing a medical alert bracelet. Physicians may also provide the parents with the information about lay organizations, such as the Food Allergy Network, that are a great source of training materials, helpful strategies, and support.

The schools should identify food-allergic students and request detailed instructions from the child's physician for the treatment of food-allergic reactions. A person in charge of treating reactions should be clearly identified and comfortable with the use of injectable epinephrine devices. There should always be at least 1 backup person with the same qualifications to recognize and treat food-allergic reactions.¹⁷⁻²¹ Finally, it is essential that epinephrine be immediately available since early administration of epinephrine for food-allergic reactions can be lifesaving, with clear evidence that fatal outcomes are associated with a delay in its administration.^{9,10}

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