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ORIGINAL ARTICLE

Food Allergy Is Associated With Potentially Fatal Childhood Asthma

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Background. Risk factors for potentially fatal childhood asthma are incompletely understood. **Objective.** To determine whether self-reported food allergy is significantly associated with potentially fatal childhood asthma. **Study design.** Medical records from 72 patients admitted to a pediatric intensive care unit (PICU) for asthmatic exacerbation were reviewed and compared in a case-control design with 2 randomly selected groups of 108 patients admitted to a regular nursing floor for asthma and 108 ambulatory patients with asthma. Factors evaluated included self-reported food allergy, gender, age, poverty area residence, race/ethnicity, inhaled steroid exposure, tobacco exposure, length of hospital stay, psychologic comorbidity, and season of admission. **Results.** At least one food allergy was documented for 13% (38/288) of the patients. Egg, peanut, fish/shellfish, milk, and tree nut accounted for 78.6% of all food allergies. Children admitted to the PICU were significantly more likely to report food allergy ($p = 0.004$) and 3.3 times more likely to report at least one food allergy compared with children admitted to a regular nursing floor, and significantly more likely to report food allergy ($p < 0.001$) and 7.4 times more likely to report at least one food allergy compared with children seen in the ambulatory setting. Children admitted to either the PICU or the regular nursing floor were significantly more likely to be African-American ($p < 0.001$) and to be younger ($p < 0.01$) compared with children seen in the ambulatory setting. **Conclusions.** Self-reported food allergy is an independent risk factor for potentially fatal childhood asthma. Asthmatic children or adolescents with food allergy are a target population for more aggressive asthma management.

Keywords asthma, asthma severity, childhood asthma, food allergy

INTRODUCTION

In the United States, asthma is the most common chronic disease in childhood and is one of the most frequent admitting diagnoses in children's hospitals. In 2002, 12% of children under the age of 18 years had a diagnosis of asthma (1). Although annual rates of asthma mortality have declined since 1999 in the United States, asthma deaths continue to occur at unacceptably high rates, particularly among African-Americans residing in urban areas (2, 3). Hospitalization rates have increased among young children 0 to 4 years of age (4). Risk factors for asthma fatality in adults include over-reliance on inhaled short-acting bronchodilators, low socioeconomic status, poor adherence to recommended treatment plans, previous life-threatening exacerbations, and psychologic comorbidity (5, 6).

Risk factors for potentially fatal childhood asthma (PFCA) are less well established. Poverty, race/ethnicity, urban area of residence, duration of asthma, male gender, and history of multiple emergency department visits within 12 months before pediatric intensive care unit (PICU) admission have been linked with an increased risk of fatal asthma in children (7–9).

The prevalence of immunoglobulin E (IgE) mediated food allergy is estimated to be approximately 3% to 4% of the US population, and asthma affects approximately 6 million children (4, 10). The coexistence of both asthma and food allergy in children is common with approximately 8% of asth-

matic children also having a food allergy (11–13). Despite the prevalence of both food allergy and asthma in children, few studies have evaluated whether food allergy is a risk factor for PFCA. In England, Roberts et al. demonstrated an association between food allergy and life-threatening asthma (14). Elevated food-specific IgE levels and allergies to peanut and milk have been associated with increased rates of hospitalization for asthma in US children (15, 16).

With the surge in the prevalence of asthma in US children in recent years, identifying independent risk factors for asthma morbidity is important for targeting asthmatics who are candidates for more aggressive management. Although an association between food allergy and asthma has been noted in several studies, no previous study has assessed whether food allergy may be independent risk factor for PFCA in an urban North American population.

METHODS

Study Design and Setting

We performed a retrospective chart review of children at the Children's Hospital, Cleveland Clinic, admitted for asthma either to the PICU or the regular nursing floor, and children with asthma seen in an ambulatory clinic. The study was approved by the Cleveland Clinic Foundation Institutional Review Board.

Study Population

Medical records from 72 patients admitted to the PICU for asthmatic exacerbation over a 10-year period from 1992–2002 were reviewed. These patients were identified as having PFCA based on admission to the PICU. Criteria for admission to the PICU included severe respiratory distress and need for administration of continuous inhaled beta-agonist. The patients were compared in a case-control design with

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2 randomly selected groups of 108 patients (1.5x): patients admitted to a regular nursing floor for asthma at the Children's Hospital, Cleveland Clinic during a 2 year period from 1996–1997 and never requiring PICU admission, and ambulatory patients with asthma seen during a 2-year period from 2000–2002 without prior hospitalization or emergency department care for asthma. Patients with asthma were identified by primary diagnosis codes (International Classification of Diseases, Ninth Revision or ICD-9) 493.X for asthma or by secondary diagnosis code of asthma with a primary code for a well-child examination (V20.20).

Data Collection

The demographic and clinical factors evaluated included self-reported food allergy, gender, age, race/ethnicity, poverty area residence, inhaled corticosteroid (ICS) exposure, tobacco exposure, length of hospital stay, psychologic comorbidity, and season of admission.

Self-reported food allergy included any food allergy recorded in the patient's history at the time of the patient encounter. Age at admission was documented for the patients in the PICU and regular nursing floor group, and age at the time of routine physical examination or acute asthma evaluation (whichever occurred first chronologically) was recorded for patients in the ambulatory group.

Poverty area residence was determined by zip code of residence (17). A patient was considered to reside in a poverty area if the percentage of poverty within the patient's zip code of residence was 20% or more. This definition of poverty was established by the Social Security Administration in 1964 as the standard used by federal agencies for statistical purposes and was subsequently modified in 1969 and 1981 (18). This definition uses total income adjusted to poverty thresholds, weighted by number and age of household members.

ICS exposure was defined by previously prescribed inhaled steroids before hospital admission or ambulatory visit. Tobacco exposure included either a personal history of tobacco smoking or passive exposure. Length of hospital stay was from the day of admission up to and including the day of discharge. Psychologic comorbidity was noted for any patient with depression, anxiety, and/or personality disorders, or those patients taking psychotropic medications. For those patients admitted to the PICU or regular nursing floor, the season (spring, summer, fall, or winter) at the time of admission was recorded.

Two reviewers collected data. One reviewer recorded information for the PICU and ambulatory group, and a second reviewer, who was blinded to study aims, recorded information for the regular nursing floor and ambulatory groups. The first reviewer verified data from 20 randomly selected charts from the ambulatory group, and the second reviewer verified data from 20 randomly selected charts from the PICU and regular nursing floor groups. A total of 60 charts were reviewed for food allergy information. A 100% agreement in the presence or absence of food allergy was observed between the two reviewers; 72% agreement would have been expected by chance alone. This corresponds to a kappa value of 1.0 (95% confidence interval: 0.59, 1.0), which implies that there was excellent agreement beyond chance.

Data Analysis

Descriptive statistics were computed for all variables using SAS version 9.1 software (SAS Institute, Cary, North Carolina). A significance level of 0.05 was used for all analyses. Kruskal-Wallis tests and Dunn's multiple comparison procedure were used to analyze differences in age between patients admitted to the PICU and the ambulatory floor and patients in the ambulatory group. Wilcoxon's rank sum test was used to compare length of hospital stay between patients admitted to the PICU and the ambulatory floor. Pearson's chi-square tests were used for categorical factors. A baseline-category logit model was used to study the multivariable associations of demographic and clinical factors with the severity of asthma as measured by grouping of patients into PICU, regular nursing floor, or ambulatory groups. The final model was chosen using a stepwise selection method and included food allergy, age, race/ethnicity, and tobacco exposure. This method started with a model containing none of the factors of interest and assessed adding or deleting factors from the model until no additional terms could enter the model on the basis of a *p* value greater than 0.30 and no factors could be eliminated from the model on the basis of a *p* value less than 0.1.

RESULTS

Demographic data for all three groups (PICU, ambulatory, and regular nursing floor groups) are shown in Table 1. Table 2 shows results of multivariable analysis including food allergy, age, race/ethnicity, and tobacco exposure are shown.

TABLE 1.—Demographic data.

	PICU	RNF	AMB ^a	<i>p</i> value ^b
Number of patients	72	108	108	
Male (%)	39 (54.2%)	63 (58.3%)	71 (65.7%)	0.27
Median age in years (25th, 75th percentiles)	7.4 (3.2, 10.8)	4.2 (2, 8.9)	9 (5, 13)	<0.0001
Poverty (%):	33 (45.8%)	45 (41.7%)	11 (10.2%)	<0.0001
Race (%):				<0.0001
Caucasian	24 (34.7%)	36 (33%)	86 (80%)	
African-American	41 (56.9%)	68 (63%)	18 (17%)	
Other	6 (8.5%)	4 (3.7%)	4 (4%)	
At least 1 food allergy (%)	20 (27.8%)	12 (11.1%)	6 (5.6%)	<0.0001
Inhaled steroid exposure	29 (40.3%)	31 (28.7%)	43 (39.8%)	0.15
Tobacco exposure (%)	1 (1.4%)	2 (2.8%)	1 (0.9%)	0.56
Median number of days in hospital (25th, 75th percentiles)	3.0 (2.0, 5.0)	2.0 (1.0, 2.0)	NA	<0.001
Psychologic comorbidity (%):	4 (5.6%)	4 (3.7%)	1 (0.9%)	0.2
Season at admission (%)				0.6
Winter	19 (26.4%)	30 (27.8%)		
Spring	10 (13.9%)	10 (9.3%)	NA	
Summer	28 (38.9%)	38 (35.2%)		
Fall	15 (20.8%)	30 (27.8%)		

PICU = pediatric intensive care unit group; RNF = regular nursing floor group; AMB = ambulatory group, NA = not applicable.

^a Information regarding race was not available for 4 patients in the ambulatory group.

^b *p* values correspond to Kruskal-Wallis test for age, Wilcoxon rank sum test for hospital stay and Pearson's chi-square for all other factors. *p* values are overall associations between the 3 groups and each factor. A significant *p* value indicates a difference between at least 2 of the 3 groups.

TABLE 2.—Multivariable analysis: *p* values and odds ratio (OR) with confidence intervals (CI)[†]

Variable	PICU vs. RNF		PICU vs. AMB		RNF vs. AMB	
	OR (95%CI)	<i>p</i> value	OR (95% CI)	<i>p</i> value	OR (95%CI)	<i>p</i> value
Food allergy	3.27 (1.45, 7.40)	0.004*	7.36 (2.54, 21.39)	<0.001*	2.25 (0.72, 6.99)	0.16
Age (1 year decrease)	0.79 (0.74, 0.86)	0.004*	1.11 (1.02, 1.19)	0.01*	1.25 (1.16, 1.35)	<0.001*
African American vs Caucasian	0.83 (0.42, 1.65)	0.59	10.09 (4.64, 21.92)	<0.001*	12.17 (5.83, 25.41)	<0.001*
Other ethnicity vs. Caucasian	2.18 (0.53, 9.03)	0.28	6.39 (1.55, 26.31)	0.01*	2.93 (0.63, 13.63)	0.17
Tobacco exposure	0.09 (0.007, 1.10)	0.059	4.67 (0.22, 98.35)	0.32	54.18 (4.13, 711.13)	0.002*

[†]Results were obtained from a baseline-category logit model.
*indicates significant *p* value (<0.05).
PICU = pediatric intensive care unit group; RNF = regular nursing floor group; AMB = ambulatory group; NA = not applicable.

Age and Gender

Across the three groups, although males slightly outnumbered females with 54.2% in the PICU group, 58.3% in the regular nursing floor group, and 65.7% in the ambulatory group, these differences were not statistically significant (*p* = 0.27). After adjusting for food allergy, race/ethnicity, and tobacco exposure, children admitted to the PICU (*p* = 0.01) or regular nursing floor (*p* < 0.01) were significantly younger compared to children in the ambulatory group. Children admitted to the PICU were significantly older (*p* = 0.004) than those admitted to the regular nursing floor.

Poverty

Compared with children in the ambulatory group, children admitted to either the PICU or regular nursing floor were significantly more likely (*p* <0.001) to reside in a poverty area (Table 1). This was not shown to be an independent risk factor.

Race/Ethnicity

Children admitted to the PICU and regular nursing floor were significantly more likely to be African-American (*p* <0.001 for both groups) compared with children in the ambulatory group. Children admitted to the PICU compared with the regular nursing floor were 10 times more likely to be African-American than Caucasian (OR [95% CI]: 10.09[4.64, 21.92]) and 6.4 times more likely to be non-Caucasian and non-African-American, adjusting for food allergy, age, and tobacco exposure (Table 2). After adjusting for food allergy, age, and tobacco exposure, children admitted to the regular nursing floor were 12 times more likely to be African-American than Caucasian (OR [95% CI]: 12.17 [5.83, 25.41]) compared with the ambulatory group.

Self-Reported Food Allergy and Asthma Morbidity

Table 3 summarizes the number and types of food allergies reported. Of the 288 medical records reviewed, 13% (38/288) of the records contained documentation of at least 1 food allergy. Detailed questions regarding the history of reactions to foods were not recorded in the chart. Patients were not assessed for IgE-mediated food allergy by either immediate skin test or serum specific IgE. Twenty-three children (8%) were allergic to 1 food, 12 (4.2%) were allergic to 2 foods, and 3 children (1%) were allergic to 3 foods for a total of 56 food allergies. The 5 most common food allergies were fish/shellfish, egg, peanut, milk, and tree nut, which accounted for 79% of cases. None of the patients admitted to the PICU or regular nursing floor reported a known ingestion of a

potential food allergen before admission. Also, these patients did not have additional symptoms that may have been related to ingestion of possible food allergens such as urticaria, angioedema, or anaphylaxis.

When compared to children admitted to the regular nursing floor, children admitted to the PICU were 3.3 times more likely to have at least one food allergy (OR [95% CI]: 3.27 [1.45, 7.40]), adjusting for age, race/ethnicity, and tobacco exposure. Compared with children in the ambulatory group, children admitted to the PICU were 7.4 times more likely to have at least one food allergy (OR [95% CI]: 7.36[2.54, 21.39]), adjusting for age, race, and tobacco exposure. Although food allergy was reported more frequently in children admitted to the regular nursing floor (11.1%) compared with the ambulatory group (5.6%), this difference was not statistically significant (*p* = 0.16).

Children admitted to the PICU for asthma were more likely to have a longer number of days in the hospital (*p* <0.001) compared with those admitted to the regular nursing floor.

Other Factors: ICS Exposure, Tobacco Exposure, Psychologic Comorbidity, and Season at Admission

When compared with children in the ambulatory group, children admitted to the PICU were 4.67 times more likely to have been exposed to tobacco (OR [95% CI]: 4.67[0.22, 98.35]), and children admitted to the regular nursing floor were 54.2 times more likely to have been exposed to tobacco (OR [95% CI]: 54.18[4.13, 711.13]) after adjusting for food allergy, age, and race (Table 2). Tobacco exposure

TABLE 3.—Self-reported food allergy.

FOOD	AMB		RNF		PICU	
	N	%	N	%	N	%
At least 1 allergy	6	5.6	12	11.1	20	27.8
Fish / shellfish	0	0.0	2	1.9	10	13.9
Egg	1	0.93	3	2.8	7	9.7
Peanut	2	1.9	3	2.8	6	8.3
Milk	1	0.93	2	1.9	2	2.8
Tree nut	1	0.93	3	2.8	1	1.4
Melon	1	0.93	1	0.93	1	1.4
Strawberry	0	0.0	2	1.9	0	0.0
Soy	0	0.0	0	0.0	1	1.4
Corn	0	0.0	0	0.0	1	1.4
Banana	0	0.0	1	0.93	0	0.0
Beef	0	0.0	1	0.93	0	0.0
Chocolate	0	0.0	1	0.93	0	0.0
Kiwi	1	0.93	0	0.0	0	0.0
Food extract	1	0.93	0	0.0	0	0.0

PICU = pediatric intensive care unit group; RNF = regular nursing floor group; AMB = ambulatory group.

was not statistically different between children admitted to PICU compared with those admitted to the regular nursing floor (OR [95% CI]: 0.09[0.007, 1.10]). The number of patients in each group with tobacco exposure was relatively small (range 1–3).

No other factors were found to be significantly different between the three groups ($p > 0.05$) including ICS exposure, psychological comorbidity, or season at admission (data not shown).

DISCUSSION

Factors previously associated with an increased risk of asthma mortality and morbidity in children include poverty, race/ethnicity, urban residence, duration of asthma, and male gender (7–9). Our study demonstrates that self-reported food allergy is an independent risk factor for PFCA. Thirteen percent (38/288) of asthmatic children in our study had documentation of self-reported food allergy. More significantly, food allergy was associated with PFCA as defined by admission to PICU for asthma. Children with asthma admitted to the PICU were significantly more likely to have self-reported food allergy compared with children with asthma who were admitted to a regular nursing floor with no history of PICU admission and to children with asthma who had never been hospitalized or required emergency department care for asthma.

This is the first report of food allergy as an independent risk factor for PFCA in a US population. Robert et al. (14) studied food allergy in a smaller group of asthmatics with PFCA in England. In this case-controlled study, pediatric patients with asthma and food allergy were at significantly greater risk for episodes of life-threatening asthma. Among 19 patients intubated secondary to asthma, 52.6% had sensitization to a food compared with only 13.2% of control subjects. Sensitization was identified by a convincing clinical history of reaction to a food supported by either positive serum-specific IgE or epicutaneous skin test.

Two other previous studies in the United States linked food allergy with potentially severe asthma in children. Wang et al. (16) measured food-specific IgE levels from over 500 random serum samples from the National Cooperative Inner City Asthma Study involving an inner-city population of asthmatic children 4 to 9 years of age. Elevated food-specific IgE levels were associated with increased rates of hospitalization for asthma. Patients with PFCA as defined by admission to PICU for asthma were not identified as a separate subset. In another study by Simpson et al., the records of 201 children with asthma who presented to an outpatient allergy department at a children's hospital over an 11-year period were reviewed, including 88 patients with asthma and food allergy and 113 patients with asthma alone (15). The presence of one or more food allergies as well as allergy to peanuts and milk were independently associated with increased number of hospitalizations for asthma. Similar to our findings, the number of PICU admissions was increased in the group with food allergy compared with the group without food allergy, but this was not statistically significant.

Other established risk factors for asthma morbidity in children including younger age and African-American race were also independently associated with increased asthma morbidity (hospitalization) in our study (7). Children admitted to either the PICU or regular nursing floor were significantly

more likely to be African-American and to be at least 1 year younger compared with children seen in the ambulatory clinic. Children admitted to the PICU or regular nursing floor were significantly more likely to reside in a poverty area compared with children seen in the ambulatory clinic, although this was not found to be an independent risk factor. Although tobacco exposure was a statistically significant risk factor in this study, the small number of cases and wide confidence limits imply this association should be interpreted cautiously. Other potential risk factors for adult asthmatics such as gender, inhaled steroid exposure, psychological comorbidity, and season at admission, which have been found to be significantly associated with asthma morbidity in previous studies in pediatric or adult asthmatics, were not shown to be statistically significant risk factors in this study (5, 6). Although food-induced respiratory symptoms may occur in approximately 2% to 8% of children with asthma, none of the patients admitted to PICU or regular nursing floor reported a known ingestion of a potential food allergen before admission and no patient had additional symptoms that may have been related to ingestion of possible food allergens such as urticaria, angioedema, or anaphylaxis (19).

Although this study was not designed to investigate a pathophysiologic mechanism to explain why children with potentially fatal asthma may be more likely to have food allergy, it is conceivable that in children with both asthma and food allergy, the latter may be a marker for an asthma phenotype more prone to develop severe asthma exacerbations. Further investigation is required to clarify the nature of the association found in this study.

Several limitations of our study merit comment. This was a retrospective chart review; however, bias was minimized by using a chart reviewer who was blinded to study aims. ICS exposure was not significantly different in the three groups studied, suggesting that ICS use was not associated with reduced asthma severity as defined by admission either to the regular nursing floor or the PICU; however, factors that may have significantly affected asthma severity and control including adherence, dose of ICS, and use of other maintenance asthma medications such as leukotriene modifiers or long-acting beta-agonists were not evaluated in this study.

A potential misclassification bias existed with the determination of patients with food allergy. No consistent information was available regarding actual history of symptoms related to ingestion of foods to which each patient reported an allergy. The perception of food allergy is often overestimated in studies of self-reported food allergy compared to the actual incidence of IgE-mediated food allergy as defined by objective diagnostic information including epicutaneous skin testing, serum-specific IgE concentrations, and/or oral food challenges. The prevalence of perceived allergy to food or food additives in US households from previous studies has ranged from 17% to 30%, while the actual prevalence of IgE-mediated food allergy is estimated to be approximately 3% to 4% of the US population (20, 21). The incidence of self-reported food allergy in our study was 13%. This number should be interpreted cautiously and is not intended to represent true IgE-mediated food allergy as the actual incidence of IgE-mediated food allergy among patients in our study cannot be determined from this study. Despite the potential for overestimation of the true incidence of IgE-mediated food

allergy by self-report, the validity of our data is supported by the finding that five of the eight foods most commonly associated with the majority of IgE-mediated food allergy accounted for 79% of the self-reported food allergies in this study.

CONCLUSIONS

In an urban US population of children and adolescents, this study demonstrates that food allergy, poverty, and African-American race are significantly associated with hospitalization either in the PICU or the regular nursing floor for asthmatic exacerbation compared with ambulatory asthmatic patients. Although poverty and race/ethnicity have previously been identified as independent risk factors for PFCA, food allergy has been shown to be an independent risk factor for PFCA in only one previous study in England involving a smaller number of patients. Our results demonstrate that in an urban setting in North America, asthmatic children or adolescents with food allergy are at higher risk for a life-threatening asthma exacerbation compared with those without food allergy. Our findings support the contention that patients with food allergy are a target population for more aggressive asthma management.

REFERENCES

1. Dey AN, Schiller JS, Tai DA. Summary health statistics for US children: National Health Interview Survey, 2002. National Center for Health Statistics. *Vital Health Stat* 2004; 510:1–87.
2. Sly RM. Decreases in Asthma Mortality in the US. *Ann Allergy Asthma Immunol* 2000; 85:121–127.
3. Castro M, Schechtman K, Halstead J, Bloomberg G. Risk factors for asthma morbidity and mortality in a large metropolitan city. *J Asthma* 2001; 38:625–636.
4. National health interview survey (NHIS 2005). Hyattsville, MD: National Center for Health Statistics (NCHS), Centers for Disease Control and Prevention, 2005. Available at http://www.cdc.gov/nchs/about/major/nhis/reports_2005.htm.
5. Strunk RC, Nicklas RA, Milgrom H, Davis ML, Ikle DN. Risk factors for fatal asthma. In: Sheffer AL, editor. *Fatal asthma*. New York: Marcel Dekker; 1998.
6. Alvarez GG, Fitzgerald JM. A systematic review of the psychological risk factors associated with near fatal asthma or fatal asthma. *Respiration* 2007; 74:228–236.
7. Aligne CA, Auinger P, Byrd RS, Weitzman M. Risk Factors for Pediatric Asthma. *Am J Respir Crit Care Med* 2000; 162:873–877.
8. Lyell PJ, Villanueva E, Burton D, Freezer NJ, Bardin PG. Risk factors for intensive care in children with acute asthma. *Respirology* 2005; 10:436–441.
9. Belessis Y, Dixon S, Thomsen A, Duffy B, Rawlinson W, Henry R, Morton J. Risk factors for an intensive care unit admission in children with asthma. *Pediatr Pulmonol* 2004; 37:201–209.
10. Sampson HA. Update on food allergy. *J Allergy Clin Immunol* 2004; 113:805–819.
11. Bousquet J, Neukirch F, Noyola A, Michel FB. Prevalence of food allergy in asthma. *Pediatr Allergy Immunol* 1992; 3:206–213.
12. Sicherer SH, Sampson HA. The role of food allergy in childhood asthma. *Immunol Allergy Clin North Am* 1998; 18:49–60.
13. Novembre E, de Martino M, Vierucci A. Foods and respiratory allergy. *J Allergy Clin Immunol* 1988; 81:1059–1065.
14. Roberts G, Patel N, Lefi-Schaffer F, Habibi P, Lack G. Food allergy as a risk factor for life-threatening asthma in childhood: a case-controlled study. *J Allergy Clin Immunol* 2003; 112:168–174.
15. Simpson AB, Glutting J, Yousef E. Food allergy and asthma morbidity in children. *Pediatr Pulmonol* 2007; 42:489–495.
16. Wang J, Visness CM, Sampson HA. Food allergen sensitization in inner-city children with asthma. *J Allergy Clin Immunol* 2005; 115:1076–1080.
17. U.S. Census Bureau, Census 2000, Summary File 1 (SF 1) and Summary File 3 (SF 3); generated by Nicola M. Vogel; using American Factfinder; (<http://factfinder.census.gov/>); (1 May 2004).
18. Poverty in the United States—1992. U.S. Census Bureau, Current Population Reports, Series P-60-185, U.S. Government Printing Office, Washington D.C., 1993.
19. James JM. Respiratory manifestations of food allergy. *Pediatrics* 2003; 111:1625–1630.
20. Good Housekeeping Institute, Consumer Research Department. *Childcare findings V, Children and Food*. New York: A Good Housekeeping Report. 1989.
21. Sloan AE, Powers ME. A perspective on popular perceptions of adverse reactions to food. *J Allergy Clin Immunol* 1986; 78:128–133.