

ORIGINAL ARTICLE

An internet survey on self-reported food allergy in Greece: clinical aspects and lack of appropriate medical consultation

D. Kalogeromitros,[†] M.P. Makris,^{†,*} C. Chliva,[†] T.N. Sergentanis,[‡] M.K. Church,[§] M. Maurer,[§] T. Psaltopoulou[†]

[†]Allergy Unit, 2nd Department Dermatology and Venereology, 'Attikon' University Hospital, Medical School, University of Athens, Athens, Greece

[‡]Department of Hygiene and Epidemiology, University of Athens Medical School, Athens, Greece

[§]Department of Dermatology and Allergy, Allergie-Centrum-Charité, Charité – Universitätsmedizin, Berlin, Germany

*Correspondence: M.P. Makris. E-mail: mmakris.allergy@gmail.com

Abstract

Background Food allergy (FA) represents a common and worldwide disorder but in publications referring to FA the reported diagnosis is rarely confirmed. Consequently, the subjectively assessed FA may negatively affect the quality of life of patients and their families.

Objective We have conducted this internet survey in order to estimate the self-reported perception of FA in Greece.

Methods A standard anonymous questionnaire was posted for a 3-month period on <http://www.in.gr>, a Greek popular Internet portal. Each individual could participate only once. Participants were screened for the presence or history of FA by a key question and were then asked to provide information on symptoms, course and management.

Results A total of 3673 adult subjects (mean age 34.2 years, range 18–74, females 61.3%), reporting FA were included in analysis. Most reported reactions were related to fruits (14.9%), seafood (10.7%) and nuts (9.2%). The first episode occurred principally during the second (29.2%) and third (30.9%) decade within 3 h from consumption (82.2%). Predominant symptoms were urticaria and oral allergy syndrome (almost 25% each one). Nearly half of the participants sought no medical advice, while 31.4% asked for an allergist's consultation. Almost 21% of reactors were hospitalized; nuts, severity of symptoms (lower respiratory and/or cardiovascular), onset in lower age, previous exercise and concomitant alcohol and/or aspirin intake were positively associated with hospitalization.

Conclusion Although FA causes severe anaphylactic episodes, almost 50% of individuals who experience symptoms perceived as FA do not seek medical advice. Awareness programmes must be carried out in order to increase consciousness about this potentially fatal medical condition.

Received: 6 September 2011; Accepted: 27 January 2012

Conflicts of interest

In relation to this manuscript, all co-authors declare no, real or perceived conflicts of interest.

Funding sources

No financial support was provided for this study.

Introduction

Food allergy represents a worldwide disorder affecting all age groups, more often children and young adults.^{1,2} In most cases, patients are instructed to or willingly avoid a series of foods resulting in profound effects on everyday diet and nutrition and even in social habits and attitude. Food allergy may present with a variety of symptoms ranging from mild localized itching to near fatal reactions requiring immediate management.³

Epidemiological studies of self-reported food allergy suggest a gross prevalence of between 3% and 35%, depending on the

spectrum of symptoms each research group uses to define the problem.^{1,2} Considering that many patients misinterpret certain symptoms, either food related or not, as food allergy, a more cautious selection of patients, using a suggestive history combined with positive food challenges, has revealed a prevalence of 1–2% to 10%.⁴ Yet, many patients never consult a physician, usually if they suffer from only mild reactions or because they have adopted an 'efficient to their belief' avoidance of the food considered as culprit for their allergy. Thus, the best way to estimate the real prevalence and incidence would be to

prospectively examine a representative sample of the overall population.⁵

The widespread use of the internet provides patients with a quick and efficient way to acquire information on medical issues.^{6,7} It also provides the ability to perform wide scale surveys by overcoming traditional problems like high financial costs. However, a selection bias to only those who use internet and self-reported are potential limitations. Despite this, internet based surveys can include large numbers of participants and moreover clearly depict the self-perception of the medical condition under investigation. This is of great importance for food allergy as the use of the diagnostic gold standard – Double Blind Placebo Controlled Food Challenges – is extremely difficult to achieve in large-scale studies and perceived food allergy can have a negative impact on the quality of life of those affected. It is also important to assess all cases of perceived food allergy as those with true food allergy, even some severe cases, may fail to access appropriate medical advice. Bearing these facts in mind, we planned the present study to estimate the characteristics of patients who self-reported food allergies, as well as factors related to hospitalization, to repeated exposure to the suspected food agent and to the use of specific allergy tests to identify the offending agent.

Materials and methods

Study design

A cross-sectional questionnaire-based survey through internet on food allergy was conducted in Greece by the Allergy Clinical Research Center of the Allergy Unit, 2nd Department of Dermatology and Venereology, University of Athens, situated at 'Attikon' General University Hospital. The questionnaire was accessible to all visitors of the 'in.gr', one of the largest online information portals in Greece, that includes a popular 'health area' through distinguished links placed on this site. For a 3-month period from October to December 2006, online visitors with a history of food allergy were invited to take part in the study through an introductory page. Each participant could answer only once; for this purpose, a safety feature of the website prohibited voting from the same IP address more than once. Individuals without a history of food allergy were excluded from the study by an introductory screening question (No 6, Appendix). Responses were collected anonymously, as it was stated that they will be used for epidemiologic research only. Demographic data of participants, including age, gender and home zip code, were also collected. After the end of the study, some results from the data analysis as well as general information and specific recommendations for food allergy patients were placed to the same online portal. The algorithm, utility and limitations of the online surveys concerning questionnaires developed by the Allergy Clinical Research Center Attikon General Hospital, Athens University, Athens, Greece has been described in detail elsewhere.⁷

Statistical analysis

Statistical analysis consisted of two steps. First, descriptive statistics were calculated. Continuous variables are presented as mean values $\pm$ SD or SE, whereas categorical variables are presented as absolute and relative frequencies. Secondly, potential risk factors were evaluated along three main axes: (i) hospitalization; (ii) repeated consumption of the suspected allergenic food after the first FA episode; and (iii) documentation with diagnostic methods. Multivariate logistic regression was performed; the factors that were significantly associated with the aforementioned items at the univariate analysis were included as independent variables. In the final model, after mutual adjustment, only the statistically significant variables were included (backward selection statistical procedure). Worthy of note, a hierarchical approach was adopted concerning the modelling of the three axes.⁸ The underlying conceptual framework envisaged the time succession: first (serious) episode $\rightarrow$ hospitalization $\rightarrow$ non-compliance with medical advice (repeated consumption of the culprit food after the episode) or compliance with medical advice (after documentation with diagnostic procedures). As a result, the model for repeated consumption also encompassed hospitalization as an independent variable, whereas the model concerning performance of diagnostic procedures for allergy included both hospitalization and repetitive consumption of the suspected allergenic food.

Concerning the categorization of risk factors, symptoms were grouped according to the affected organ/system: lower airway (tightness of breath, wheezing cough, voice hoarseness), upper airway (nasal congestion, nasal drip, ocular symptoms, sneezing), skin (pruritic rash, angioedema, itching/burning sensation, eczema), cardiovascular (tachycardia, dizziness, loss of consciousness) and gastrointestinal (abdominal pain, diarrhoea, vomiting/nausea, stool irregularities). Oral symptoms (pruritus in the oral cavity) were grouped separately. Co-existing triggering factors were treated as a binary variable i.e. any (alcohol consumption, physical exercise, aspirin intake) vs. none; similarly, follow-up of patients was treated as a binary variable i.e. follow-up by any physician (allergist, internist, gastroenterologist, other specialty) vs. not existing.

In the multivariate analyses, apart from statistically significant findings ($P < 0.05$ was considered as statistically significant), borderline findings ($0.10 < P < 0.05$) are also presented, to provide insight into possibly meaningful factors which did not reach significance due to lack of statistical power. All analyses were performed with STATA version 8.0 (STATA Corporation, College Station, TX, USA).

Results

Participants

The final dataset, on which analysis was based, included 3673 respondents aged between 18 and 74 years (median age 32 years).

Of these, the majority, 61%, were females and 96% had undertaken some form of higher education; 33% and 63% having attended high school or university respectively. More than half, 55%, of the respondents stated that they had a co-existing allergic atopic disease, allergic rhinitis, asthma or atopic dermatitis. Answers about the age of onset of their condition depicted on Fig. 1, revealed that almost 60% of respondents became food allergic between the ages of 11 and 30 years, after which numbers declined.

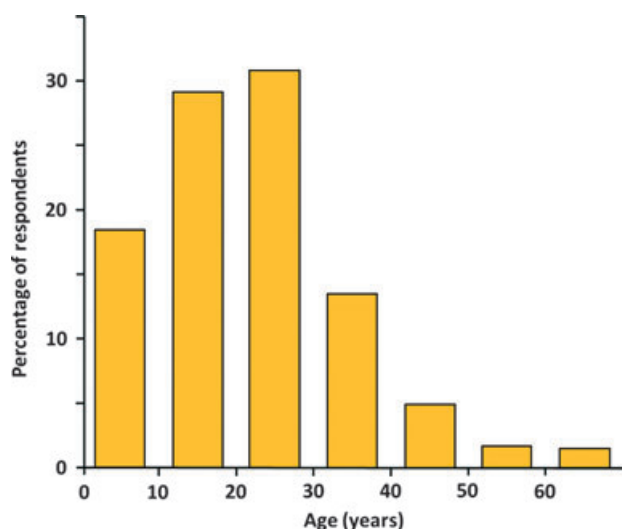


Figure 1 The reported age of respondents at the onset of food allergy.

Offending foods, symptoms and medical consultation

The foods to which the respondents attributed their allergy are presented on Fig. 2. Fruits were the leading self-reported cause of food allergy (14.9%) followed by shellfish/seafood (10.7%), nuts (9.2%) and prepacked pre-prepared meals (9%). One-third (33.7%) of respondents stated that their problem food no longer caused problems when cooked, indicating the presence of a heat labile allergen. This percentage according to the self-reported offending food was analysed as follows: 9.9% fruit, 5.6% cacao-chocolate, 5.2% prepacked food, 5.1% vegetables, 4.1% egg, 1.7% selfish-seafood, 1.3% nuts, 0.8% beans, legumes, peas. The majority of reactions (82%) occurred during the first 3 h after consumption of the suspected food and 86% occurred in the absence of coexisting triggering factors; concomitant physical activity, alcohol consumption and aspirin use being reported in only 3.6%, 8.3% and 2.1% of cases respectively.

The spectrum of symptoms reported to result from food allergy are listed in Table 1. Of the oral and gastrointestinal symptoms, itching of lips, tongue and oral cavity, suggestive of oral allergy syndrome, predominated with gastrointestinal symptoms being much less common. Of the systemic symptoms, pruritic skin rash and chest tightness were each reported by around a quarter of respondents. Potentially life threatening reactions, angioedema and loss of consciousness were reported by 13% and 6.2% of respondents respectively. Furthermore, 21% of respondents stated that they had been hospitalized due to severe food allergy reactions.

Notably, almost half of the respondents (46%) sought no medical consultation regarding their food reactions, whereas only 31% were referred to an allergist; the same percentage submitted to allergy diagnostic testing. Surprisingly, more than three quarters of

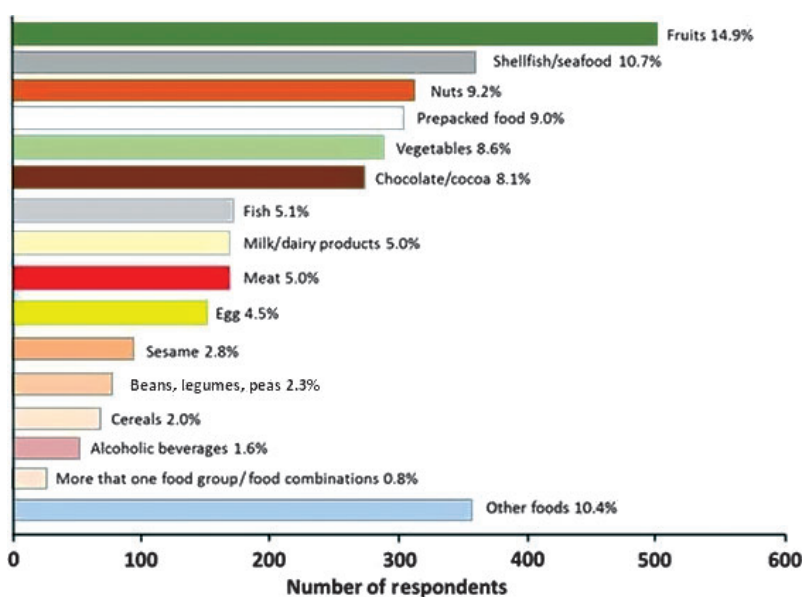


Figure 2 The offending foods according to patients' perception.

Table 1 Self-reported symptoms of food allergy

Oral and gastrointestinal symptoms	
Itching of lips, tongue, oral cavity	25.9%
Abdominal pain	14.4%
Nausea, vomiting	10.0%
Diarrhoea	13.7%
Stool irregularities (e.g. blood, mucus)	3.1%
Skin symptoms	
Pruritic rash	26.0%
Angioedema in the lips, eyelids, face	13.0%
Itching, burning sensation	10.1%
Eczema	6.0%
Respiratory tract and ocular symptoms	
Tightness of the chest	22.0%
Wheezing cough	3.0%
Voice hoarseness	6.8%
Nasal drip	2.4%
Nasal congestion	5.1%
Sneezing	1.4%
Ophthalmic symptoms	4.4%
Cardiovascular and central nervous symptoms	
Dizziness	13.5%
Tachycardia	13.3%
Unconsciousness	6.2%

The number of reports in this table adds up to more than 100% because respondents were allowed to choose up to 10 symptoms in total.

reactors (81%) consumed the suspected allergenic food again, 58% of them within 6 months of the first episode. The time interval between reaction and re-consumption of the suspected food was less than 6 months in 57.9% of responders, 6–12 months in 16.5% and more than 12 months in the remaining 16.5%. Food allergy symptoms emerged after re-exposure in three of four cases (75%), often presenting with symptoms of equal severity (64%) or more severe (11%) compared with the initial episode. Finally, 26% of respondents reported that symptoms also occurred in the absence of the culprit food suggesting that these individuals may not have true food allergy or, possibly, had not defined their suspected allergenic food correctly.

Multivariate analyses

The results of the multivariate logistic regression concerning risk factors for hospitalization are presented in Table 2. Allergy to nuts (OR = 1.74), predominant lower airways' symptoms (OR = 2.30), additional cardiovascular symptoms (OR = 2.58) and coexistent triggering factors (OR = 2.40) were independently positively associated with hospitalization, whereas older age at first episode (OR = 0.84) was negatively associated with it. Coexistence of another allergic disease was also associated with hospitalization at a borderline level (OR = 1.35).

Accordingly, multivariate logistic regression regarding risk factors for repeated consumption of the suspected allergenic food is presented in Table 3. Prior hospitalization (OR = 0.53) and allergy to fish or shellfish (OR = 0.67) seemed to play a protective role, encouraging the allergic patient not to repeatedly consume this food again. Conversely, disappearance of symptoms when the food is boiled (OR = 1.57) and occurrence of symptoms in the absence of the suspected allergenic food (OR = 1.48) were positively associated with repeated consumption.

The analysis referring to 'What drives patients to request allergic tests?' is presented in Table 4. In the vast majority the greatest motivation appeared to be a recommendation by a physician, usually a primary care physician (OR = 29.3). Allergy to nuts (OR = 1.75), predominant lower respiratory symptoms (OR = 1.92), repeated episodes of food allergy (OR = 1.63), a history of hospitalization (OR = 1.39) were all associated with significant probability of undergoing appropriate allergic tests. Conversely, the fact that patients were able to repeatedly consume the suspected allergenic food and not have symptoms after the first episode was related to an increased probability of not undergoing allergy testing.

Discussion

This internet-based survey completed by 3673 respondents gave novel insights into the self-reported, allergy-causing foods in Greece, the most common symptoms that they produce, the medical consultations that are, or are not, undertaken, and the risk factors for repeated consumption of a suspected allergenic

Table 2 Results of multivariate logistic regression analysis for hospitalization

Variables retained	Category or increment	OR (95% CI)	P-value
Positive (aggravating) associations			
Additional cardiovascular symptoms	Cardiovascular vs. gastrointestinal or oral symptoms	2.58 (1.88–3.53)	<0.001
Coexistent triggering factors	Any (exercise, aspirin, alcohol consumption) vs. none	2.40 (1.61–3.59)	<0.001
Predominant lower respiratory symptoms	Lower respiratory symptoms. vs. upper respiratory or skin symptoms	2.30 (1.68–3.15)	<0.001
Allergy to nuts	Nuts vs. all other foods	1.74 (1.10–2.74)	=0.018
Coexistence of another allergic disease	Yes vs. no	1.35 (0.99–1.84)	=0.058
Negative (protective) associations			
Age at first episode	10 year increase in age	0.84 (0.74–0.96)	=0.011

95% CI, confidence interval; OR, odds ratio.

Table 3 Results of multivariate logistic regression analysis for repeated consumption of the suspected allergenic food

Variables retained	Category or increment	OR (95% CI)	P-value
Positive (aggravating) associations			
Disappearance of symptoms when the food is boiled	Yes vs. no	1.57 (1.27–1.94)	<0.001
Occurrence of symptoms in the absence of the suspected allergenic food	Yes vs. no	1.48 (1.18–1.86)	=0.001
Negative (protective) associations			
Hospitalization	Yes vs. no	0.53 (0.43–0.65)	<0.001
Allergy to fish or shellfish	Fish or shellfish vs. all other	0.67 (0.53–0.85)	=0.001

95% CI, confidence interval; OR, odds ratio.

Table 4 Results of multivariate logistic regression analysis for the documentation with Skin Prick Tests

Variables retained	Category or increment	OR (95% CI)	P-value
Positive (aggravating) associations			
Patient followed-up by a doctor	Any doctor vs. nobody	29.3 (21.4–40.0)	<0.001
Predominant lower respiratory symptoms	Lower respiratory symptoms. vs. upper respiratory or skin symptoms	1.92 (1.57–2.36)	<0.001
Allergy to nuts	Nuts vs. all other	1.75 (1.28–2.40)	=0.018
Frequency of FA	More than once vs. once	1.63 (1.23–2.14)	=0.001
Hospitalization	Yes vs. no	1.39 (1.12–1.73)	=0.003
Occurrence of symptoms also in the absence of the suspected allergenic food	Yes vs. no	1.22 (0.99–1.49)	=0.064
Negative (protective) associations			
Repeated consumption of the suspected allergenic food after the first episode	Yes vs. no	0.75 (0.58–0.97)	=0.029

95% CI, confidence interval; OR, odds ratio.

food and hospitalization. Nevertheless, the most impressive finding of this study is that despite the severity of the reactions that required hospitalization in almost 20% of the responders, half of the sufferers did not seek medical advice and consequently had no concern about prophylaxis and the adequate treatment of similar reactions.

Although surveys of this type can yield valuable information, they do have limitations. First, as in a similar survey on urticaria,⁶ the respondents belonged mainly to one demographic group, young and middle-aged individuals with a high educational level. Whether this indicates that the prevalence of food allergy is greater in this group or whether it is predominantly this group who use the internet cannot be discerned. Second, presence of genuine food allergy was not confirmed by a physician using specific IgE measurements and double blind placebo controlled food challenges (DBPCFC) that represent the gold-standard for the documentation of food allergy.^{9,10} Thus, some individuals may have had symptoms which may not have been caused by food allergy. This may well have been the case with those respondents who had no symptoms when again eating the suspected allergenic food and those who reported that symptoms also occurred in the absence of the suspected food. Furthermore, another common limitation in questionnaire based studies is the recall error, especially in conditions that manifest as recurrent acute episodes like FA; this type of

error may be more important in specific questions referring to time, e.g. the age at the onset of food allergy.

As already mentioned, questionnaire-based surveys should be interpreted with caution as the estimated prevalence of food allergy is usually greater than its actual incidence. In a relevant study performed on 1994 in Netherlands, Jansen *et al.*¹¹ estimated using questionnaires that the prevalence of food allergy was 12.4%, whereas DBPCFC were positive in only 2.4% of the studied population. Also, in the same year, Young *et al.*¹² published a population study conducted in the United Kingdom which also concluded that there was a marked difference between the perceived prevalence (20.4%) and the confirmed prevalence (3–4%) of food allergy based on DBPCFC to eight foods responsible for half the reactions.

Our study is in accordance with previous studies that have shown that females report food allergy more often than do males.^{13,14} However, the voluntary nature of participation in our survey does not allow us to draw any definitive conclusions about gender differences as it may be that the questionnaire was answered predominantly by females. Atopic predisposition, as expected, is higher in individuals reporting food allergy, with more than half of them reporting concomitant allergic rhinitis, asthma or atopic dermatitis; this proportion is much higher than the reported prevalence of atopy documented with skin prick tests in the Greek paediatric population (7–12 years) in ISAAC phase 2

study that was determined to be 14.4% in Athens and 26.8% in Thessaloniki.¹⁵ Fruits were reported to be the most prominent food allergens in Greece, followed by shellfish/seafood and nuts; these findings are in accordance with epidemiological studies from other Mediterranean countries, probably due to similar feeding habits called the 'Mediterranean diet' mostly comprised of fruit, vegetables, pulses, seafood, cheese, olive oil and nuts. A large scale questionnaire-based study conducted in France¹⁴ showed a higher prevalence of allergy to fruits, particularly of the Rosaceae family and those cross-reacting with latex, such as avocado, kiwi, banana and chestnut, followed by vegetables, shellfish and nuts. Similarly, a survey of Spanish adults with food allergy¹⁶ revealed a high occurrence of fruit allergy followed by tree nuts and crustaceans. In contrast, data from Germany, a non-Mediterranean country, showed that nuts and fruits are the predominant cause of food allergy whereas fish/shellfish are responsible for a rather low proportion, probably reflecting their low consumption in this country.¹⁷

Regarding symptomatology, our survey revealed skin symptoms to be the most common, followed by symptoms of the oral cavity suggestive of oral allergy syndrome and lower respiratory symptoms. A potentially life threatening loss of consciousness was reported 6.2% of the respondents. The European Community Respiratory Health Survey (ECRHS) of 17 280 patients in 15 countries,¹⁸ revealed a 37% prevalence of rash/itchy skin to patients with self-reported food allergy. Diarrhoea and vomiting were equally reported (36.9%) whereas symptoms of the lower respiratory tract were less common (10%). On the other hand, in a German population survey,¹⁹ oral allergy syndrome was reported to be the most common food allergy reaction (42.9%), with skin reactions second (28.7%) and systemic symptoms of only a rather low incidence.

Factors related to more severe clinical manifestations are indeed of particular interest. In our study, nut allergy, lower airway or cardiovascular symptoms, early onset of disease and concomitant aggravating factors were all associated with increased risk of hospitalization after a food allergy reaction. Previous studies have convincingly related nuts with more serious allergic reactions, particularly anaphylaxis²⁰ and, although rare, fatal incidents.²¹ In causing anaphylaxis, tree nuts and peanuts were the most common culprit foods (26% prevalence), followed by shellfish (23%) and fish (14%).²⁰ Severity of symptoms also increases the risk of hospitalization.²² Regarding the risk of hospitalization of patients with early onset of food allergy, previous data are scarce. Manivanan *et al.* reported that younger patients more likely present with anaphylactic reactions and receive increased doses of epinephrine.²³ According to Muñoz-Furlong and Weiss, teenagers and young adults develop more serious reactions but this fact is attributed to a reckless exposure to culprit foods or failure to carry self-injectable epinephrine.²⁴ The relationship of anaphylaxis to aggravating factors like exercise, alcohol and NSAIDs is also well established.²⁵

Surprisingly enough, almost half of the participants did not refer to a doctor for their food allergy. Of those who did, only 57.5% underwent allergy testing, almost equal to the number of patients evaluated by an allergist. The eventual evaluation by a doctor was the most significant predicting factor for submission to allergy tests. The primary reasons driving patients to seek specialized medical advice and treatment were lower airway symptoms, nut allergy, re-occurrence of reactions and prior hospitalization for food allergic reaction. Notably, cases of fatal food allergy anaphylaxis are not included in our data owned to the methodology; this fact combined with the above mentioned reluctance of sufferers to seek medical advice increases the necessity for the development of awareness programmes on food allergy targeted to general population.

In conclusion, internet questionnaire-based surveys on conditions, such as food allergy, mainly because of their low cost and minimum disturbance of the participants, may be conducted in large numbers of individuals providing important information, especially in countries such as in Greece, where there were no such available data. Descriptive statistics, such as the reported foods causing food allergy, the most common symptoms that they produce, the age of onset and the possible risk factors, may be utilized as a first step to develop more sophisticated protocols to allow more detailed data to be obtained. In parallel this and similar surveys may help to increase the level of awareness about food allergy in the general population.

References

- 1 Rona RJ, Keil T, Summers C *et al.* The prevalence of food allergy: a meta-analysis. *J Allergy Clin Immunol* 2007; **120**: 638–646.
- 2 Vierk KA, Koehler KM, Fein SB, Street DA. Prevalence of self-reported food allergy in American adults and use of food labels. *J Allergy Clin Immunol* 2007; **119**: 1504–1510.
- 3 Wang J, Sampson HA. Food allergy. *J Clin Invest* 2011; **121**: 827–835.
- 4 Chafen JJ, Newberry SJ, Riedl MA, *et al.* Diagnosing and managing common food allergies: a systematic review. *JAMA* 2010; **303**:1848–1856.
- 5 Venter C, Pereira B, Voigt K *et al.* Prevalence and cumulative incidence of food hypersensitivity in the first 3 years of life. *Allergy* 2008; **63**: 354–359.
- 6 Allen KJ, Koplin JJ, Gould C *et al.* Prevalence of self-reported allergies to food in Australia as assessed by internet-based questionnaires. *Med J Austr* 2009; **190**: 46–47.
- 7 Kalogeromitros D, Psaltopoulou T, Makris M *et al.* Can Internet surveys help us understanding allergic disorders? – results from a large survey in urticaria in Greece *J Eur Acad Dermatol Venereol* 2011; **25**: 532–537.
- 8 Papadodima SA, Sakellidis EI, Sergeantanis TN *et al.* Smoking in prison: a hierarchical approach at the crossroad of personality and childhood events. *Eur J Public Health* 2010; **20**: 470–474.
- 9 Sicherer SH. Epidemiology of food allergy. *J Allergy Clin Immunol* 2011; **127**: 594–602.
- 10 Zuidmeer L, Goldhahn K, Rona R *et al.* The prevalence of plant food allergies: a systematic review. *J Allergy Clin Immunol* 2008; **121**: 1210–1218.
- 11 Jansen JJN, Kardinaal AFM, Huijbers G *et al.* Prevalence of food allergy and intolerance in the adult Dutch population. *J Allergy Clin Immunol* 1994; **93**: 446–456.

- 12 Young E, Stoneham MD, Petrukevitch A *et al.* A population study of food intolerance. *Lancet* 1994; **343**: 1127–1130.
- 13 Altman DR, Chiaramonte LT. Public perception of food allergy. *J Allergy Clin Immunol* 1996; **97**: 1247–1251.
- 14 Kanny G, Moneret-Vautrin DA, Flabbee J *et al.* Population study of food allergy in France. *J Allergy Clin Immunol* 2001; **108**: 133–140.
- 15 Weinmayr G, Weiland SK, Björkstén B, *et al.* ISAAC Phase Two Study Group. Atopic sensitization and the international variation of asthma symptom prevalence in children. *Am J Respir Crit Care Med* 2007; **176**: 565–574.
- 16 Alvarado MI, Pérez M. Study of food allergy on Spanish population. *Allergol Immunopathol (Madr)* 2006; **34**: 185–193.
- 17 Zuberbier T, Edenharter G, Worm M *et al.* Prevalence of adverse reactions to food in Germany – a population study. *Allergy* 2004; **59**: 338–345.
- 18 Woods RK, Abramson M, Bailey M *et al.* International prevalence of reported food allergies and intolerances. Comparisons arising from the European Community Respiratory Health Survey (ECRHS) 1991 – 1994. *Eur J Clin Nutr* 2001; **55**: 298–304.
- 19 Schäfer T, Böhler E, Ruhdorfer S *et al.* Epidemiology of food allergy/food intolerance in adults: associations with other manifestations of atopy. *Allergy* 2001; **56**: 1172–1179.
- 20 Banerji A, Rudders SA, Corel B *et al.* Repeat epinephrine treatments for food-related allergic reactions that present to the emergency department. *Allergy Asthma Proc* 2010; **31**: 308–316.
- 21 Summers CW, Pumphrey RS, Woods CN *et al.* Factors predicting anaphylaxis to peanuts and tree nuts in patients referred to a specialist center. *J Allergy Clin Immunol* 2008; **121**: 632–638.
- 22 Banerji A, Rudders SA, Corel B *et al.* Predictors of hospital admission for food-related allergic reactions that present to the emergency department. *Ann Allergy Asthma Immunol* 2011; **106**: 42–48.
- 23 Manivannan V, Campbell R, Bellolio MF *et al.* Factors associated with repeated use of epinephrine for the treatment of anaphylaxis. *Ann Allergy Asthma Immunol* 2009; **103**: 395–400.
- 24 Muñoz-Furlong A, Weiss CC. Characteristics of food-allergic patients placing them at risk for a fatal anaphylactic episode. *Curr Allergy Asthma Rep* 2009; **9**: 57–63.
- 25 Atkins D, Bock SA. Fatal anaphylaxis to foods: epidemiology, recognition, and prevention. *Curr Allergy Asthma Rep* 2009; **9**: 179–185.