

# Prevalence of Food Allergy among Children in Al-Ain City, United Arab Emirates

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## Key Words

Allergens • Children • Food allergy • Symptoms • United Arab Emirates

## Abstract

**Background:** Food allergy (FA) in children is an important health problem. However, the prevalence of FA in the United Arab Emirates (UAE) has not yet been determined. This cross-sectional study was carried out to assess the prevalence of FA among school children aged 6–9 years in Al-Ain city, UAE. **Methods:** We used multistage random sampling in order to get a sample of 397 school children whose parents completed a self-administered questionnaire designed to assess the presence or absence of physician diagnosis of FA and other allergic diseases. **Results:** The study showed that the prevalence of physician-diagnosed FA in children was 8% (95% CI 5.4–10.8%). Eggs, fruits and fish were the main allergies reported. FA was independently related to a family history of FA, to a small sibship size and to a personal history of other atopic diseases. **Conclusions:** The prevalence of FA in Al-Ain city was 8%. A history of FA in first-degree family members and a small sibship size were associated with a higher risk of FA in children. FA was related to a personal history of other atopic diseases.

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## Introduction

Food allergy (FA) is an immunologic response to a food protein [1]. It is considered an important cause of morbidity in children and accounts for a significant proportion of anaphylaxis and severe allergic reactions in children [2, 3]. Worldwide, it is estimated that it affects about 5–8% of children and about 1.5% of the general population [4], and the prevalence is apparently rising [5]. It is not clear, however, whether this rise reflects a real increase, an increase in awareness or an improvement in diagnosis [6]. Usually, the public perception of the magnitude of the problem exceeds the prevalence found in studies [7]. In Spain, the prevalence of FA among patients (adults and children) referred to an allergy unit was reported to be 9% [8], while in France, about 2% of school children were reported to have FA [9]. In the United States, a study showed that 28% of mothers perceived their children to have had at least one adverse reaction to food, but only 5% were confirmed to have a reaction by a double-blind placebo-controlled food challenge [10]. In Denmark, a study in over 1,700 children reported that 7% had symptoms suggestive of cow milk allergy in the first year of life, with only 2% confirmed by oral challenge [11]. A study in 10 European countries indicated parentally perceived FA prevalence was 5% and the most affected age group was 2–3 years old [12].

The prevalence of FA is the highest in the first 2 years of life and decreases with age. The most common food

allergens causing reactions in children include milk, egg, wheat, soy, peanuts, tree nuts, fish and shellfish. While the majority of children outgrow their allergy to milk, egg, wheat and soy, allergies to peanut, tree nuts, fish and shellfish are often lifelong [13]. Although any food can cause anaphylaxis, the most commonly implicated foods for severe allergic reactions are peanuts, tree nuts, fish and shellfish [14].

Dietary factors can influence the prevalence of food allergies in a population. For example, peanut allergy is one of the most common food allergies in the United States [13], while seafood is a common food allergen in Hong Kong and sesame a major food allergen for children in Israel [15, 16].

In the Middle East, epidemiological studies discussing this important health problem are scarce. This is the first cross-sectional study in the region to determine the prevalence of physician-diagnosed FA among school children aged 6–9 years in the Al-Ain district, UAE.

## Materials and Methods

A cross-sectional study of governmental primary school children aged 6–9 years of all nationalities and both genders was carried out in the Al-Ain district in December 2006. The district is located in the interior of Abu Dhabi Emirate and constitutes its second largest district with an approximate population of 614,180, according to a recent estimate in 2008 [17]. Subjects were selected randomly using multistage random sampling. Firstly, 4 male and 4 female schools were selected randomly from a list of primary schools in the district provided by the Ministry of Education. Secondly, 2 classes from each grade were selected randomly from the selected schools. Thirdly, all students from the selected classes were approached and given a detailed questionnaire to be completed by their parents. Children whose parents gave informed consent by returning the completed self-administered questionnaire were enrolled. A sample size of 400 was calculated to estimate a 95% confidence interval (CI) for the prevalence of FA of about 25% with an approximate width of 10%.

The questionnaire included questions about allergic illness and atopic family history. A child had a family history of allergic diseases if his/her father or his/her mother had ever suffered from asthma, allergic rhinitis/conjunctivitis (AR), eczema or FA. Other relevant information was gathered such as age, gender, nationality, age of the mother and the father, number of older and younger siblings, and feeding history in the first 6 months of life. A child was considered to have FA or other allergic illnesses such as asthma, eczema, hay fever or drug allergy only if it was diagnosed by a physician. Parents were also asked about the age of onset of FA, the frequency of reactions to food, the food that triggers the symptoms, which symptoms are experienced, the persistence of symptoms and the type of medical care sought. The total number of questions was 35.

In order to assess which child characteristics were independently related to FA, we conducted a stepwise multiple logistic regression (backward Wald method) with FA (yes/no) as the de-

**Table 1.** Characteristics of schoolchildren that participated in the study of FA in Al-Ain city, UAE (n = 397)

| Variable                                  |               |
|-------------------------------------------|---------------|
| Age, years (mean $\pm$ SD)                | 7.2 $\pm$ 1.1 |
| Female                                    | 52%           |
| Nationality                               |               |
| UAE nationals                             | 82%           |
| Other GC countries                        | 15%           |
| Other Arabs                               | 3%            |
| Feeding (milk) in first 6 months of life  |               |
| Breast fed alone                          | 69%           |
| Bottle fed alone                          | 2%            |
| Breast and bottle fed                     | 29%           |
| Semi-solid food in first 6 months of life | 62%           |

GC countries: Gulf Cooperative countries (UAE, Bahrain, Kuwait, Oman, Saudi Arabia and Qatar).

pendent variable and gender, age, age of the mother at birth, exclusive breastfeeding until 6 months, introduction of solid food before 6 months, sibship size, number of older siblings, family history of FA and family history of other atopic diseases as independent variables (resulting model is defined as model A). To model A we added the personal history of other atopic diseases (AR, asthma, eczema and drug allergy; model B). In this way we were able to assess how these other allergic diseases were related to FA, while at the same time adjusting for possibly confounding child characteristics. A p value of 0.05 or less was considered significant. Data were analyzed using SPSS statistical package (version 15). The study was approved by the Ethics Committee of the Faculty of Medicine and Health Sciences of the UAE University.

## Results

The questionnaire was distributed among 660 schoolchildren. Of these, 397 returned a completed questionnaire (response rate 60%). This was our study sample. The mean age of the sample population was 7 years (SD 1.06). Table 1 shows demographic characteristics and feeding history in the first 6 months of life.

A history of atopy in first-degree family members was reported as follows: 6% had a father with a history of FA, 4% had a mother with FA and 9% had a brother and/or a sister with FA. The mean age of the father was 38.6 years (SD 8.1) and for the mother 32.5 years (SD 5.4).

The prevalence of physician-diagnosed FA was 8.1% (95% CI 5.6–11.1%). Prevalence of other atopic diseases is presented in table 2a for the whole study population and in table 2b for those 32 children who reported a history of FA. The differences in the prevalence of atopic disease

**Table 2.** Prevalence of FA and other atopic disorders**a** Prevalence of FA and other atopic disorders among school children (n = 397)

|                                        | %         | 95% CI    |
|----------------------------------------|-----------|-----------|
| Physician diagnosis of FA              | 32 (8.1)  | 5.6–11.2  |
| Physician diagnosis of asthma          | 54 (13.6) | 10.4–17.4 |
| Physician diagnosis of eczema          | 35 (8.8)  | 6.2–12.0  |
| Physician diagnosis of AR <sup>1</sup> | 25 (6.3)  | 4.1–9.2   |
| Physician diagnosis of drug allergy    | 16 (4.0)  | 2.3–6.5   |

**b** Prevalence of other atopic disorders among those with a history of FA (n = 32)

|                                        | %         | 95% CI    | p*    |
|----------------------------------------|-----------|-----------|-------|
| Physician diagnosis of asthma          | 12 (37.5) | 21.1–56.3 | 0.000 |
| Physician diagnosis of eczema          | 13 (40.6) | 23.7–59.4 | 0.000 |
| Physician diagnosis of AR <sup>1</sup> | 5 (15.6)  | 5.3–32.8  | 0.01  |
| Physician diagnosis of drug allergy    | 7 (21.9)  | 9.2–40.0  | 0.000 |

<sup>1</sup> AR or conjunctivitis.

\*p values are the result of chi-square tests for the difference between the prevalence of allergic disease in those with FA and those without FA.

between the children without FA and those with FA were statistically significant.

#### *Onset of Symptoms*

First symptoms of FA were reported in the neonatal period (before 1 month) by 7% of children with a history of FA, 13% reported the first symptoms between 1–6 months, 28% between 6–12 months, 35% between 1–3 years and 17% after the age of 3 years.

#### *Duration of Symptoms*

Fifty-six percent of children with FA were still having symptoms of allergy at the time of the survey. Of those who outgrew their symptoms, 13% had symptoms only in the first year of life, 13% had symptoms till the age of 2 years and 18% until the age of 3 years, 31% had outgrown their symptoms by the age of 5 years and 25% at the age of 7 years.

#### *Frequency of Symptoms*

Forty-three percent of children with FA had food-induced immediate IgE-mediated allergic symptoms more than 10 times during their life time, 17% had 6–10 episodes, 33% had 2–5 episodes and 7% had 1 episode of FA.

**Table 3.** Types of food allergens in children with FA (n = 32)

| Food       | Percent |
|------------|---------|
| Eggs       | 40      |
| Fruits     | 40      |
| Fish       | 33      |
| Peanuts    | 27      |
| Tree nuts  | 13      |
| Cow milk   | 13      |
| Wheat      | 7       |
| Vegetables | 7       |

Eleven children reported more than 1 allergenic type of food.

Twelve children reported fruit allergy (4 banana, 3 mango, 3 kiwi, 1 orange, 1 grapes, 1 peach, 1 pineapple), while 4 children reported vegetable allergies (tomatoes).

**Table 4.** Allergic reaction in children with FA (n = 32)

| Reaction to food              | Percent |
|-------------------------------|---------|
| Skin redness and/or hives     | 57      |
| Itching                       | 46      |
| Cough                         | 43      |
| Hoarseness                    | 39      |
| Nasal congestion and sneezing | 33      |
| Red itchy eyes                | 28      |
| Palpitation                   | 21      |
| Diarrhea                      | 18      |
| Nausea and vomiting           | 18      |
| Shortness of breath           | 14      |
| Angioedema                    | 14      |
| Wheezing                      | 11      |
| Anaphylaxis <sup>1</sup>      | 36      |

<sup>1</sup> Anaphylaxis is considered when at least 2 organ systems are involved.

#### *Allergens*

The commonest types of food allergens reported were: eggs in 40%, fruits (mainly banana, kiwi and mango) in 40%, followed by fish (shellfish not included) in 31% of the subjects with FA (table 3).

#### *Symptoms*

The most frequent symptoms of FA that were reported were: skin redness and/or hives (57%), itching (46%), cough (43%), hoarseness (39%), anaphylaxis (36%), nasal congestion and sneezing (33%; table 4).

**Table 5.** Prevalence of physician-diagnosed FA, association with child characteristics and results from multivariable logistic regression

|                                                     | Prevalence |       |            | Crude OR, 95% CI and p value |      |            | Multivariable logistic model B <sup>1</sup> |
|-----------------------------------------------------|------------|-------|------------|------------------------------|------|------------|---------------------------------------------|
|                                                     | %          | OR    | 95% CI     | p value                      | OR   | 95% CI     | p value                                     |
| Gender                                              |            |       |            |                              |      |            |                                             |
| Male                                                | 6.3        | –     | –          | –                            |      |            |                                             |
| Female                                              | 9.8        | 1.60  | 0.76–3.38  | 0.29                         |      |            |                                             |
| Age, years                                          |            |       |            |                              |      |            |                                             |
| <7                                                  | 6.9        | –     | –          | –                            |      |            |                                             |
| ≥7                                                  | 9.2        | 1.37  | 0.58–3.28  | 0.61                         |      |            |                                             |
| Age mother (birth)                                  |            |       |            |                              |      |            |                                             |
| <25                                                 | 8.5        | –     | –          | –                            |      |            |                                             |
| ≥25                                                 | 9.1        | 1.09  | 0.51–2.34  | 0.98                         |      |            |                                             |
| Exclusive breastfeeding 6 months                    |            |       |            |                              |      |            |                                             |
| No                                                  | 9.3        | –     | –          | –                            |      |            |                                             |
| Yes                                                 | 5.7        | 0.59  | 0.25–1.40  | 0.31                         |      |            |                                             |
| Any solid food <6 months                            |            |       |            |                              |      |            |                                             |
| No                                                  | 5.3        | –     | –          | –                            |      |            |                                             |
| Yes                                                 | 9.9        | 1.95  | 0.85–4.45  | 0.16                         |      |            |                                             |
| Sibship size                                        |            |       |            |                              |      |            |                                             |
| <5                                                  | 11.6       | –     | –          | –                            |      |            |                                             |
| 5+                                                  | 5.1        | 0.41  | 0.19–0.89  | 0.03                         |      |            |                                             |
| Family history <sup>2</sup> of FA                   |            |       |            |                              |      |            |                                             |
| No                                                  | 5.5        | –     | –          | –                            | –    | –          | –                                           |
| Yes                                                 | 23.3       | 5.26  | 2.45–11.24 | <0.0005                      | 3.92 | 1.64–9.43  | 0.002                                       |
| Family history of other atopic disease <sup>3</sup> |            |       |            |                              |      |            |                                             |
| No                                                  | 4.1        | –     | –          | –                            |      |            |                                             |
| Yes                                                 | 11.1       | 2.95  | 1.24–6.99  | 0.01                         |      |            |                                             |
| Personal AR <sup>4</sup>                            |            |       |            |                              |      |            |                                             |
| No                                                  | 7.0        | –     | –          | –                            |      |            |                                             |
| Yes                                                 | 20.0       | 3.32  | 1.15–9.56  | 0.03                         |      |            |                                             |
| Personal asthma                                     |            |       |            |                              |      |            |                                             |
| No                                                  | 5.9        | –     | –          | –                            | –    | –          | –                                           |
| Yes                                                 | 22.2       | 4.59  | 2.09–10.05 | <0.0005                      | 4.37 | 1.76–10.85 | 0.002                                       |
| Personal eczema                                     |            |       |            |                              |      |            |                                             |
| No                                                  | 5.3        | –     | –          | –                            | –    | –          | –                                           |
| Yes                                                 | 37.1       | 10.64 | 4.65–24.31 | <0.0005                      | 9.66 | 3.72–25.09 | <0.0005                                     |
| Personal drug allergy                               |            |       |            |                              |      |            |                                             |
| No                                                  | 6.6        | –     | –          | –                            | –    | –          | –                                           |
| Yes                                                 | 43.8       | 11.04 | 3.80–32.13 | <0.0005                      | 4.35 | 1.29–14.65 | 0.02                                        |

Results for model A (see Methods; this model included sibship size and family history of FA as significant independent variables) are only shown in the text.

<sup>1</sup> In model B, personal history of atopic disorders was added to model A and the stepwise method selected the variables that contributed significantly to this model.

<sup>2</sup> Family history: history of disease in father, mother and/or siblings.

<sup>3</sup> Other atopic diseases: asthma, AR or eczema.

<sup>4</sup> AR or conjunctivitis.

### Medical Care

Twenty percent of children with FA had visited the hospital for treatment, and 30% had been admitted for 1 day or less and no prolonged hospitalization was reported. Twenty-two percent of children with FA had taken

regular medications to control their allergy; 57% of those who received treatment were using antihistamine syrup and 29% were using inhalers. None of the children with FA had access to an adrenaline auto-injector (EpiPen) at the time of the study.

#### *Associations of FA with Child Characteristics*

Crude odds ratios (OR) with 95% CI of FA are shown in table 5. Significant crude OR were found for sibship size, family history of FA and of other atopic diseases, personal history of AR, of asthma, of eczema and of drug allergy.

The multivariable logistic regression for model A [where personal history of (other) allergic diseases were not yet included in the model, results not shown in the table] showed that there was a statistically significant independent relationship of FA with sibship size (OR for sibship size >4: 0.43, 95% CI 0.18–0.95,  $p = 0.03$ ) and family history of FA (OR = 4.76, 95% CI 2.17–10.53,  $p < 0.0005$ ): children from a smaller sibship and with a family history of FA were more likely to suffer from FA themselves. When we added personal history of other atopic diseases to the model (model B), the resulting model comprised personal history of asthma, eczema and drug allergy as significant independent variables together with family history of FA. Sibship size was not significant any more in this model. All adjusted OR and 95% CI are shown in table 5.

#### **Discussion**

This is the first epidemiological study in the UAE to assess the prevalence of FA among children. FA was found to be present in 8% of the study population. This prevalence is consistent with some studies [8, 18], but was higher compared to findings in other studies from The Netherlands, Denmark, Sweden and France that have reported prevalences of 1.4–1.8, 3.3, 2 and 6%, respectively [19–21]. However, the prevalence was lower than that reported in a survey in Japan which has estimated that 12.6% of children have an immediate-type food allergic reaction [22]. This wide variation in the prevalence of FA probably reflects differences in the study population, lifestyle, diagnostic criteria and study design.

#### *Onset and Duration of Symptoms*

FA in our study most commonly presented for the first time between 1 and 3 years of age, 75% had outgrown their symptoms by the age of 5 years and none had symptoms by the age of 7 years. This is in agreement with some of the literature [9, 10, 13]. Although there is evidence that about 25% of infants with IgE-mediated cow milk allergy retain their sensitivity into the second decade and about 35% develop allergic reactions to other foods [7]. Egg allergy resolved in 37% by the age of 10 years [23], wheat

allergy resolved in 56% by the age of 8 years and 65% by the age of 12 years [24], and most peanut and tree nut allergies are never lost [25].

#### *Allergens*

A substantial proportion of our study population reported to have reaction to eggs, fruits and fish. The order of importance of specific allergens varies in different countries, reflecting a possible interaction of genetic factors, cultural and dietary habits, and exposure to new allergenic products early in life [16]. For example, peanut allergy is very common in the UK [26], France [27], Switzerland [28] and North America [29, 30], but very rare in Italy [31] and Singapore [32].

#### *Symptoms*

Cutaneous reaction was the most common symptom of FA in our study. This is consistent with previous studies which have shown that the skin constitutes the principal target organ in FA, being involved in more than 80% of cases [13]. A similar study in France showed that the most frequent symptoms of FA in children were urticaria (in 38.7% of the children with FA) [9]. Similarly, a prospective study of cow milk allergy in Danish infants during the first 3 years of life reported that 64% of cases of cow milk allergy presented with cutaneous symptoms [11].

#### *Medical Care*

Medical care in the case of FA included emergency hospitalization in 30% of cases and ER visit in 20% of cases. However, a similar study in France showed that hospitalization for FA occurred in 7.3% of children with FA [27].

#### *Prevalence of Other Atopic Diseases, Comparison with Previous Studies in the UAE*

We found a prevalence of asthma of 13.6%, allergic rhinitis of 6.3% and eczema was 8.8%; these results are consistent with findings of a previous study of asthma and atopy among children in the UAE [33].

#### *Associations with Child Characteristics*

The prevalence of FA was not significantly related to gender. This is in agreement with a similar study in France [9]. Furthermore, FA was not related to exclusive breastfeeding in the first 6 months of life or to the introduction of semi-solid food during the first 6 months of life. Studies investigating the effects of dietary restrictions on the prevention of allergy have been disappoint-

ing. On the other hand, current data suggest that exclusive breastfeeding should be encouraged for at least 4–6 months in infants at both high and low risk of atopy [34].

Family history of other atopic diseases, a variable that had a significant crude OR, was not selected as a significant variable in the multivariable models A and B mainly because of its association with the stronger predictor family history of FA.

The analysis showed that a history of FA was significantly associated with a personal history of atopic diseases such as asthma, eczema and AR. This last variable had a significant crude OR, but was not selected in the multivariable model B because of its association with personal history of other atopic diseases. Our results support the hypothesis of FA as a first step in the 'allergic march' leading to the development of allergic asthma or AR [35–38], though the mechanism is not yet fully understood. FA is often considered one of the earliest manifestations of atopy, and sensitization to food is a risk factor for the subsequent appearance of respiratory allergy and asthma [34].

FA was significantly less common in larger families as is the case with allergic diseases in general [39]. Therefore, it is not surprising that in our model B (where we included a history of several allergic diseases) the significant association with sibship size disappeared.

FA was significantly higher among children with a family history of FA in first-degree family members. This is comparable to findings of a study on FA in France [27].

### Limitations of This Study

The response rate of this questionnaire-based study was 60% and although this is a relatively high response rate for this type of study, selective participation could not be ruled out, especially because we did not have any

information on nonresponders. Usually, patients with the disease that is subject of a study are more motivated to participate than their healthy counterparts, so an overestimation of the prevalence of FA cannot be excluded.

The number of participants with FA was small ( $n = 32$ ) and therefore no detailed analyses regarding onset and duration per allergenic type of food were possible.

Objective tests of allergic sensitization to food allergens (skin prick test or specific IgE) were not done to confirm the diagnosis of the reported FA as they are not feasible in population-based studies. Furthermore, the study population comprised the age group 6–9 years, so the possibility of recall bias could not be ruled out.

### Conclusion

The prevalence of physician-diagnosed FA in children of Al-Ain city, UAE was 8%. Eggs, fruits and fish were the main allergens reported. Family history of FA in first-degree family members and a small sibship size were risk factors for FA in children. FA was strongly associated with other atopic diseases and this result supports the hypothesis that FA is a first step in the allergic march leading to the development of allergic asthma or AR. The survey should be continued to confirm FA using double-blind oral challenge tests and other objective data such as skin testing and RAST studies.

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