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## **Prevalence of Self-Reported and Doctor-Diagnosed Food Allergies among Schoolchildren Aged 6-14 in Al-Karak Governorate: A Questionnaire-Based Survey**

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### **Abstract**

Food allergies are common in children and could be potentially fatal. This study used a cross-sectional questionnaire-based survey to estimate the prevalence of self-reported and doctor-diagnosed food allergies. Its further aim was to identify the common food allergens and food allergy symptoms among schoolchildren aged 6-14 in Al-Karak Governorate in South Jordan. Among the 1241 children evaluated, the overall prevalence of self-reported food allergy of 11.2% was determined, while the prevalence of doctor-diagnosed food allergy was 3.4%. In terms of relative frequency, egg accounted for more than a third of all reactions.

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The second most common allergen was fish (26.1%), followed by cow's milk (24.6%) and nuts (21%). The findings further revealed that, of the 138 individuals that reported food allergy, 57.2% had itchy skin and eczema and 23.2% experienced mouth engorgement. Gastrointestinal and respiratory symptoms were reported in 22.5 % and 26.8% of the cases, respectively. The best predictors for childhood food allergy were a personal history of asthma, eczema and allergic rhinitis ( $p < 0.001$ ). This survey has provided the first population-based epidemiological information related to food allergy amongst children in South Jordan. The prevalence of self-reported and doctor-diagnosed food allergy is highly comparable to the data reported for other countries in the region.

**Keywords:** food allergy; prevalence; questionnaire survey; schoolchildren.

## **1. Introduction**

Food allergy is an emerging public health and nutritional issue. While prevalence of food allergy appears to have been increasing in both developed and developing countries in the last 10–15 years, the reported rates across the world are subject to significant variation. Findings of various studies indicate that 3–41% of children suffer from food allergies worldwide [1-3]. In the US, a recent study estimated that food allergy affects 8% of children [4]. On the other hand, similar studies have been relatively scarce in Asia, due to a wide range of controversies, definitions, diagnostic criteria, and management practices. In the Middle East (UAE), evidence suggests that 8% of children suffer from food allergies [5]. In contrast, lower rates of self/parent-reported food allergy have been published for Japan [6] and Hong Kong [7], where prevalence is reported to be around 5% or less. In Israel, the prevalence of self-reported food allergy was also found to be, on average, less than 5% (3.2% in Jewish and 5.0% in Arabic children) [2]. However, accurate determination of the food allergy burden in many developing regions in Asia, such as Jordan, remains an important and presently unmet need.

Typically, the diagnosis of childhood food allergy relies on the self-reported symptoms. In most cases, the clinical manifestations represent an IgE-mediated hypersensitivity response that is associated with atopic manifestations, such as urticaria, angioedema, vomiting, diarrhea, eczema, rhinitis, and anaphylaxis [8]. Confirming the food allergy diagnosis requires open or blinded food challenges. However, these are not routinely recommended due to clinical concerns, such as potential to induce anaphylaxis. Skin prick tests, on the other hand, are widely administered, even though empirical evidence indicates that they successfully predict the disease in only 50% of the cases [9, 10]. Presently, no therapies that can be administered to prevent or treat food allergy exist. Thus, for those affected, the only option is to avoid exposure to the food allergen. Moreover, treatment of allergy symptoms mainly involves palliative measures. Because the most common food allergens—eggs, milk, nuts, wheat, vegetables, fruits and fish—are highly prevalent in the diet in different modern cultures [11], patients and their families must remain constantly vigilant. This restrictive lifestyle may have a significant psychosocial impact on the allergic individuals and their families [12].

Due to the paucity of food allergy prevalence studies in Jordan, we conducted a questionnaire-based survey of self-reported and doctor-diagnosed food allergies and the associated risk factors in South Jordan. Our findings

can inform the public health officials on the disease burden and may offer some suggestions for minimizing the allergy-related risks.

## **2. Methodology**

### **2.1. Study design and ethical considerations**

We adopted a descriptive cross-sectional design for this study. In order to collect the data for the subsequent analyses, questionnaires and consent forms were sent to the parents of 1400 schoolchildren aged 6–14 years attending 12 randomly selected public and private schools in Al-Karak Governorate. All information pertinent to the study objectives was obtained from the parent, as a proxy respondent for children aged 10 and below, while, in the older age group, both parent and child contributed to the survey. Of the 1400 questionnaires sent, 1241 were correctly completed and returned, corresponding to an overall response rate of 88.6% (87.2% for males and 89.1% for females). The study was approved by the Ethics (approval no. 201211) and Scientific Committees of the faculty of Medicine at Mutah University. Permission for data collection was obtained from the Directorate of Education of Al-Karak Governorate, and from the respective schools' directors. Returning the completed questionnaire was considered to imply participants' informed consent.

### **2.2. Selection of schools and data collection**

We obtained approvals for distributing the study questionnaire from the Directorate of Education of Al-Karak Governorate. To identify the study population, a random sample of 12 schools was selected from the list of all public and private primary schools in Al-Karak. Next, a letter was sent to the school directors, outlining the purpose of the study and the procedures that were to be employed. Once a permission to conduct the study in a particular school was granted, we sought the help of schoolteachers in distributing the questionnaires to the students. Each student was given the study questionnaire and a consent form that explained the study goals and procedures. The returned questionnaires were collected by the schoolteachers, who submitted them to the school director.

### **2.3. Questionnaire**

The study questionnaire consisted of three parts. Part one comprised questions aimed at collecting the socio-demographic data (age, sex, birth weight and breastfeeding). Part two contained questions that focused on food allergy, including self-reporting and doctor-diagnosed food allergy, types of allergen foods, and signs and symptoms of food allergy. Part three contained an Arabic version of the ISAAC questionnaire, translated and used in a study in neighboring Lebanon [13]. The questions in this part pertained to co-morbid allergies (asthma, allergic rhinitis and eczema) reported directly by the child or the parent. Prior to including these questions in the survey, we obtained the permission to use their translation from the authors.

### **2.4. Setting**

Al-Karak Governorate is located about 140 km South of Amman, the capital of Jordan, and has a population of 249,100 (corresponding to 3.9% of the estimated population of Jordan in 2012) [14].

## 2.5. Statistical analysis

As the data was normally distributed, it was subjected to parametric analysis, in addition to the Chi-square test, which enabled prevalence comparisons. Simple and multi-logistic regressions were used to calculate Crude and Adjusted Odds Ratio (Crude OR and AOR, respectively), and 95% confidence intervals (95% CI) to assess the relationship between risk factors and food allergy, including the potential confounders. A  $p$ -value  $< 0.05$  was considered statistically significant. All the analyses were performed using SPSS software version 16.0 (SPSS Inc., Chicago, IL, USA).

## 3. Results

### 3.1. Prevalence of self-reported and doctor-diagnosed food allergies

Among the 1241 respondents, 138 (11.2%; 95% CI 9.49-13.01%) reported having food allergy. The prevalence of reported food allergy by sex and age groups was calculated and the findings are shown in Table 1. As the results indicate, a similar percentage of boys and girls reported adverse reactions to food (10.2% and 12.0%, respectively) and there was no association between reported food allergy and gender ( $p = 0.332$ ). On the other hand, the proportion of schoolchildren that reported food allergy decreased with age, and this relationship was found to be statistically significant ( $p < 0.001$ ).

When asked whether the self-reported food allergy was diagnosed by a doctor, the parents of 42 children (3.4%) confirmed that their children had a diagnosed food allergy. Figure 1 shows the distribution of the children with a diagnosed and self-reported food allergy by gender. Although a greater number of girls reported food allergy relative to the boys, the latter were more likely to have the food allergy diagnosed by the doctor (3.5% compared to 3.3% of the girls). Nonetheless, no significant association between diagnosed food allergy and gender was found.

Table 1. Self-reported food allergy prevalence by sex and age group

Overall	Total (N)	Food Allergy (Yes)	P-Value	95% CI†
	1236	138 (11.2%)		9.49-13.01
Sex			0.332	
Male	567	58 (10.2%)		7.93-12.93
Female	668	80 (12.0%)		9.67*-14.61
Age group			<0.001*	
6-10	702	98 (14.0%)		11.54-16.67
11-14	534	40 (7.50%)		5.47-9.96

\* P-value  $< 0.05$

†95% Confidence Intervals (n = 1241)

### 3.2. Frequency of self-reported food allergy by food items

The relative frequency of self-reported food allergy by food items was analyzed and the results are presented in Table 2. As can be seen, egg accounted for more than a third of all reactions (34.1%). The second most common food item was fish (26.1%), followed by cow’s milk and dairy products (24.6%), peanuts (21%), fruit (7.2%), vegetables (6.5%) and wheat (1.4%). A majority of respondents (79.5%) had adverse reactions to a single food, while about 14.5% had reactions to two, and 6.5% reacted to three or more items. Boys had statistically significantly more reactions to cow’s milk protein than girls did ( $p = 0.007$ ).

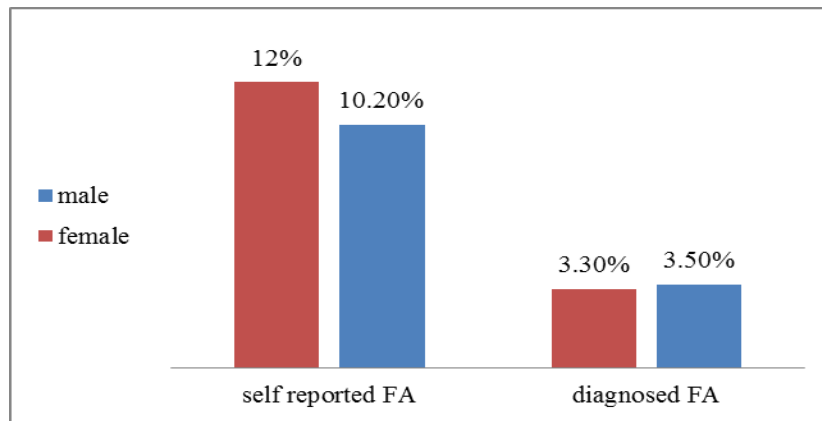


Figure 1. Prevalence of self-reported and doctor-diagnosed food allergy by gender (Total no = 567 for males, 668 for females)

Table 2. Frequency of adverse food reactions by food items

Type of Food Allergy (Yes)	Male (n=58)	Female (n=80)	P-value	Total	95% C.I. †
Cow milk	21(36.2%)	13(16.2%)	0.007*	34(24.6)	17.99-32.34
Egg	17(29.3%)	30(37.5%)	0.316	47 (34.1)	26.52-42.26
Fish	12(20.7%)	24(30.0%)	0.219	36 (26.1%)	19.28-33.89
Nut	16(27.6%)	13(16.2%)	0.107	29(21.0%)	14.83-28.41
Wheat	0 (.0%)	2 (2.5%)	0.225	2 (1.4%)	0.24-4.70
Fruits	4 (6.9%)	6(7.5%)	0.893	10(7.2%)	3.74-12.54
Vegetable	3(5.2%)	6(7.5%)	0.585	9(6.5%)	3.22-11.63
Combine Food Allergy					
1 Item Only	43(74.1%)	66(82.5%)	0.234	109(79.0%)	71.59-85.17
2 Items	7 (12.1%)	13(16.2%)	0.491	20 (14.5%)	9.34-21.12
3 Items	8 (13.8%)	1 (1.2%)	0.003*	9 (6.5%)	3.22-11.63

\* P-value < 0.05

†95% Confidence Intervals (Total n = 138)

### 3.3. Signs and symptoms of self-reported food allergy

The respondents were also asked to indicate their signs and symptoms of food allergy. The gathered data was subsequently analyzed and is presented in Table 3.

Table 3. Signs and symptoms of adverse food reactions

Type of Reactions (Side Effects)	Total (n=138)	95% C.I.†
1. Nausea, Vomiting and diarrhea	31 (22.5%)	15.5-29.4
2. Mouth Engorgement	32 (23.2%)	16.1-30.2
3. Itchy Skin And Eczema	79 (57.2%)	49.0-65.5
4. Cough And Wheezy Chest	24 (17.4%)	11.1-23.7
5. Sneezing And Running Nose	13 (9.4%)	4.5-14.3
6. Itchy And Red Eye	27 (19.6%)	12.9-26.2
7. anaphylaxis	0	0

†95% Confidence Intervals (n = 138)

Among the 138 children that reported having food allergy, 79 (57.2%) had itchy skin and eczema and 32 (23.2%) experienced mouth engorgement. Combined gastrointestinal symptoms accounted for 22.5 % of reactions, while respiratory symptoms were reported in 26.8% cases (17.4% of the children reported cough and wheezy chest, while 9.4% noted sneezing and runny nose). No cases of anaphylaxis were reported.

### 3.4. Co-morbid atopic disorders (asthma, allergic rhinitis and eczema)

The self-reported and family history of allergic diseases (asthma, allergic rhinitis and eczema) burden was estimated in the previous survey conducted by the author in South Jordan using the International Study of Asthma and Allergy in Childhood (ISAAC) questionnaire (In Press).

To identify the characteristics associated with self-reported food allergy, simple logistic regressions of each type of atopy (asthma, atopic dermatitis or allergic rhino-conjunctivitis), birth weight and breastfeeding were conducted, with food allergy as the dependent variable (Table 4).

Stepwise multi-logistic regression with forward entry—with the child's food allergy status as the dependent variable, and all the significant characteristics shown in Table 4 as independent variables—was used to determine a subset of characteristics that best predicts the presence of food allergy within the target population (Table 5). The findings indicate that, among the children that reported experiencing food allergy, the rates for reported wheeze and allergic rhinitis are about twice as high as in their healthy counterparts, while the rate for reported eczema is about 2-3 fold higher.

Table 4. Associations between birth weight, breast feeding, personal and family history of atopic disorders with food allergy by simple logistic regression.

variables	Crude OR* (95% CI)	P-value
Birth Weight (kg)	0.939 (0.66-1.36)	0.725
Breast feeding (No)	1.013 (0.679-1.51)	0.951
Self-reported allergic rhinitis	1.79 (1.15-2.79)	0.010†
Self -reported eczema	2.21 (1.14-4.27)	0.019†
Self -reported wheeze	1.86 (1.13-3.06)	0.015†
Family history of allergic rhinitis	1.33 (0.86-2.1)	0.204
Family history of eczema	1.41 (0.80-2.5)	0.233
Family history of asthma	0.86 (0.44-1.71)	0.672

Crude Odds Ratios with 95% Confidence Intervals (n = 1241)

†P-value < 0.05

Table 5. Best predictors of childhood food allergy by Multiple logistic regression

Variables	AOR* (95% CI)	P-value	Chi square
Self -reported allergic rhinitis	1.82 (1.18-2.81)	0.006†	7.16
Self -reported eczema	2.31 (1.21-4.44)	0.012†	5.66
Self -reported wheeze	1.99 (1.23-3.22)	0.005†	7.31

\*(Adjusted odds ratios with 95% confidence intervals) (n = 1241)

†P-value < 0.05

#### 4. Discussion

Adverse reactions to food and food allergies are an increasing problem among primary school children. Published studies on food allergy time-trends confirm the rising prevalence in Asia [15]. Moreover, a gradient of food allergy with progressive economic development also provides indirect evidence that this issue is associated with westernization. This premise is supported by higher rates of food allergy in Chinese born in Hong Kong (4.8%) compared with those born in mainland China (2.4%) [16].

While many studies on food allergy have been conducted thus far, this is the first time its prevalence has been investigated in school-aged children in Jordan. The findings reported here revealed that almost 11.2% of the schoolchildren in Al-Karak Governorate in South Jordan self-reported food allergy, with doctor-diagnosed diagnosis in third of these cases (3.4%). These results are consistent with those determined in previous studies [17, 18], whereby approximately 20% of UK and 25% of Swedish population perceived that they had food allergy, even though a true adverse food reaction was confirmed in only 1.4-1.8% and 6% of these cases, respectively.

The reasons behind this incongruence between the perceived and the doctor-diagnosed food allergy, however, presently remain unclear. Some authors attributed it to the greater number of cases of food intolerance, mistakenly regarded as food allergy [19], while some suggested influence of psychological factors [20]. Other possible causes or contributing factors are yet to be identified.

In Jordan, no nationally standardized Food Allergy/Anaphylaxis Action plans presently exist, even where auto-injectors are available and training for teachers and other community carers supervising children with food allergies is provided. Moreover, it is important that the correct diagnosis of food allergy is made, as the current treatment relies solely on the elimination of the responsible food(s) and beverage(s). Thus, allergic children typically consume a restrictive diet and therefore may be at risk of developing nutritional deficiencies. The findings reported here clearly suggest that governments and health policy makers in Jordan must develop a greater awareness of the significance and impact of food allergy, particularly in schoolchildren.

The present study also indicated that, in boys, the prevalence of doctor-diagnosed food allergy was higher than in girls, even though this difference was not statistically significant. These findings are concordant with the published data on the relationship between gender and incidence of food allergy [21]. In contrast, in this study, a greater number of girls self-reported food allergy compared to boys. Causes of this disparity may require further investigation [22].

The prevalence of food allergy tends to decrease with age, and significantly differs between children and adults [23]. Some studies suggest that about 50-85% of children outgrow food allergy [24-26]. This is in line with our findings, which revealed lower incidence of food allergy among older children. As we focused on children aged 6-14, this may suggest that the prevalence of food allergy might be increasing until age 10 years, after which it starts to diminish, as children grow.

In our study sample, the most common food allergens were egg, fish, cow's milk and nuts. The number of affected schoolchildren was relatively similar across all regions, with regional variations in the relative frequency of these. More specifically, 1 in 3 children that reported suffering from food allergy attributed their symptoms to egg intolerance, further substantiating the impression that this is a major concern in Jordan. Moreover, this result is in agreement with other reports on most common food allergens in Asia [27]. However, according to the extant studies conducted in Middle East, in this region cow's milk allergy is more prevalent [28].

Among the schoolchildren that took part in our study, none reported experiencing anaphylaxis. It is thus likely that the allergic individuals rely on strict avoidance of allergens, due to a lack of curative therapies and nationally standardized Food Allergy/Anaphylaxis Action plans. However, this strict avoidance may have an adverse psychosocial effect on allergic individuals and their families [12], as well as result in nutritional deficiencies [29].



Evidence suggests that food allergy is associated with and may exacerbate other immune mediated conditions, such as asthma, allergic rhinitis and eczema [2]. This corroborates the results of our study, where children who reported food allergy, compared with overall population, have a significantly higher prevalence of all three atopic disorders (asthma, allergic rhinitis and eczema).

The link between other factors, such as breastfeeding and birth weight, and food allergy is still controversial [30, 31], and was not established in our study.

### **5. Strengths and Limitations of the Study**

The main strength of our study is that it is the first attempt to establish prevalence of food allergy among schoolchildren in Jordan. Moreover, the response rate (up to 88.6%) achieved is very high for this type of study. Moreover, we relied on a self-reported questionnaire as a data collection instrument. This is an extremely cost-efficient and convenient survey method, enabling us to reach a great number of potential study participants. In view of the rapid changes in epidemiology observed elsewhere, it is pertinent to conduct more studies of this kind in the future.

The aforementioned advantages of a questionnaire-based survey notwithstanding, this approach also has a potential to introduce subjectivity to the data, as all information is provided from the perspective of the participant. This can lead to problems arising from variability in the perception of symptoms, unavoidable self-selection and memory bias. Thus, there is a need for a standard well designed, reproducible, and validated questionnaire that has been translated to many languages. Having a uniform data collection instrument that can be cross-culturally adapted could help affected individuals and medical professionals in making the initial diagnosis of food allergy.

### **6. Conclusion**

This survey has provided the first population based epidemiological information related to food allergy amongst school children in South Jordan. The results should provide significant reference values and serve as baseline information for subsequent food allergy screening, diagnosis and treatment.

A standard population based childhood food allergy health survey should be conducted regularly with larger sample to determine the true prevalence and to update policy makers and health professionals, in order to support adequate food allergy management guidelines in schools such as creating awareness of food allergy prevalence, its risk factors and treatment options that can bring down mortality and morbidity caused by this public health problem.

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## Conflict of Interests

The authors declare no conflict of interest.

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