

Prevalence of Food Allergy among Schoolchildren in Lebanon

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Keywords

Prevalence · Schoolchildren · Food allergy

Abstract

Introduction: Food allergy (FA) is a global health problem with an ongoing rise in prevalence, especially in developed countries. It has been reported to be most prevalent in children, although cases in adults have been increasing as well. FA may lead to life-threatening clinical manifestations. Data in Lebanon and the Middle East are limited. To our knowledge, few studies tackled its prevalence in children in this region. **Aim:** This study aims at determining self-reported prevalence of FA in schoolchildren (ages 3–17 years) in Lebanon and describes its characteristics. **Method:** Throughout this cross-sectional study, 5 schools from 3 different governorates in Lebanon (Beirut, Mt. Lebanon, and Beqaa) were contacted to participate and 5,312 questionnaires were sent out to be completed by the parents and sent back to the school during May 2019. **Results:** 2,610 questionnaires were collected (49.13%). A hundred and forty-eight (6%) children reported to have FA, 58% were males. 80% of them were breastfed, 51% were diagnosed between the ages of 2 and 14 years. Common allergens included cow's milk and milk products (22.46%), fruits and vegetables (16.58%), eggs (8.02%), and nuts (5.88%). Allergic symptoms included skin reactions (45.08%), gastrointestinal (GI) symptoms (29.53%),

respiratory symptoms (14.51%), and systemic symptoms (10.88%). 82% of the population with FA has sought professional advice, out of which 54% were confirmed by a physician. Common methods of diagnosis were IgE test (35.71%), food elimination (27.92%), and skin prick test (18.83%). χ^2 analysis has shown that a higher percentage of children with FA had skin reactions (58.8%, $p = 0.033$) and GI symptoms (30.41%, $p = 0.047$). A higher percentage of children with allergies were breastfed. No relation between the presence of FA and delivery mode was observed. **Conclusion:** This study has shown that the self-reported prevalence of FA among Lebanese schoolchildren is 6%, and it was correlated with skin and GI symptoms. The most common allergen was cow's milk. A higher proportion of children with FA were breastfed. No association between the mode of delivery and FA was found. Larger studies are needed to confirm the above findings.

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Introduction

Food allergy (FA) is an adverse immune-mediated reaction to a particular food [1]. Although several types of FAs have been identified, accurate diagnosis remains dif-

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ficult. Tests such as skin prick test (SPT) and serum specific IgEs are performed to detect the presence of FA, yet the double-blind placebo-controlled food challenge (DB-PCFC) remains the gold standard [1]. Clinical manifestations of FA range from mild to significant and life-threatening symptoms. Depending on the nature of the immune reaction, FA can be manifested by skin reactions, respiratory, or gastrointestinal (GI) problems [2]. In severe cases, FA reactions can lead to anaphylaxis that could be fatal. Its management relies on the avoidance of allergenic food due to the lack of a curative treatment [2]. However, recently, studies showed that Palforzia (peanut [*Arachis hypogea*] allergen powder-dnfp) a new drug approved by the Food and Drug Administration is used to induce tolerance for peanuts [3].

Cases of FA have been rapidly increasing in the past few decades for complex reasons, mainly attributable to the economic development and industrialization of countries [4]. Its burden is mostly affecting infants and children, where the prevalence has reached 10% in some countries [4]. While most children's allergy (cow's milk, eggs, wheat, and soy) resolves by the age of 5, some allergies remain throughout their lifetime, such as peanut, tree nut, and fish allergies [5]. In the U.S, the prevalence of FA in children has increased by 18% in the past decade [6], where studies showed that the burden of the increasing prevalence has both economic and public health costs on the US health system, estimated to reach billions of dollars annually [7]. Hospitalizations due to food-triggered anaphylaxis have been increasing in several countries in Europe and the USA, especially in young children [8]. Systematic reviews have shown that the case mortality rate of anaphylaxis is 0.65%–2% [8].

In schools, children with FA are exposed to allergens especially if protective policies are not integrated. A study performed in France on schoolchildren showed that 7% ($n = 2,716$) reported to have FA, where the average age of diagnosis was 3.4 ± 2.8 years, and that most of them had FA to cow's milk [9]. In a study performed in China, it was apparent that 3.41% of 5,542 children, whose ages ranged from 7 to 12 years, had FA. The study used a standardized questionnaire, SPT, and specific IgEs tests to determine the presence of FA and concluded that several factors, such as family history of allergies, early age (<8 years) and smoke environment were associated with higher risk [10]. In the United Arab Emirates (UAE), 8% of children aged 6–9 years were diagnosed with FA by physicians. The study was conducted through a self-administered questionnaire that was completed by 397 parents in Al-Ain City. Eggs, fruits, and fish were the most

common allergens, and FA was strongly associated with family history of FA and atopic diseases [11]. A Kuwaiti study has shown a 4.1% prevalence of FA in children aged 11–14 years, with eggs being the most reported allergen [12]. According to the World Allergy Organization the burden of FA in children on the economy and health systems remains to be imprecisely determined in several regions in the world, especially in the Middle East [4].

In Lebanon, information on FA in general is scarce, indicating the need for research to quantify its prevalence, specifically in children due to their progressive immunological and cognitive development [13]. Children with FA have been found to be at risk of growth problems, especially those with cow's milk and multiple FA, where they are less likely to consume calcium and vitamin D-containing food items [14]. The aim of this study is to determine the prevalence of FA in schoolchildren in Lebanon and identify the main food allergens, the signs and symptoms of the allergic reactions, the correlation between having FA and atopic dermatitis, and the association between breastfeeding and type of delivery and the presence of FA. The results of this research study will contribute to raising awareness on the status of FA among children in Lebanon, which will be the basis for creating a safer environment in schools through specific policy design and staff training for timely and adequate management of allergic accidents.

Materials and Methods

Study Design

A cross-sectional study was conducted in May 2019 in schoolchildren aged 3–17 years. A convenient clustered sampling was followed, and 5 schools were chosen from 3 different governorates (Beirut, Mount. Lebanon, Beqaa). Schools were selected based on convenience sampling. A total of 2,610 questionnaires out of the 5,312 distributed to the schools were collected.

Questionnaire and Variables

A pilot questionnaire was performed, and it included questions about the presence of FA, the age of diagnosis, the culprit allergens, signs and symptoms of the reaction, ways of diagnosis, atopic history, type of delivery, and whether children were breastfed or not. Other information such as year of birth, gender, and number of children per family were also collected.

Statistical Analysis

Data entry was done on excel and exported to JMP®, Version 15 SAS Institute Inc., Cary, NC, USA, 1989–2019 for analysis. Descriptive analysis was conducted, presenting the prevalence of FA and other factors. χ^2 analysis was performed to assess significant differences between the presence of FA and having GI or skin reactions. The threshold of significance was set at 0.05.

Table 1. Most common allergens among participants

Allergens	Students, <i>n</i>	Percentage
Cow's milk and milk product	42	22.46
Fruits and vegetables	31	16.58
Other	30	16.04
Eggs	15	8.02
Nuts	11	5.88
Legumes	11	5.88
Crustaceans and mollusks	10	5.35
Wheat	10	5.35
Peanuts	9	4.81
Fish and fish products	7	3.74
Walnuts	4	2.14
Sesame and sesame products	3	1.60
Soy and soy products	2	1.07
Lupine and lupine products	1	0.53
Sheep and goat milk	1	0.55
Total	187	

Results

Prevalence

A total number of 2,610 out of 5,312 questionnaires were returned (49.13%) and 58% of the respondents were males. The prevalence of FA among participants was 6% (CI 95%; 4.8–6.6). Fifty-one percent were diagnosed between the ages of 36 and 168 months. Moreover, 21% of the total population with FA was breastfed.

Culprit Allergens

The most common allergens were cow's milk (22.46%), fruits and vegetables (16.58%), eggs (8.02%), and nuts (5.88%) (Table 1).

Signs and Symptoms

Skin reactions (skin rash, urticaria, or angioedema) were the most prevalent symptoms (45.08%). GI symptoms such as diarrhea, vomiting, constipation, and abdominal pain were reported by 29.53% of the respondents, while 14.51% of the respondents had respiratory symptoms (cough, dyspnea, and wheezing) and 10.88% had systemic symptoms (hypotension and laryngeal angioedema).

Diagnosis

About 82% of the population with FA has sought professional advice, out of which 54% were confirmed cases of FA by the physician. Generally, the most common methods of diagnosis used were IgE test (35.71%) and

Table 2. Methods of diagnosis for FA

Testing for FA	Students, <i>n</i>	Percentage
Blood test	55	35.71
Food elimination	43	27.92
Skin test	29	18.83
Clinical history	22	14.29
Endoscopy	3	1.95
Colonoscopy	1	0.65
Gastroscopy	1	0.65
Total	154	

food elimination (27.92%), followed by skin test (18.83%) (Table 2). χ^2 analyses show that a higher percentage of children with FA had atopic dermatitis (58.8%, $p = 0.03$) and GI symptoms (30.41%, $p = 0.047$).

We further found an association between breastfeeding and the presence of FA ($p = 0.0122$), where a higher percentage of children with allergies were breastfed. On the other hand, no relation between the presence of FA and delivery mode was observed.

Discussion

This study is one of the few epidemiologic studies performed in Lebanon with the aim of determining the prevalence of FA in schoolchildren, and identifying its different aspects, such as the most common allergen, allergic symptoms, and diagnostic tests. Moreover, this study evaluated the significance in the presence of FA and certain allergic reactions, the relation between breastfeeding and the development of FA, as well as the association between mode of delivery and the presence of FA.

Prevalence

The prevalence of FA among schoolchildren in our current study performed in Lebanon, was found to be 6% (CI 95%; 4.8–6.6) (CI = 95%). In Canada and the USA, reports showed that the prevalence is about 7%–8% [7, 15], whereas in Europe, the prevalence was lower, where a study that included 10 European countries showed the prevalence of FA in children to be 5% [16]. In similar studies performed in UAE [11] and Kuwait [12], the prevalence was 8 and 4%, respectively. Results may differ due to several reasons. First, the sample size and the study population are different, where the Canadian and American studies targeted the whole population, and not just

children. Moreover, the diagnostic criteria by which the studies are determining the presence of FA also affect the results, since self-reported prevalence tends to overestimate the actual presence of FA in the population.

Culprit Allergens

Cow's milk was the most reported allergen in this study. Cow's milk is the most common and frequently reported allergen among children worldwide [17]. This is consistent with the results found in Canada and the USA, where cow's milk accounts for the most prevalent culprit food in the population according to the World Allergy Organization [4]. In Europe, eggs and fruits remain the most reported allergens in the population [4]. The results of this study are different from those of UAE [11] and Kuwait [12], where eggs were the most reported allergen in the population. This may be due to dietary habits, for example, in Lebanon, cow's milk and cow's milk products are widely consumed and a common ingredient in multiple Lebanese dishes. In China, the leading allergen was shrimp [10]. The heterogeneity among studies is due to the difference in the geographical location, and cultural and dietary patterns [10]. It has been reported that in some countries, young adults with allergies to peanuts and tree nuts have a higher risk of fatal anaphylaxis. Moreover, cow's milk and seafood allergies are also being reported to becoming more common triggers of fatal anaphylaxis reactions [8].

Signs and Symptoms

The most prevalent symptom of FA in this study was skin reactions. This is consistent with studies performed in Kuwait, China, France, and UAE. Skin reactions are the most common type of allergic reactions in the literature, such as atopic dermatitis, that is commonly present in the early stages of life [18], as well as urticaria and/or angioedema. This was further asserted through bivariate analysis, where a higher proportion of children with FA have atopic dermatitis. It is directly caused by FA in 30–40% of children aged <5 years [19].

Diagnosis

Most of the respondents sought the advice of a physician; a pediatrician most commonly, or an allergy specialist that explains why diagnosis through IgE blood test was the most reported in this study. Although it is not the most reliable diagnostic method of FA, IgE measurement is valuable in screening and diagnosing FA when done through consistent laboratory testing [20]. However, not all food allergens can be accurately determined through

IgE antibodies since not all cutoff values have been indicated [20]. Food elimination was the second most common method of diagnosis among participants. It relies on an avoidance and reintroduction period of the suspected food but can be challenging and time-consuming, especially if the child and/or their parent do not suspect a certain food [21]. The SPT was also a common diagnostic method in this study, although it was the least reported among participants. The limitation of the SPT is that patients might react to foods only if they were processed in a certain way [21]. In addition, there are no standardized extracts, which affects their potency [21]. The DBPCFC remains to be the gold standard for the diagnosis of FA despite not being often used in clinical settings [22]. In this study, diagnosis of FA was not based on DBPCFC. This test is highly lacking diagnostic criteria since it is often perceived as challenging to conduct because it can be costly, time-consuming, and might pose a risk for patients. Performing a DBPCFC requires highly trained allergy practitioners in a specialized clinical setting. These factors limit the use of DBPCFC in diagnosing FA [22].

FA and Atopic Dermatitis

Our results show that a higher percentage of children with FA have atopic dermatitis (58.8%, $p = 0.033$). Rigorous evidence demonstrates that FA and atopic dermatitis are highly associated [23]. Studies show that 20–40% of children who suffer from atopic dermatitis will have an IgE-mediated FA [23], which often exacerbates the symptoms of atopic dermatitis [24]. Some culprit foods such as cow's milk and eggs have been found to directly induce flares in atopic dermatitis [25]. Therefore, atopic dermatitis is associated with FA; however, it is not a manifestation of FA [26].

Mode of Delivery and Breastfeeding

An association between breastfeeding and the presence of FA ($p = 0.0122$) has been found in this study; although a higher percentage of children with allergies were breastfed, there is wide evidence from international health associations that exclusive breastfeeding for the first 6 months of the infant's life is protective from atopic diseases and allergies [20]. In a cohort study on infant feeding patterns and FA, it has been found that multiple feeding sources in the first 6 months of the infant's life is associated with FA later in life (at 6 years old) [27]. On the other hand, no relation between the presence of FA and mode of delivery was observed in this study. The mode of delivery has been associated with changes in the infant's microbiome, through delaying colonization of

the microbiome in the infant's intestines, which increases the risk for allergic diseases [28]. Moreover, a meta-analysis showed that C-section is associated with an increased risk of several atopic diseases and allergies, such as rhinitis, asthma, and FA in children [29].

This study examined the prevalence of FA in school-children. It revealed the need to have a more accurate method in determining FA prevalence among schoolchildren, the need to address the severity of FA in school settings, and implement a management policy to avoid accidental reactions that could be fatal. FA is a challenging public health issue, where it is increasing in prevalence, and yet treatment other than avoidance has not been established [4]. Further studies are necessary to establish comprehensive data on FA among children in Lebanon.

Statement of Ethics

A written informed consent was obtained from parents before entering the study. Parents were informed about the study; their participation was voluntary, and they had the right to withdraw at any moment. Only filled questionnaires with a signed informed consent were enrolled in the study. IRB Approval Number HPC-001-2021 was provided by the Ethics Committee.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Author Contributions

Carla Irani and Dominique Dano coordinated the research study, supervised the findings, and edited the final manuscript. Jana Sakakini collected data from Beirut, performed data compilation and cleanup, and wrote the manuscript. Souheil Hallit, Rana Bikai, and Pascale Salameh completed the statistical analysis. Greta Sahyoun facilitated data collected from schools in Bekaa and Kesserwan.

Data Availability Statement

The data that support the findings of this study are not publicly available due to confidentiality of the participants but are available from the corresponding author (D.D.) upon reasonable request.

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