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Food Allergy and Asthma Exacerbation In Asthmatic Children

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ABSTRACT

Background: Asthma and allergy are both complex diseases caused by environmental and genetic factors. Food allergy (FA) and asthma have been shown to frequently co-exist with one another; however, the exact link and the extent to which they impact each other are still not fully understood.

Objective: To assess association of bronchial asthma and food allergy, relationship between asthma exacerbation and food allergy.

Patients and methods: A case control study included 100 asthmatic children ranging in age from 2 to 18 years. Clinical criteria, serum total and specific IgE (sIgE) for common food allergens were done.

Results: Serum food-specific IgE test results came back with a positive and negative percentage of 44 percent and 56 percent, respectively. We found that FA was linked to moderate to severe persistent asthma in children, and that food allergy increased the proportion of uncontrolled asthma in children.

Conclusion: Children who had food allergy had greater number of exacerbations and hospitalizations. Patients with asthma should be evaluated for food allergies, since they are a risk factor for asthma aggravation.

Keywords: Food allergy; Asthma exacerbation; Asthmatic children.

INTRODUCTION

One of the most prevalent serious non-communicable illnesses, asthma significantly lowers quality of life for many people. According to disability-adjusted life years, asthma is the 16th most common cause of years spent with a handicap and the 28th most common source of disease burden globally. Globally, 300 million people suffer from asthma, and it's possible that another 100 million people may get it by 2025. The frequency, severity, and mortality of asthma vary greatly geographically. Although there is a larger prevalence of asthma in high-income nations, low- and middle-income countries account for the majority of asthma-related deaths [1]. A study in Egypt evaluated asthma prevalence as 13.4% among Egyptian children [2], and another study evaluated it as 12.5 % among school children [3].

FA is a significant health concern nowadays. The frequency of it has considerably grown over the past 20 years, particularly in rich westernised nations. As their economies expand, developing nations exhibit similar patterns, and their populations are also embracing a more westernised way of life. FA prevalence is thought to be 5% in adults and 8% in kids overall [4].

The most common food allergens, which are responsible for around 90% of unpleasant responses of this kind, include proteins found in cow's milk, eggs, peanuts, tree nuts, soy, wheat flour, fish, marine mollusks, crustaceans, and cephalopods. Common allergies include berries, citrus fruit, honey, sesame seeds, and a number of other foods and additives [5].

Asthma and allergy are both complex diseases caused by environmental and genetic factors. Several large genome wide association studies have been conducted on asthma phenotypes, atopic dermatitis and allergic diseases [6]. Over the years, asthma has increasingly been recognized as a disease that has an allergic component, although the focus has predominantly been on environmental allergens for example, cat and home dust mite allergies. It is generally known that exposure to inhaled allergens can be a factor in the exacerbation of asthma although the impact of allergen avoidance on asthma is still unclear. The effectiveness of avoiding house-dust-mite allergen in the management of asthma has been examined, and it was discovered that employing allergen-impermeable coverings as a single intervention to prevent house-dust-mite allergen had no effect on patients' clinical asthma [7].

FA and asthma have been demonstrated to commonly coexist; nevertheless, the precise connection and the amount to which they influence one another are still unclear. Asthma and food allergies have very comparable risk factors (such as atopic eczema and allergen sensitization, as well as parent or family history of allergies), and research has shown that asthma may even emerge before food allergies do [8].

According to research by **Aldurayish *et al.*** [9], children who were co-sensitized to popular foods and aeroallergens had a greater chance of getting the respiratory allergy illness when compared to children who were not sensitized. In a different study, children with food allergies had an earlier age at which they acquired asthma and a higher incidence of the condition. Regarding the time of food sensitization, it was discovered that food sensitization early in childhood (i.e., before 2 years of age), either with or without concomitant inhalant sensitization, was a powerful predictor of the development of asthma since school-going age [7].

Notably, having both asthma and a food allergy raises the chance of anaphylaxis caused by foods as well as life-threatening asthmatic episodes and asthmatic episodes triggered by food allergens. Clinicians must

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thoroughly assess the coexistence of both disorders in order to provide patients with the relevant dietary recommendations and medications (such as inhaled beta-agonists and self-injectable adrenaline devices) for potentially life-threatening episodes [10].

This study aimed to assess association of bronchial asthma and food allergy, relationship between asthma exacerbation and food allergy.

PATIENT AND METHODS

Study design: case control study was carried out in Pediatric Department in Banha University Hospitals. Collected samples were tested in the laboratory of Clinical Pathology Department at Benha University Hospitals.

Size of samples: 100 children participated in this study after obtaining consent from their parents.

Inclusion criteria:

1- Age from 2–18 years.
2- Diagnosed as bronchial asthma.
3- Atopic or non-atopic asthma.

Exclusion criteria:

1- Children below 2 years.
2- Any chronic illness other than asthma e.g.; heart failure, renal failure, liver cell failure.

All children underwent the following:

History:

Full history taking including:
Asthma type and severity.
Asthma control.
Medications used.
History of food allergy.
Number of asthma exacerbations during last 12 months.
Number of hospitalization due to asthma exacerbations during last 12 months.
Family history of asthma or food allergy.

Full clinical examination:

Vital signs.
Chest examination to assess asthma.
Cardiac examination.
Abdominal examination to detect GIT manifestations.

Investigations:

Routine investigations:

- Complete Blood Count (CBC) for WBCs and eosinophils.
- C-reactive protein (CRP) Level.
- Chest X-ray to exclude pneumonia.

Peak expiratory flow rate (PEFR).

Immunological Assessment.

The determination of atopic status includes serological evaluation of the total IgE and sIgE antibodies against food-allergens. The common food allergens, which we evaluated including egg white/egg yolk mix, cow`s milk, cacao (Chocolate), wheat flour, peanut, orange, strawberry, banana, mango, tomato, onion, chicken, meat, fish.

Using commercially available assays (the Biocheck Total IgE kit from Biokit, South San Francisco, CA 95090, USA), total blood IgE levels were quantified and shown in IU/ml. According to the age-dependent upper limit of normal, normal values were established. The predicted minimum detectable IgE concentration by this test is 5.0 IU/ml.

German-made AllergyScreen/AlleisaScreen Spec. IgE is a serum specific IgE test for food allergens. For the quantitative measurement of particular IgE in human serum, using the immunoblot assay. None or very little evidence was used to interpret the outcomes. Low: 0.35 to 0.69 IU/ml, Increased: 0.70 to 3.49 IU/ml, Significantly Increased: 3.50 to 17.49 IU/ml, High: 17.50 to 49.99 IU/ml, Very High: 50.00 to 100 IU/ml, and Extremely High: >100.00 IU/ml.

Ethical approval:

The study complied with the Helsinki Declaration and was approved by the Ethical Committee of Benha University. Before enrolling any children in the study, parents of all potential participants were given the opportunity to provide informed written permission after being informed of the study's goals.

Statistical analysis

SPSS version 24 for Windows® was used to collect, code, analyse the data. The Shapiro-Wilk test was employed to ensure that the data distribution was normal. Frequencies and relative percentages were employed to depict qualitative data, which were compared by chi^2 test. Mean and standard deviation (SD) were used to express quantitative data. To compare two independent groups of regularly distributed variables (parametric data), the independent samples t-test was utilised. P values of 0.05 or less were deemed significant.

RESULTS

Table (1) shows description of the studied group as regard personal data (age, sex), family history and control medications.

Table (1): Demographic data of cases

Variable	Value
Number	100
Age (y), Mean±SD	8.7700±3.10703
Sex	
Male	55 (55%)
Female	45 (45%)
FH of asthma	59 (59%)
FH of food allergy	34 (34%)
Asthma medications:	
ICS	80 (80%)
SABA	75 (75%)
Leukotriene inhibitors	57 (57%)
LABA	19 (19%)

Table (2) shows type of asthma (atopic, non-atopic), asthma severity and level of asthma control.

Table (2): Classification of asthma in the studied patients

Variable	Value
Asthma type:	
Atopic	77 (77%)
Non atopic	23 (23%)
Asthma severity:	
Mild intermittent	22 (22%)
Mild persistent	34 (34%)
Moderate persistent	26 (26%)
Sever persistent	18 (18%)
Asthma control:	
Controlled	56 (56%)
Partly controlled	27 (27%)
Uncontrolled	17 (17%)

Table (3) shows number of food allergens perceived from history and relationship between it and sIgE against food allergens. It shows that egg, fish and banana had higher proportion of sIgE positivity.

Table (3): Relationship between sIgE positive and perceived FA of the studied patients

Food allergens	Perceived allergy	sIgE positivity
Egg white/egg yolk mix	30	28
Cow`s milk	25	20
Cacao (Chocolate)	15	9
Wheat flour	12	12
Peanut	18	15
Orange	6	12
Strawberry	15	13
Banana	28	25
Mango	18	14
Tomato	12	15
Onion	9	9
Chicken	0	6
Meat	0	9
Fish	29	24

Table 4 shows the mean total IgE in the serum of the studied cases.

Table (4): Serum total IgE level in the studied patients

	Number	Mean	SD
Serum total IgE (kU/L)	100	105.78	6.43586

Table (5) shows relationship between level of asthma control and food allergy. It was discovered that more kids without food allergies had symptoms that were fully under control, whereas more kids with food allergies had symptoms that were just partially or inadequately under control.

Table (5): Relationship between level of asthma control and FA in the studied patients

Food allergy	Well controlled n (%)	Partly controlled n (%)	Poorly controlled n (%)	*P* value
Present	11 (19.6%)	20 (74.1%)	13 (76.5%)	<0.001*
Absent	45 (80.4%)	7 (25.9%)	4 (23.5%)	

*: Significant

Table (6) shows relationship between asthma severity and food allergy. It was discovered that more children with food allergies had moderate to severe chronic asthma, while more children without food allergies had milder asthma.

Table (6): Relationship between asthma severity and FA in the studied patients

Food allergy	Mild intermittent n (%)	Mild persistent n (%)	Moderate persistent n (%)	Sever persistent n (%)	P value
Present	4(18.2%)	7(20.6%)	19(73.1%)	14(77.8%)	<0.001*
Absent	18(81.8%)	27(79.4%)	7(26.9%)	4(22.2%)	

*: Significant

Table (7) shows relationship between number of exacerbations, number of hospitalization and food allergy. It shows that children who had food allergy had greater number of exacerbations and hospitalizations and children who didn't have food allergy had less number of exacerbations and hospitalizations.

Table (7): Relationship between number of exacerbations, number of hospitalization and food allergy in the studied patients

Food allergy	Present	Absent	*P* value
Number	44	56	
Number of exacerbations Mean±SD	2.86± 0.377	0.53±0.213	<0.001*****
Number of hospitalization Mean±SD	1.29±0.170	0.26±0.106	<0.01*

*: Significant

DISCUSSION

Our study was done on 100 patients suffering from bronchial asthma. 55% of children were males and 45% were females. Mean age of study group was 8.7 years. 59% of children had family history of bronchial asthma and 34% had family history of food allergy. 77% of children had atopic asthma and 23% had non atopic asthma.

As regard asthma severity; 22% of children had mild intermittent asthma, 34% had mild persistent asthma, 26% had moderate persistent asthma and 18% had sever persistent asthma. As regard asthma control; 56% of children had well controlled asthma, 27% had partly controlled asthma and 17% had poorly controlled asthma.

We asked about the history of food allergies in kids and employed serum total and specific IgE against food allergens, which is a proven technique to identify food allergies in kids. 44 of 100 kids with asthma had been given a food allergy diagnosis. The sIgE test result was used to make the diagnosis of FA. There were 44% of children with asthma who had dietary allergies. Detected food allergens were egg (28%), banana (25%), fish (24%), cow's milk (20%), peanut (15%), tomato (15%), mango (14%), and strawberry (13%), wheat flour (12%), cacao (Chocolate) (9%) and onion (9%).

This is consistent with a study in Egypt, which reported that approximately 38.9% of children with asthma had food allergies. Cow milk and casein accounted for the majority (68%) of the detected food allergens, followed by chicken (56%) and eggs (59%), bananas (52%) and fish (52%) as well as wheat (48%) and peanuts (31%) [11].

Our result was in line with another study that found food allergies in 48% of individuals with asthma [12]. While other research indicated that between 34% and 78% of asthmatic patients reported having symptoms connected to eating [13, 14]. Additionally, **Aba-Alkhail and El-Gamal**[15] showed that 29% of people had clinical food sensitivity.

Additionally, a prospective survey conducted by **Friedlander *et al.*** [16] in 2013 of 300 asthmatic kids revealed that 24% of them had a food allergy, and of them, 12% had several food allergies. On the other hand, **Krogulska *et al.*** [17] found that 9.8% of children with asthma had IgE-related food allergy.

According to research by **Cherian *et al.*** [18], the most prevalent dietary allergies identified by patients were grapes, citrus fruits, and bananas. According to a different research, patients most frequently reported allergies to cow's milk, hen's eggs, and peanuts [19]. According to a different research, patients most frequently identified grains, beans, bananas, and citrus as allergens [20]. Children under the age of 16 are frequently allergic to brinjal, prawns, bananas, spinach, and eggs[21].

Because various groups have distinct eating habits, genetic histories, and environmental factors, the disparity in prevalence should be expected.

Although the main self-reported food antigens were egg, banana, and other foods, fewer people who reported having a food allergy to these items were sIgE positive. Even while there was a low overall incidence of allergy to these foods, other allergens including tomato, orange, and chicken exhibited a greater correlation between reported food allergy and sIgE positive.

This is similar to a study by **Cherian *et al.*** [18] in which they used skin prick testing (SPT) for diagnosis of food allergy, they reported that less than half of those who reported food allergies to banana and other fruits exhibited SPT positive, despite the fact that these items were the most often self-identified antigens. However, there was a greater correlation between reported food allergy and SPT positive for other allergens such hen's egg, mutton, and peanut.

In our study, children with food allergies had a greater percentage of uncontrolled asthma, whereas children without food allergies had a higher percentage of managed asthma. This agrees with the conclusions of a number of research [18, 19, 22].

Our study revealed a connection between food allergy and moderate to severe chronic asthma, and children who didn't have food allergy mostly had mild asthma. This was similar to the findings of other studies [18,23].

This was in line with research results that divided the children into atopic and non-atopic groups. The atopic group consisted of all kids with elevated total IgE levels above the ULN for their age and/or positive sIgE results against at least one food or respiratory allergen above EAST class 1. The non-atopic group includes kids with normal total IgE levels, negative sIgE against tested allergens (0.35 kU/L EAST class 0), and no past allergy diagnosis or symptoms. They categorised all of the investigated children into three groups based on the asthma symptoms between exacerbations: mild, moderate, and moderate to severe chronic asthma. Statistically speaking, the majority of children with moderate to severe chronic asthma are also atopic ($p = 0.076$). In addition, children with atopic sensitization are more likely than children without it (21.1%) to develop uncontrolled asthma (56%) [24].

From our study, we also found that children who had food allergy had greater number of exacerbations and hospitalizations and children who didn't have food allergy had less number of exacerbations and hospitalizations. This was similar to a study which concluded that food allergies particularly in children with numerous food allergies, are linked to higher asthma morbidity, greater use of medical resources, and impaired lung function [16]. This was comparable to **Wang *et al.*** [23] study, which found that children with food allergy sensitization were more likely to be hospitalised for asthma and required more steroid medication. In contrast, research indicated that food sensitization did not correlate with the amount of asthma episodes experienced during the previous 12 months. This conclusion may be related to the unique relationship between each allergen and ageing [24].

CONCLUSION

Children who had food allergy had greater number of exacerbations and hospitalizations. Patients with asthma should be evaluated for food allergies, since they are a risk factor for asthma aggravation.

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