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Research article

Prevalence of common food allergies in Erbil Province, Kurdistan Region of Iraq

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Abstract: *Background:* Nowadays food allergy is the public health problem worldwide and prevalence of food allergy was increased that causes morbidity, there is no prevalence study to determine and reported most of the food allergen in Erbil City. *Aims:* To determine the prevalence of most common food allergy in Erbil City, and determination of intensity of allergic response among allergic patients against 36 identified food allergens items. *Methods:* A total number of 170 patients with suspected of food allergy were checked in the present study. The study was carried out for patients who visited the private clinical sectors in between (2018–2020), in Erbil Province, Kurdistan Region of Iraq. Determination of specific IgE (s-IgE) antibody was examined for suspected patients using "Food Iraq1" kit (Catalog no: DP 3436-1601-1 E, IVD-approved, and CE-certified EUROLINE immunoblot), contains strip for 36 different allergens. *Results:* The present study illustrated that the food allergy prevalence (measured by specific IgE concentration). The rate of occurrence of food allergy is 10% among males and 12.35% among females. Furthermore, data also revealed that allergy prevalence was 12.35% among individuals aged 13–30 and 10% among those 31–52 years. Seafood mix (13.15%), grain mix (9.21%) and soybean (6.57%) in both male and female patients are the highest allergic response to food allergens often reported among these products respectively with different percentages. The most susceptible food allergens are the combination of fish (12.76%), chicken (7.44%), garlic and sesame (5.31%). Seafood mix, chicken and grain mix showed the highest incidence of food allergies respectively, with regard to aged groups. *Conclusions:* Based on the results in present study, we conclude that, the prevalence of food allergy was differing in between males and females in different age groups. Our study reached to that,

there are no association between food allergens in males and age group of 13–30 years, but in other hand the association between food allergens in females and age group 31–52 years observed.

Keywords: food allergy; specific IgE; food allergy profile; food allergens; allergic patients; Erbil

1. Introduction

Clemens von Pirquet originally defined the term allergy as meaning the increased capacity of the body to react to a foreign substance. Today the term allergy means oversensitivity to a foreign substance that is normally harmless [1]. A major safety concern is food allergy [2]. Food allergy affects many millions of peoples and is responsible for substantial morbidity and reduced quality of life in patients, families and communities [3]. To date, the focus of the adult food allergy examination has been on a limited number of specific allergens [4]. In recent decades, it is generally accepted that the prevalence of food allergy has increased, especially in westernized countries [5].

The incidence of food allergies is increasing globally [6]. Recent studies show that in the Middle East Region, allergic diseases are growing strongly [7]. The prevalence of clinically identified food allergy ranges widely from 1% to 13% [8]. Food allergy (FA) prevalence varies in different countries, as estimates are influenced by several factors; such as age, race, dietary intake frequency, and cooking method [9]. Food allergy, which now affects up to 8% of children and 5% of adults in Westernized countries, has become a public health priority for developing therapies for this potentially life-threatening condition [10].

Food allergies are caused to exposure to certain life-threatening antigens by IgE- or cell-mediated humoral immune response. Such allergies are one of the main food safety issues in developed countries, affecting 1–10 percent of the global population, with a higher incidence in children [11]. Immunoglobulin E (IgE)-mediated food allergy is a leading cause of anaphylaxis, and so it is important to refer to an allergist for prompt and effective diagnosis and care [12]. Type I hypersensitivity responses caused by the cross-linking of IgE attached to the surface of mast cells and basophils underlie adverse food allergy reactions [13]. Important evidence indicates the key roles that mast cells, IgE and TH2 cytokines play in mediating food allergy [14]. Despite the vast number of foods that trigger immunoglobulin E (IgE)-mediated reactions, most prevalence studies have concentrated on the most common allergenic foods, i.e. cow's milk, hen's egg, peanut, tree nut, wheat, soy, fish and shellfish [15].

2. Materials and methods

2.1. Sample collection

A total of 170 blood samples were collected from patients suffering from allergy from an unknown source. All serum samples were subjected for determination of the presence of food allergy by varieties of foods. They visited the private clinical sectors of Erbil Province, Kurdistan Region, Iraq between 2018 to 2020. All blood samples collected inside the (10 mL) gel tube, it contains clotting activators, after clotting, centrifuged them for 15 min at 5000 round per minute (RPM).

Blood serums have been subjected to food allergy analysis regarding the manufactures instructions of the test. Blood samples were sorted in the different aged groups (13–30 and 31–52 years) and also classifying them regarding to the genders in males and females.

2.2. Detection food allergens IgE test

Clarifications of food allergies can carry out by using various food allergy profiles. Human IgE antibodies against the most frequent food allergens in serum, can determine semi-quantitatively or qualitatively based on the test system. Country-specific food allergy profiles are available which have been developed with about regional eating habits. The EUROLINE test kit provides semi-quantitative in vitro determination of allergen-specific (sIgE) in serum, contributing to the diagnosis of allergies. The test is multipara meter assay containing optimized combinations of relevant allergens, enabling the analysis of sIgE against these different allergens in one test. In this study, we used the country-specific food allergy profile "Food Iraq 1" (Catalog no: DP 3436-160-1 E, IVD-approved, and CE-certified EUROLINE immunoblot) test kit contains a test strip with 36 different allergens. All serum samples have been subjected for determinations of food allergies according to the manufacturer's instructions. Briefly, test strips coated with 36 food allergens: egg white (f1), egg yolk (f75), cow's milk (f2), nBos d8-casein (f78), wheat flour (f4), rye flour (f5), rice (f9), grain mix 2 (fs13), sesame (f10), peanut (f13), soybean (f14), hazelnut (f17), almond (f20), pistachio (f144), walnut (f256), gluten (f79), strawberry (f44), apple (f49), blue grape (f50), kiwi (f84), banana (f92), mango (f93), peach (f95), cherry (f97), honeydew melon (f87), citrus mix 2 (fs32), tomato (f25), potato (f35), bell pepper (f46), garlic (f47), celery (f85), eggplant (f262), chicken (f83), meat mix 5 (fs28), shrimp/prawn (f24) and seafood mix 3 (fs12). In addition to food allergens, strip coated with a cross-reactive carbohydrate determinant (CCD) and an indicator band. Test strips are first moistened with 1.0 mL of working strength universal buffer for 5 min, then aspirate off all liquid. Directly incubated with 400 μL of undiluted patient serum to bind s-IgE antibodies if present. If samples contain specific antibodies of class IgE, they will bind to the allergens coated on the strip. Subsequently, the bound s-IgE antibodies were detected using an enzyme-linked anti-human IgE catalyzing a color reaction. After stopping the reaction by using deionized or distilled water, place the incubated test strip onto the adhesive foil of the green work protocol (created in the EUROLINE scan program) using a pair of tweezers. The position of the test strips can be corrected while they are wet. As soon as all test strips have been placed onto the protocol, they should be pressed hard using filter paper and left to air dry. The drying process should take place without any direct light, in a room as dark as possible. After they have dried, the test strip will be stuck to the adhesive foil. Incubated strips that are still moist show a background coloring that disappears when they are completely dry. Therefore the evaluation of the strips only takes place after strips have completely dried. Class of antibodies can be classified into the following types depending on the concentration range and their explanation (Table 1).

Table 1. Class of antibodies with concentration range and explanations.

Class	Concentration (Ku/I)	Explanation
0	<0.35	No specific antibodies detected
1	0.35 ≤ sIgE < 0.7	Very weak antibody detection
2	0.7 ≤ sIgE < 3.5	Weak antibody detection
3	3.5 ≤ sIgE < 17.5	Definite antibody detection
4	17.5 ≤ sIgE < 50	Strong antibody detection
5	50 ≤ sIgE < 100	Very high antibody titer
6	≥100	Very high antibody titer

2.3. Ethics approval of research

Patients' rights and ethic approval statement explaining: Ethical approval for this research has not been obtained from the institutional review board or committee because all blood samples have been collected from a private clinical diagnostic laboratory, which officially has been recognized by the ministry of health Kurdistan Regional government of Iraq. Ministry of health instructions for Ethical criteria and patient's rights mandatory should take into consideration at all diagnostic laboratories in the Kurdistan Region of Iraq. Contentment for blood drawing orally earned from all patients after proceeding of all ethical instructions. Patients' and clients' information (name, age, and gender) electronically submitted to the lab database.

2.4. Statistical analysis

The chi-square was applied to examine the relationship between the prevalence of food allergy and the types of antibodies detection in allergic patients from different genders and aged groups. P-values <0.05 were considered to be statistically significant.

3. Results

The present study illustrated that the food allergy prevalence (measured by specific IgE concentration) in males is 10% and 12.35% in females. Food allergy prevalence was 12.35% among individuals age 13–30 years and 10% among 31–52 years .Table 2 clarifying the prevalence of food allergy in between different aged groups with male and female.

Table 2. Distribution of positive and negative food allergy according to ages and gender.

		N (%) positive	N (%) negative	Total (%)
Age groups (years)	13–30	21 (12.35)	55 (32.35)	76 (44.70)
	31–52	17 (10)	77 (45.29)	94 (55.29)
	Total	38 (22.35)	132 (77.64)	170 (100)
Gender	Male	17 (10)	77 (45.29)	94 (55.29)
	Female	21 (12.35)	55 (32.35)	76 (44.70)
	Total	38 (22.35)	132 (77.64)	170 (100)

Prevalence of positive results for 36 food allergens items in all 170 screened samples illustrated in Table 3, regarding to aged groups and genders.

Table 3. Prevalence of positive food allergy in all 170 screened samples according to gender and aged groups.

Food allergy	Number of screened		Positive food allergy		Number of screened		Positive food allergy	
	Male	Female	Male	Female	13–30 years	31–52 years	13–30 years	31–52 years
Egg white	76	94	4 (5.26)	2 (2.12)	76	94	4 (5.26)	2 (2.12)
Egg yolk	76	94	2 (2.63)	2 (2.12)	76	94	3 (3.94)	1 (1.06)
Cow's milk	76	94	1 (1.31)	2 (2.12)	76	94	2 (2.63)	1 (1.06)
nBos d8-casein	76	94	1 (1.31)	2 (2.12)	76	94	2 (2.63)	1 (1.06)
Wheat flour	76	94	2 (2.63)	2 (2.12)	76	94	2 (2.63)	2 (2.12)
Rye flour	76	94	2 (2.63)	3 (3.19)	76	94	1 (1.31)	4 (4.25)
Rice (f9)	76	94	3 (3.94)	3 (3.19)	76	94	3 (3.94)	3 (3.19)
Grain mix	76	94	7 (9.21)	4 (4.25)	76	94	5 (6.57)	6 (6.38)
Sesame	76	94	5 (6.57)	5 (5.31)	76	94	4 (5.26)	6 (6.38)
Soybean	76	94	5 (6.57)	3 (3.19)	76	94	6 (7.89)	2 (2.12)
Gluten	76	94	1 (1.31)	2 (2.12)	76	94	1 (1.31)	2 (2.12)
Hazelnut	76	94	3 (3.94)	0 (0)	76	94	2 (2.63)	1 (1.06)
Almond	76	94	2 (2.63)	3 (3.19)	76	94	4 (5.26)	1 (1.06)
Walnut	76	94	2 (2.63)	2 (2.12)	76	94	3 (3.94)	3 (3.19)
Pistachio	76	94	3 (3.94)	3 (3.19)	76	94	4 (5.26)	2 (2.12)
Peanut	76	94	3 (3.94)	4 (4.25)	76	94	4 (5.26)	3 (3.19)
Strawberry	76	94	2 (2.63)	2 (2.12)	76	94	1 (1.31)	3 (3.19)
Apple	76	94	2 (2.63)	4 (4.25)	76	94	5 (6.57)	1 (1.06)
Blue grape	76	94	1 (1.31)	0 (0)	76	94	1 (1.31)	0 (0)
Kiwi	76	94	4 (5.26)	2 (2.12)	76	94	1 (1.31)	5 (5.31)
Banana	76	94	2 (2.63)	0 (0)	76	94	2 (2.63)	0 (0)
Mango	76	94	1 (1.31)	3 (3.19)	76	94	3 (3.94)	1 (1.06)
Peach	76	94	2 (2.63)	4 (4.25)	76	94	4 (5.26)	2 (2.12)
Cherry	76	94	1 (1.31)	3 (3.19)	76	94	4 (5.26)	0 (0)
Honeydew melon	76	94	1 (1.31)	1 (1.06)	76	94	2 (2.63)	0 (0)
Citrus mix	76	94	2 (2.63)	1 (1.06)	76	94	1 (1.31)	2 (2.12)
Bell pepper	76	94	2 (2.63)	1 (1.06)	76	94	1 (1.31)	2 (2.12)
Eggplant	76	94	2 (2.63)	1 (1.06)	76	94	1 (1.31)	2 (2.12)
Tomato	76	94	2 (2.63)	2 (2.12)	76	94	2 (2.63)	2 (2.12)
Potato	76	94	3 (3.94)	2 (2.12)	76	94	3 (3.94)	2 (2.12)
Garlic	76	94	3 (3.94)	5 (5.31)	76	94	4 (5.26)	4 (4.25)
Celery	76	94	3 (3.94)	0 (0)	76	94	2 (2.63)	1 (1.06)
Chicken	76	94	4 (5.26)	7 (7.44)	76	94	5 (6.57)	6 (6.38)
Meat mix	76	94	1 (1.31)	2 (2.12)	76	94	1 (1.31)	2 (2.12)
Shrimp/prawn	76	94	3 (3.94)	4 (4.25)	76	94	2 (2.63)	5 (5.31)
Seafood mix	76	94	10 (13.15)	12 (12.76)	76	94	11 (14.47)	11 (11.70)

Prevalence percentage for all allergens items have been checked in all positive cases, regarding to the aged groups and gender (Table 4).

Table 4. Prevalence (%) of food allergens in all 38 allergic patients according to aged groups and gender.

Item number	Food allergy	Age groups		Gender	
		13–30	31–52	Male	Female
1	Egg white	4 (19.04)	2 (11.76)	4 (23.52)	2 (9.52)
2	Egg yolk	3 (14.28)	1 (5.88)	2 (11.76)	2 (9.52)
3	Cow's milk	2 (9.52)	1 (5.88)	1 (5.88)	2 (9.52)
4	nBos d8-casein	2 (9.52)	1 (5.88)	1 (5.88)	2 (9.52)
5	Wheat flour	2 (9.52)	2 (11.76)	2 (11.76)	2 (9.52)
6	Rye flour	1 (4.76)	4 (23.52)	2 (11.76)	3 (14.28)
7	Rice (f9)	3 (14.28)	3 (17.64)	3 (17.64)	3 (14.28)
8	Grain mix	5 (23.80)	6 (35.29)	7 (41.17)	4 (19.04)
9	Sesame	4 (19.04)	6 (35.29)	5 (29.41)	5 (23.80)
10	Soybean	6 (28.57)	2 (11.76)	5 (29.41)	3 (14.28)
11	Gluten	1 (4.76)	2 (11.76)	1 (5.88)	2 (9.52)
12	Hazelnut	2 (9.52)	1 (5.88)	3 (17.64)	0 (0)
13	Almond	4 (19.04)	1 (5.88)	2 (11.76)	3 (14.28)
14	Walnut	3 (14.28)	3 (17.64)	2 (11.76)	2 (9.52)
15	Pistachio	4 (19.04)	2 (11.76)	3 (17.64)	3 (14.28)
16	Peanut	4 (19.04)	3 (17.64)	3 (17.64)	4 (19.04)
17	Strawberry	1 (4.76)	3 (17.64)	2 (11.76)	2 (9.52)
18	Apple	5 (23.80)	1 (5.88)	2 (11.76)	4 (19.04)
19	Blue grape	1 (4.76)	0 (0)	1 (5.88)	0 (0)
20	Kiwi	1 (4.76)	5 (29.41)	4 (23.52)	2 (9.52)
21	Banana	2 (9.52)	0 (0)	2 (11.76)	0 (0)
22	Mango	3 (14.28)	1 (5.88)	1 (5.88)	3 (14.28)
23	Peach	4 (19.04)	2 (11.76)	2 (11.76)	4 (19.04)
24	Cherry	4 (19.04)	0 (0)	1 (5.88)	3 (14.28)
25	Honeydew melon	2 (9.52)	0 (0)	1 (5.88)	1 (4.76)
26	Citrus mix	1 (4.76)	2 (11.76)	2 (11.76)	1 (4.76)
27	Bell pepper	1 (4.76)	2 (11.76)	2 (11.76)	1 (4.76)
28	Eggplant	1 (4.76)	2 (11.76)	2 (11.76)	1 (4.76)
29	Tomato	2 (9.52)	2 (11.76)	2 (11.76)	2 (9.52)
30	Potato	3 (14.28)	2 (11.76)	3 (17.64)	2 (9.52)
31	Garlic	4 (19.04)	4 (23.52)	3 (17.64)	5 (23.80)
32	Celery	2 (9.52)	1 (5.88)	3 (17.64)	0 (0)
33	Chicken	5 (23.80)	6 (35.29)	4 (23.52)	7 (33.3)
34	Meat mix	1 (4.76)	2 (11.76)	1 (5.88)	2 (9.52)
35	Shrimp/prawn	2 (9.52)	5 (29.41)	3 (17.64)	4 (19.04)
36	Seafood mix	11 (52.38)	11 (64.70)	10 (58.82)	12 (57.14)
P value		0.08	0.0006	0.14	0.002

Allergic response class and response strength to all food allergen products have been tested in all positive cases. The prevalence percentage of food allergen products with class and severity of allergic reaction is shown in Table 5.

Table 5. Prevalence (%) of food allergens with class and intensity of antibodies detection in all 38 allergic patients.

Number	Food allergen	No specific antibodie detected (class 0)		Very weak antibody detection (class 1)		Weak antibody detection (class 2)		Definite antibody detection (class 3)		Strong antibody detection (class 4)		Very high antibody titer (class 5)		Total	
		N	%	N	%	N	%	N	%	N	%	N	%	N	%
1	Egg white	32	84.21	1	2.63	2	5.26	2	5.26	0	0	1	2.63	38	100
2	Egg yolk	34	89.47	3	7.89	0	0	0	0	0	0	1	2.63	38	100
3	Cow's milk	35	92.10	2	5.26	1	2.63	0	0	0	0	0	0	38	100
4	nBos d8-casein	35	92.10	2	5.26	1	2.63	0	0	0	0	0	0	38	100
5	Wheat flour	34	89.47	1	2.63	2	5.26	3	7.89	0	0	0	0	38	100
6	Rye flour	33	86.84	4	10.52	1	2.63	0	0	0	0	0	0	38	100
7	Rice	32	84.21	3	7.89	2	5.26	1	2.63	0	0	0	0	38	100
8	Grain mix	27	71.05	6	15.78	4	10.52	1	2.63	0	0	0	0	38	100
9	Sesame	28	73.68	6	15.78	2	5.26	2	5.26	0	0	0	0	38	100
10	Soybean	30	78.94	3	7.89	3	7.89	2	5.26	0	0	0	0	38	100
11	Gluten	35	92.10	3	7.89	0	0	0	0	0	0	0	0	38	100
12	Hazelnut	35	92.10	2	5.26	1	2.63	0	0	0	0	0	0	38	100
13	Almond	33	86.84	1	2.63	2	5.26	2	5.26	0	0	0	0	38	100
14	Walnut	32	84.21	4	10.52	2	5.26	0	0	0	0	0	0	38	100
15	Pistachio	32	84.21	2	5.26	2	5.26	2	5.26	0	0	0	0	38	100
16	Peanut	31	81.57	5	13.15	1	2.63	1	2.63	0	0	0	0	38	100
17	Strawberry	34	89.47	1	2.63	2	5.26	1	2.63	0	0	0	0	38	100
18	Apple	32	84.21	2	5.26	2	5.26	1	2.63	1	2.63	0	0	38	100
19	Blue grape	37	97.36	0	0	1	2.63	0	0	0	0	0	0	38	100
20	Kiwi	32	84.21	4	10.52	2	5.26	0	0	0	0	0	0	38	100
21	Banana	36	94.73	2	2.63	0	0	0	0	0	0	0	0	38	100
22	Mango	34	89.47	3	7.89	1	2.63	0	0	0	0	0	0	38	100
23	Peach	32	84.21	2	5.26	2	5.26	1	2.63	1	2.63	0	0	38	100
24	Cherry	34	84.21	1	2.63	2	5.26	0	0	1	2.63	0	0	38	100
25	Honeydew melon	36	94.73	1	2.63	1	2.63	0	0	0	0	0	0	38	100
26	Citrus mix	35	92.10	2	5.26	1	2.63	0	0	0	0	0	0	38	100
27	Bell pepper	35	92.10	2	5.26	1	2.63	0	0	0	0	0	0	38	100
28	Eggplant	35	92.10	2	5.26	1	2.63	0	0	0	0	0	0	38	100
29	Tomato	34	84.21	3	7.89	1	2.63	0	0	0	0	0	0	38	100
30	Potato	33	86.84	2	5.26	2	5.26	1	2.63	0	0	0	0	38	100
31	Garlic	30	78.94	2	5.26	4	10.52	1	2.63	1	2.63	0	0	38	100
32	Celery	35	92.10	0	0	3	7.89	0	0	0	0	0	0	38	100
33	Chicken	27	71.05	1	7.89	4	10.52	1	2.63	3	7.89	2	0	38	100
34	Meat mix	35	92.10	2	5.26	0	0	1	2.63	0	0	0	0	38	100
35	Shrimp/prawn	31	81.57	3	7.89	1	2.63	3	7.89	0	0	0	0	38	100
36	Seafood mix	16	42.10	4	10.52	5	13.15	10	26.31	2	5.26	1	2.63	38	100
P value		0.9		0.7		0.7		0.00001		0.006		0.1		-	-

4. Discussion

This research was carried out to determine the prevalence of food allergy in the Erbil Province Kurdistan Region of Iraq. We were unable to find any published data about prevalence food allergy in Erbil. Total 94 males (55.29%) and 76 females (44.70%) were studied and their ages range were in between 13 to 52 years old and mean of SD 32.57 ± 11.36 years. In the Middle East, studies about food allergy prevalence are scarce. A recent study done in the United Arab Emirates showed that the most common food allergens were seafood and nuts [16]. Another study showed that the highest frequency of food specific IgE is to hazelnuts and peanuts, with a marked increase in reactions to hazelnut [17].

Most sensitivities to food allergens in males observed in these food items respectively, seafood: 10 (13.15%), grain mix: 7 (9.21%), sesame and soybean: 5 (6.57%) and followed by chicken, kiwi, and egg white: 4 (5.26%). But in females most sensitivity to food allergens were observed in seafood: 12 (12.76%), chicken: 7 (7.44%), garlic and sesame: 5 (5.31%) respectively. Also, negative results observed for allergic response among females for each one of the following items: almond, blue grape, banana, and celery. Among the two aged groups, seafood was the most prevalent food allergen: 11 (14.47%) in both aged groups respectively (Table 2). The study proved that the eight most common food allergens are eggs, milk, peanuts, tree nuts, soy, wheat, crustacean shellfish and fish, all of them are frequently consumed in the US [18].

Prevalence of food allergy in asthmatic children under 18 years of age had significant association with gender, birth weight, history of other allergies, family history of allergy, type of coexistent allergy and age of initiation of symptoms, age of introduction of complementary feeding, consumption of cow milk before one year of age and also duration of breast feeding [19]. The prevalence of food allergy among adolescent age group has been confirmed to be comparatively low in Turkey. Peanuts and tree nuts were determined to be the most common causes of IgE-mediated food allergy [20].

Recent findings are informing changes to population health guidelines in developed countries, which have the potential to halt or reverse the increase in food allergy prevalence. By contrast, food allergy in the developing world remains understudied [21]. There were no statistically significant differences in median age, sex, family history of allergy, or history of allergic diseases and food reactions [22]. We separated the food allergen in allergic patients in too many classes: egg, milk, grain/cereal, nut, fruits, vegetables/green and meats/seafood. Among these classes, the most sensitive response in allergic patients observed to seafood which has a higher percentage: 22 (57.89%), then chicken: 11 (28.94%), shrimp/prawn 7: (18.42%) and meat mix: 3 (7.89%) respectively. Among fruit classes, the apple with 6 (15.78%) was more prevalence in allergic patients, as well as peanuts with 7 (18.42%) showed the greatest sensitivity in allergic patients rather than other nuts. Cereals in grain mix 2 with 11 (28.94%) are more recorded allergen among grains. Cow's milk with 3 (7.89%) and egg white with 6 (15.78%) were the most common allergens in milk and in egg groups (Table 3).

There are differences among allergic patients for types of food allergen according to genders and aged groups. The highest percentage of food allergens were in seafood mix (contains codfish, shrimp/prawn, blue mussel, tuna, salmon): 10 (58.82%), grain mix (contains wheat flour, oat flour, corn, sesame, buckwheat flour): 7 (41.17%), sesame and soybean: 5 (29.41%) in male groups. While in female group, the most food allergens were seafood mix, chicken, sesame, and garlic. Also statistically there is a significant relationship between food allergens in females and the p-value

was 0.002, on the other hand statistically there are no significant relations for food allergens in males groups and the p-value was 0.14. Based on our results, in female group no positive results observed for the these items, hazelnut, garlic, and banana: 0 (0%) but in contrast for male group the was 3 (17.64%) for garlic and hazelnut respectively and 0 (0%) to the banana. There are many differences in the prevalence of food allergens in allergic patients based on the aged groups, for instance in allergic patients which their age were in between (31–52 years), no allergic responses have been detected against these items banana, cherry and honeydew melon. But some of these items mentioned above, give positive results 2 (9.52%), 4 (19.04%) and 2 (9.52%) respectively, in allergic patients which their ages range from (13–30 years). There are statically differences between these two groups, the p-value was 0.08 in 13–30 years which statically not significant, however, the p-value was 0.0006 in 31–52 years which statically significant (Table 4).

Allergy with banana has been identified (0.04% to 1.2%) in different studies all over the world. Rarely, anaphylaxis has been reported with banana, oral-cutaneous allergy with it mostly observed. Symptoms of systemic reactions such as skin involvement, hypotension, angioedema, respiratory arrest have been reported in patients with anaphylaxis [23]. Betv 2-specific IgE antibodies have been shown to recognize profilins in apple, banana, carrot, celery, cherry, hazelnut, pear, pineapple, potato and tomato. Patients with birch pollen allergy who exhibit IgE reactivity to birch-related allergens in foods frequently ignore clinical symptoms when eating certain foods [24]. In the absence of a cure for food allergy, prevalence will increase steadily even if incidence remains stable. If incidence also increases, then the rates of increase in prevalence will likely accelerate exponentially [25]. In a meta-analysis of 51 studies, self-reported allergy to milk, egg, peanut and seafood ranged from 3% to 35% [26].

In the serum of the majority of food allergy patients, specific IgE antibodies against nuts (f13, f17), soybean (f14), cows' milk (f2) and especially casein (f78) were dominant and reached to class (3–6), but the most often diagnosed allergic response was caused by potato (f35) (antibodies in 2–4 classes) [27]. Of all the different reactions induced by food allergens, the most frequent are hypersensitivity mediated by specific immunoglobulins E (IgE). In vitro biosensing of specific IgE levels is an alternative approach to invasive risky in vivo tests for diagnosing food allergy in humans [28]. Network analysis identified most associations between Early epitope-specific IgE with either early epitope-specific (IgEG4) or early epitope-specific (IgEIgD), indicating that IgE-secreting plasma cells could originate from either sequential isotype switch from antigen-experienced intermediate isotypes or directly from the IgD+ B cells [29].

The classes of antibodies detection vary among 36 different food allergens: no specific antibodies detected, very weak antibody detection, weak antibody detection, definite antibody detection strong antibody detection, very high antibody titer. The highest frequency of very high antibody titer was detected only in egg white, egg yolk, and seafood mix (2.63%). Also, the p-value was 0.1 and statistically was not significant. Out of 36 food allergens, only in 6 of them strong antibody has been detected. The highest rate of strong antibody has been found in chicken (7.89%) rather than 5 remained food allergens. Statistically, there was a strong and significant relationship observed between food allergen and classes of antibody detection, the p-value was 0.006. Very weak antibody detection was observed in most food allergen. No allergic reactions recorded for only blue grape among all other allergens. Rye flour, grain mix, sesame, walnut, peanut, kiwi, shrimp/prawn, and seafood mix were showed the highest frequency of very weak antibodies and statistically not significant was observed, the p-value was 0.7. Also for most of the food allergens, weak antibodies were seen except for egg yolk, gluten, blue grape, banana, and meat mix, as well as there no

relationship between food allergens and antibodies detection with class 2 and the value was 0.7. Definite antibodies were detected in certain food allergens and the p-value was 0.00001. The association between allergic patients was statistically strong with a food allergen. Among the 36 allergic foods, a larger number of antibodies are found in the seafood mix (Table 5).

5. Conclusions

Our work represents the first prevalence and detection study for the 36 food allergens in different genders and aged groups in Erbil province, among allergic patients. The highest prevalence of food allergy observed in females in comparison with the male, as well as the highest frequency of food allergy seen among the 13–30 years allergic patients in comparison with 31–52 years.

Conflict of interests

All authors declare no conflicts of interest in this paper.

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