

Food Allergies in Our Latex Allergic Patients

Lateks Allerjik Hastalarımızda Görülen Besin Allerjileri

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ABSTRACT Objective: Food allergies are common in adults as well as in childhood. We aimed to screen food allergies in our latex allergic patients. **Material and Methods:** The study was conducted between September 2012 and July 2013 at the Ege University Faculty of Medicine, Division of Allergy and Clinical Immunology. In 32 patients; the diagnosis was confirmed by latex-specific IgE analysis and/or nasal provocation test and/or latex skin prick test. The patients were tested for allergy to latex cross-reactive foods, and prick test was performed with aeroallergens and food-specific IgE analyse was conducted. All of patient's sera were tested for CCD; rk202 (Pineapple bromelain specific IgE), latex and birch profilin (Hev b 8; latex profilin; rk221, rt216; birch profilin specific IgE), and LTP-specific IgE (rf420; Pru p3 specific IgE). This study was approved by Ege University Faculty of Medicine and written consents were received from all patients. **Results:** In 38% of the patients (12/32), foods prick tests were negative and in 62% of the patients (20/32), these were positive. In patients, food-specific IgE was detected in 31% (10/32). Food allergy rate was found to be 44% based on the history and it was rate rose to 62% based on prick tests. 3 of 18 isolated latex allergic patients had food-specific IgE positivity. In 10 of 18 patients, positivity was determined in prick tests with foods. In only 3 individuals, specific IgE with rk202, rf420, rt216 and rk221 were positive. In 14 patients (44%), aeroallergens sensitivities were detected. Foods specific IgE positivity was found in 5 out of 14 patients. The food prick test was positive in 10 out of 14 patients. **Conclusion:** The rate of food allergies in latex allergies was 62% in food prick tests and 31% in food-specific IgE tests. Food-specific IgE positivity was more prevalent in isolated latex allergics, but there was no difference in food prick tests between combined pollen and latex allergic and isolated latex allergies. As a result, there is a need for further studies in which double-blind nutritional provocation tests with a larger sample size are supplemented.

Keywords: Latex allergy; food allergy; cross reactivity

ÖZET Amaç: Besin allerjileri çocukluk çağında sık rastlanmakla birlikte erişkinlerde de görülmektedir. Biz de lateks allerjik hastalarımızda besin allerjisini araştırmayı amaçladık. **Gereç ve Yöntemler:** Ege Üniversitesi Tıp Fakültesi İmmünoloji ve Allerji polikliniğine Eylül 2012-Temmuz 2013 arasında başvuran ve deri testleri ve/veya spesifik IgE ve/veya nazal uyarı testleri ile lateks allerjisi saptanmış 32 hasta çalışmaya alındı. Lateksle çapraz reaktif gıda kitleri ile prick ve tazeleri ile de prick to prick testi uygulandı. Gıda spesifik IgE'ler Phadia ImmunoCAP (Pharmacia, Uppsala, Sweden) metodu ile bakıldı. Aeroallergenlerle prick testi yapıldı ve serumlar bromelain (rk202: pineapple bromelain spesifik IgE), lateks ve huş profilin (Hev b 8: latex profilin, rk221, rt216: birch profilin specific IgE), ve LTP-spesifik IgE (rf420: Pru p3 specific IgE) ile test edildi. Ege Üniversitesi Tıp Fakültesi Etik Kurulu'ndan onay alındı. Hastalardan yazılı onam alındı. **Bulgular:** On iki kişide (%38) gıda prick negatif, 20 kişide (%62) ise pozitif saptandı. 10 (%31) kişide gıda spesifik IgE pozitifliği bulundu. Gıda allerjisi oranı öykü temel alınırsa %44, prick alınırsa %62 bulundu. İzole lateks allerjik 18 hastanın 3'ünde lateksle çapraz reaktif gıda spesifik IgE pozitifliği ve 10 hastada da lateksle çapraz-reaktif gıdalarla prick pozitifliği saptandı. Üç bireyde rk202, rf420, rt216 ve rk221 spesifik IgE pozitif bulundu. 14 hastada (%44), lateks yamırsa aeroallergenlerle pozitiflik saptandı. Gıda spesifik IgE pozitifliği 14 hastanın 5'inde, lateksle çapraz reaktif gıda prick pozitifliği ise 14 hastanın 10'unda tespit edildi. **Sonuç:** Lateks allerjiklerde besin allerjisi oranı gıda prick testlerde, %62 gıda spesifik IgE testlerinde %31 bulundu. Lateks spesifik IgE pozitif hastalarda gıda spesifik IgE pozitifliği daha fazla idi. İzole lateks allerjiklerde gıda spesifik IgE pozitifliği daha fazla görülürken, gıda prick testlerinde, kombine polen ve lateks allerjik olanlarla izole lateks allerjikler arasında bir fark saptanmadı. Sonuç olarak bu konuda örneklem büyüklüğü daha geniş çift kör besin provakasyon testlerinin de ek olarak yapıldığı çalışmalara ihtiyaç vardır.

Anahtar Kelimeler: Lateks allerjisi; besin allerjisi; çapraz reaktivite

Food allergies are common in adults as well as in childhood. Latex is a substance frequently encountered in daily life. Latex allergy can cause a spectrum of clinical signs ranging from contact dermatitis, allergic rhinitis, asthma to anaphylaxis.^{1,2} Latex is produced by the lectin cells of the rubber tree named *Hevea brasiliensis*.³ The natural latex is processed to add many chemicals into it and turn into a very durable, flexible material. Latex is frequently used in many medical devices and daily life.⁴ Today, 14 latex antigens capable of producing specific IgE have been produced with recombinant DNA technology. These proteins are numbered 1-14 by the World Health Organization's recommendation according to the number and weight of amino acids they contain. Differential diagnosis can be made by the detection of these antigens. For example, Hev b 1 and b 3 are found in the spina bifida, Hev b 2,5,7 is cross-reacted with the food, Hev b 1,3,4,6 is detected only in the latex allergy.^{5,6} Most of the identified latex allergens (Hev b 1-13) are herbal protective shell proteins.⁷

Hev b 8 is a latex profilin. Profilin is a group of panallergens commonly found in plants.⁸ Profilin is a protein that is present in all eukaryotic cells and is responsible for cross-reactivity between pollen, latex, and plant foods.⁹ Profilin (Hev b 8) is for the cross-reaction between ragweed, wormwood, birch tree, phleum pratense, timothy and rye grass and latex.¹⁰ It is also responsible for cross-reactivation with fruits such as kiwi and avocado.⁵ Pollen or vegetable allergies are present in all latex allergics with profilin-specific IgE positive. In some patients with pollen or vegetable allergies, latex prick and specific IgE may be positive, but the clinic of latex allergy is absent and provocation tests are negative.¹¹ The patient is sensitized with pollen by the airways and exhibits an allergic reaction to food antigen with a structural similarity to the pollen. Pollen food syndrome usually presents with pruritus and swelling of the mouth and throat during or just after ingestion of fresh, uncooked fruits and vegetables. Latex fruit syndrome is another cross-reactivity syndrome. It is the association of latex allergy and allergy to plant foods, which affects up to 50% of latex-allergic patients.¹²

Hev b12, a latex allergen, is also a Lipid Transfer Protein (LTP). LTPs are panallergens that are potentially responsible for cross-reactions between plants (fruit, nuts, grains, latex and pollen).⁷ Cross Reactive Carbohydrate Determinant (CCD) is found predominantly in plants and invertebrates. In in vitro tests, false positive IgE antibodies were detected against many plant allergens, including latex, and their CCDs, as well as against invertebrates such as bee and hornet, cockroach, mite and shellfish.^{13,14} Food allergies found in latex allergic patients are also important in clinic of latex allergy. Food allergic people may also be susceptible to latex. In some studies, IgE-mediated reactions to a wide variety of foodstuffs, especially fruits, are seen in 20-60% of latex allergic patients. Nearly half of these people have had serious allergic reactions, including anaphylaxis to food. This association is linked to the immunological cross-reaction between latex proteins and food proteins. The main responsible fruits are chestnut, avocado and banana.¹⁵ Oral allergy syndrome (OAS) is observed in food allergic patients. OAS includes general itching, urticaria, angioedema (AE), nausea, vomiting, dyspnea or anaphylactic findings. It should also be considered in latex susceptible individuals in this regard.¹⁶ OAS is a mild allergic reactions that frequently affecting only the oral mucosa. It starts with oral irritation, straining in the throat, swelling of the lips and then proceeding to systemic symptoms. In 1988, Ortolani and colleagues described OAS following fruit and vegetable intake and described the relationship between allergic rhinitis and pollen susceptibility. The pollen fruit allergy relation was frequently referred to as OAS.¹⁰ The foods that were most frequently associated with OAS were fruits (68.5%), vegetables (22.0%) and seafood (19.3%). Pollen-food syndrome describes a clinic developed due to cross reactivity between pollen, raw fruits, vegetables and spices.¹⁰ It is also referred to as "pollen-related food allergy" because of the cross reactivity between herbal foods such as hazelnut, apple, peach and cherry and birch pollen.¹⁷ Food allergies associated with latex allergy are as follows:

Association or prevalence of latex plant and food allergy:¹⁸

1. High:
Banana, Avocado, Chestnut, Kiwi
2. Medium:
Apple, Carrot, Celery, Papaya, Potato, Tomato, Melon
3. Low or unidentifiable:
Pepper, Plum, Coconut, Cherry, Nut, Sunflower seed, Pineapple, Walnut, Citrus, Strawberry, Soybean, Coconut, Figs, Peanut, Peas, Grape, Buckwheat, Castor, Pear, Mango, Sweet Pepper, Peach, Rye, Cayenne Bean, Apricot, Dill, Lychee, Passion, Thyme, Pumpkin, Nectarine, Sage, Trabzon date.

MATERIAL AND METHODS

The study was conducted between September 2012 and July 2013 at the Ege University Faculty of Medicine, Department of Internal Medicine, Division of Allergy and Clinical Immunology. Thirty-two patients with latex allergy were included in the study. Their age ranges were between 23-50 years. In the latex allergy group; the diagnosis was confirmed by latex-specific IgE analysis and/or nasal provocation test and/or latex skin prick test.

Skin Prick Test (SPT): SPTs were performed with a standardised prick test needle (Stallerpoint). SPTs were performed with latex and commercially available common aeroallergens (grass, weed, tree pollen, house dust mites, moulds, animal dander and foods; ALK-Abello, Madrid, Spain). Latex SPT material contained 500 g/ml latex protein. Physiological saline was used as a negative control, and histamine (10 mg/ml) was used as a positive control. SPT results were assessed after 20 min. The presence of an induration with a diameter at least 3 mm greater than that of the negative control with associated erythema was considered positive.

Serological Analysis: We used the ImmunoCAP, currently marketed as the Phadia ImmunoCAP (Pharmacia, Uppsala, Sweden), because it is the most widely employed and reliable method.¹⁹

For the latex and food specific IgE analysis, values higher than 0.35 kU/l were considered positive. The results were graded on a 6-point scale as recommended by the manufacturer.

Nasal Provocation Test (NPT): The 4th vial (ALK-Abello) produced for latex-specific sublingual immunotherapy was used as the allergen source. One millilitre of this vial contains 500 g/ml latex protein, 0.5 ml of glycerol, 3 mg of phenol and 9 mg of sodium chloride. The diluent portion of this vial containing no latex protein was used as a placebo. The diluent was produced at Ege University Pharmacology Laboratories. The allergen was diluted 10, 100, 1,000 and 10,000 times, corresponding to 50, 5, 0.5 and 0.05 g/ml latex protein, respectively, and the placebo was diluted 10 times with physiological saline prior to the NPT. The placebo and incremental doses of allergen were applied to all groups using nasal applicators spraying 0.1 ml per application. Symptoms observed during the NPT were scored as follows: sneezing, 0-2 times= 0 points, 3-4 times= 1 point, 65 times= 3 points; itching, 1 point each for itching of the nose, ear or palate, for a total of 3 possible points; rhinorrhoea, none= 0 points, mild= 1 point, moderate = 2 points, severe= 3 points; nasal block, none = 0 points, mild= 1 point, moderate= 2 points, severe= 3 points; eye symptoms (watering of the eyes, itching, redness), 1 point each, but with only 1 point possible. The test was discontinued if the symptom score reached 5 or reached 4 with a decrease in the nasal flow rate of 40% of the basal value.²⁰

The patients were also tested for allergy to latex cross-reactive food such as potato, tomato, carrot, banana, kiwi, apple, peach, celery, chestnut, melon and pineapple. Both skin prick test with commercial extract and prick to prick testing with fresh samples were performed. In all patients, prick test performed with aeroallergens. Food-specific IgE analyses were conducted for every patient. The all patient's sera were tested for CCD; rk202 (Pineapple bromelain specific IgE), latex and birch profilin (Hev b 8; latex profilin-rk221, rt216, birch profilin specific IgE), and LTP-specific IgE (rf420; Pru p3 specific IgE).

This study was approved by Ege University Faculty of Medicine and written consents were received from all patients.

Patients' age ranges were between 23-50 years, 28 of whom were female and 4 were male. In the latex-allergic patients, latex-associated clinical symptoms were evaluated and the frequency of rhinitis was found to be 90%, asthma 34%, conjunctivitis 53%, dermatitis 84.4% and a history of anaphylaxis was 3.1% (Table 1). There was no correlation between any of the symptoms and latex-IgE levels ($p>0.05$).

The presence of latex allergy was confirmed by Pharmacia Latex ELISA Immuncap (Pharmacia Upjohn, Upsala Sweden) and/or latex prick test (Alk Abello Madrid, Spain) and/or nasal provocation tests in these patients. Latex-specific IgE was found to be positive in 27 patients and negative in 5 of the patients, whereas the latex skin prick test was positive in 30 patients and negative in only 2 of patients. Table 2 shows SPT and specific IgE results of patients in latex allergic patient with positive latex-specific IgE.

TABLE 1: Distribution of the patients with latex- allergy according to age, sex, occupation and symptoms.

Patients Number n=32				Conjunctivitis n=17	Asthma n=11	Rhinitis n=29	Angioedema n=9	Dermatitis n=27
Age (year)	Sex	Job						
1	40	M	Lab. technician	-	-	+	-	+
2	29	M	Lab. technician	+	-	+	-	+
3	26	F	Nurse	-	-	+	-	+
4	36	F	Lab. technician	+	-	+	-	+
5	38	F	Nurse	-	-	+	-	+
6	43	F	Nurse	-	+	+	-	+
7	28	F	Nurse	+	-	+	-	-
8	35	F	Nurse	+	-	+	-	+
9	31	F	Nurse	-	+	+	-	+
10	23	M	Dentist	-	-	+	-	+
11	30	F	Nurse	-	+	+	-	+
12	29	F	Nurse	-	-	+	+	+
13	50	F	Teacher	-	-	+	+	+
14	32	F	Nurse	+	-	+	+	+
15	39	M	Surgeon	-	-	+	+	+
16	32	F	Nurse	+	-	+	-	-
17	33	F	Nurse	+	+	-	-	+
18	38	F	Nurse	+	-	+	-	+
19	34	F	Hospital staff	+	+	+	+	+
20	36	F	Dentist	+	+	+	+	+
21	30	F	House wife	-	-	-	+	+
22	43	F	Nurse	+	-	+	-	-
23	36	F	Nurse	+	-	+	-	+
24	35	F	Hospital staff	+	-	+	-	+
25	25	F	Nurse	+	+	-	+	-
26	25	F	Nurse	-	-	+	-	+
27	28	F	Nurse	-	+	+	-	+
28	47	F	Nurse	+	-	+	-	+
29	31	F	Nurse	-	-	+	-	+
30	24	F	Student	-	+	+	-	-
31	46	F	Nurse	+	+	+	-	+
32	29	F	Surgeon	+	+	+	+	+

TABLE 2: SPT and specific IgE results of patients in latex allergic patient with positive latex-specific IgE.

Patients n=27	Age (year)	Sex	Aeroallergen	Aeroallergen	Pollen	Latex	Latex profilin	Birch Profilin	Pineapple	Pru p3
			sensitisation (SPT)	sensitisation without pollen (SPT)	sensitisation (SPT)	specific IgE (k82)	specific IgE (Hev b8) rk221	specific IgE rt216	specific IgE (CCD) rk202	specific IgE (LTP) rf420
1	40	M	+	+	-	4+	-	-	-	-
2	29	M	-	-	-	5+	-	-	-	-
3	26	F	+	-	+	3+	-	-	-	-
4	36	F	-	-	-	2+	-	-	-	-
5	38	F	-	-	-	2+	-	-	-	-
6	43	F	+	+	+	4+	-	-	-	-
7	28	F	+	-	+	4+	-	-	-	-
8	35	F	+	-	+	2+	-	-	-	-
9	31	F	+	+	-	5+	-	-	-	-
10	23	M	-	-	-	4+	-	-	-	-
11	30	F	-	-	-	4+	2+	1+	-	-
12	29	F	+	+	+	4+	-	-	-	-
13	50	F	+	+	-	3+	-	-	-	-
14	32	F	-	-	-	2+	-	-	-	-
15	39	M	-	-	-	3+	-	-	-	-
16	32	F	+	-	+	2+	-	-	-	-
17	33	F	+	+	-	2+	-	-	2+	-
18	38	F	-	-	-	4+	-	-	-	-
19	34	F	-	-	-	2+	-	-	-	-
20	36	F	+	-	+	3+	-	-	-	-
21	30	F	-	-	-	3+	-	-	-	-
22	43	F	-	-	-	6+	-	-	1+	2+
23	36	F	+	+	+	3+	-	-	-	-
24	35	F	+	-	+	2+	-	-	-	-
25	25	F	+	+	-	4+	-	-	-	-
26	25	F	+	-	+	1+	-	-	-	-
27	28	F	+	-	+	4+	-	-	-	-

In latex allergic patients, prick and specific IgE positivity was found in 27 (84%) and latex specific IgE negative in 5 (16%) of the patients, whereas the latex skin prick test was positive in 30 (94%) patients and negative in only 2 (6%) of patients. There was only latex prick positivity in 3 (9%) patients and latex prick and specific IgE negativity in 2 (6%) patients. These 2 people were diagnosed with NPT. The history was positive for all patients.

In 18 latex allergic patients (56%), isolated latex allergy was detected as prick and/or latex specific IgE and/or NPT, while in the remaining 14 patients (44%) there was additionally one or more allergen susceptibility in a prick test with aeroal-

lergens. It was against house dust in three patients (22%), house dust in addition to grasses pollen in 2 patients (14%) and in addition to alternaria prick positivity in 1 patient (7%). In the remaining 8 patients (57%), the prick test was positive with tree and / or grasses pollen.

All patients were undergone to skin prick tests using Alk Abello commercial kits and prick-to-prick tests with fresh foods being cross-reactive with latex. In addition, Pharmacia Elisa Immuncap (Pharmacia Upjohn, Upsala Sweden) was administered with fx1, fx2, fx5, fx9, fx20, fx28 and fx32 in patients. Kit contents are listed in Table 3.

TABLE 3: ELISA Immuncap commercial food kits.

Pharmacia Elisa Immuncap Commercial Food Kits	
fx1:	peanuts, nuts, almonds, brazil walnuts, coconut
fx2:	fish, shrimp, mussels, tuna, salmon,
fx5:	milk, fish, egg whites, soy beans, peanuts, wheat
fx9:	almond, kiwi, melon, banana, grape
fx20:	wheat, rye, barley, rice
fx28:	sesame, shrimp, beef, kiwi
fx32:	lentils, peas, beans, goat horn

TABLE 4: Evaluation of immuncap measurements.

kU/L 0.35-0.70 at lower limit +
0.71-3.5 moderate positive ++
3.51-17.5 high positive +++
17.51-50 very high positive ++++
51-100 very high positive +++++
> 100 very high positive ++++++
<0.1 not significant, negative, 0.1-0.34 clinical significance? negative, cut-off 0.35

Values higher than 0.35 kU/l were considered positive.

The results were rated on a 6-point scale recommended by the manufacturer (Table 4).

STATISTICS

The Pearson Chi-Square test was used to compare the positivity of test recombinants with latex cross-reactive food kits and fresh foods, aeroallergens and food-specific IgE tests. It was also used to compare latex-specific IgE positivity with aeroallergens to prick and food-specific IgE tests. Frequency analysis was performed for symptoms seen in patient with latex allergies. Nonparametric Correlations were used to evaluate nasal provocation tests.

RESULTS

In our study, all 32 latex allergic patients were undergone to prick with fresh foods and commercial kits of foods being cross-reactive with latex. Twelve patients were (38%) negative and 20 patients (62%) were found to be positive for one or more foods. These positives respectively were 31%

chestnut (10), 28% kiwi and banana (18), 22% potatoes (7), 19% peach (6), 13% tomatoes (4), 9%, celery and pineapple (6), 3% carrots and apples (2) (Table 5).

Chestnut, kiwi and banana were the most common food allergies in our study in accordance with literature information.²¹

The food allergy history in patients with latex allergy is shown in Table 6.

In latex allergic patients, one or more food-specific IgE was detected in 31% (10/32) in food-specific IgE tests. Food-specific IgE tests were negative in 69% of the patients (22/32) (Table 7).

In our study, the positivity level 1 and 2 detected by ELISA immuncap with food specific IgE were positive. The prick and/or prick-to-prick tests were positive for one or more foods with cross-reactive latex in all patients but one of them was excluded (Px:20).

There was no correlation between latex-specific IgE levels and the levels of fx1, fx2, fx5, fx9, fx20, fx28, or fx32-specific IgE detected(chi-square: p>0.05).

In 10 patients (31%), there was no history of food allergies, although the prick test was positive with one or more foods with latex cross reactive foods. Four patients (13%) had a history of food allergies but prick tests were negative. Ten patients (31%) had a positive history and positive prick test. Eight patients (25%), had both negative history and prick tests (Table 8).

History, prick and or/prick to prick test and food specific IgE positivity were seen in 1 individual. History and food specific IgE positivity was found in 1 individual, only specific IgE positivity in 8 individuals (Table 9).

DISCUSSION

Latex allergy is a rare disease in society. In the general population, it was 0.2%, while it was reported between 10-40% in health workers. The rate of food allergies in latex allergies is between 20-60%. Food allergy studies done in adults are less than children.

TABLE 5: Shows skin prick tests made with commercial kits and fresh forms of latex cross-reactive foods in latex allergic patients.

Prick and Prick to Prick Tests with Cross Reactive Foods in Latex Allergic Patients											
Prick Test Foods	1+		2+		3+		4+		5+		Total* Number of patients n %
	Commercial	Fresh	Commercial	Fresh	Commercial	Fresh	Commercial	Fresh	Commercial	Fresh	
Kiwi	2	1	2	5	-	3	1	-	-	-	9/32, 28%
Melon	-	1	-	1	-	-	-	-	-	-	2/32, 6%
Carrot	-	-	-	1	-	-	-	-	-	-	1/32, 3%
Celery	-	-	-	2	-	-	-	-	-	-	2/32, 6%
Tomato	-	2	-	2	-	-	-	-	-	-	4/32, 13%
Chestnut	1	3	-	4	-	-	1	2	-	-	10/32, 31%
Potato	1	5	1	-	-	-	-	-	-	-	7/32, 22%
Peach	-	1	-	4	-	1	-	-	-	-	6/32, 19%
Apple	-	-	1	-	-	-	-	-	-	-	1/32, 3%
Pear	2	1	-	1	-	-	-	-	-	-	3/32, 9%
Peanut	-	-	-	-	-	-	-	-	-	-	0, 0%
Pineapple	-	1	-	1	-	-	-	-	-	-	2/32, 6%
Banana	1	3	1	3	1	-	1	1	1	-	9/32, 28%

* The total number is higher than normal due to patients with positive prick test with different foods. In the case of a positive test for the same person in the skin tests of the same foods with commercial and fresh forms, the total was calculated as one person.

There was no clinical history of food allergies in 56% of our latex allergic patients (18/32). The remaining 44% (14/32) of the patients had OAS, AE, dyspnea, rhinitis, urticaria, anaphylaxis, and combinations of them in clinical history (Table 1).

In 10 patients (31%), there was no history of food allergies, although the prick and or prick to prick test was positive with one or more commercial or fresh foods with latex cross reactive foods. Ten patients (31%) had a positive history and positive prick or prick to prick test.

In our study, the positivity level 1 and 2 detected by ELISA immunocap with food specific IgE were positive in 10 patients. The prick and /or prick-to-prick tests were positive for one or more foods with cross-reactive latex in 9 patients but one of them was excluded. There was no correlation between latex-specific IgE levels and the levels of fx1, fx2, fx5, fx9, fx20, fx28, or fx32-specific IgE detected.

The all patient's sera were tested for CCD, latex and birch profilin, and LTP-specific IgE. In latex allergic patients. In three patients, rf420 (LTP) and rt216 (birch profilin)-specific IgE positivity were present. There were latex specific IgE positivity in these patients.

TABLE 6: Foods allergy in history with latex allergic patients.

Patients Number	Foods Allergic in the history
6	Tomatoes, chestnuts
7	Banana, curry
8	Chestnut, banana, peach, apricot
11	Almond, cherry, anchovy
16	Fish, olives, chocolate, fruit cake
17	Chestnut, banana
18	Peach, chestnut
20	Tomatoes, grapes
22	Kiwi, pineapple
23	Eggplant, plum
24	Bananas, apples, chestnuts, dates, pomegranates, nuts, walnuts, peppers, loquat, fermented foods
28	Banana
30	Pear
31	Tomatoes, apricots, peaches, plums, nuts

In one patient, only rk202 (bromelain)-specific IgE was positive, whereas in another patient both rf420 (LTP) and rk202 (bromelain)-specific IgE positivity was found. The third patient was tested positive for rt216 (birch profilin)-specific IgE.

There was one patient found with rk221 latex profilin-specific IgE positivity, fx5 and fx20-spe-

TABLE 7: Food-specific IgE positivity in latex allergic patients.

Patient	Latex Prick	Latex Sp. IgE	Fx1	Fx2	Fx5	Fx9	Fx20	Fx28	Fx32	Aeroallergen Sensitivity
P 1	2+	4+	2+	2+	1+	-	2+	2+	-	+
P 3	3+	5+	-	-	-	1+	1+	-	-	+
P 4	2+	3+	-	-	-	-	2+	-	-	-
P 9	5+	4+	-	-	-	1+	-	1+	-	+
P11	4+	2+	-	1+	1+	2+	2+	1+	-	-
P13	4+	4+	-	-	1+	1+	1+	-	-	+
P20	1+	2+	2+	-	1+	1+	2+	1+	1+	-
P21	-	-	-	2+	-	-	-	-	-	-
P24	4+	3+	-	-	-	-	2+	-	-	-
P26	4+	6+	-	2+	-	1+	1+	2+	1+	+

Px: shows the patient number (Table 1).

cific IgE positivity, as well as positive skin test results for kiwi and banana commercial preparations and fresh celery, chestnut, tomato and pineapple, and fx5 and fx20-specific IgE positivity. This is probably due to the profilin found in vegetables.

Only one patient had rt216 (birch pollen)-specific IgE; however, there was no relationship between the presence of this IgE and skin prick tests for grass, tree and weed pollens. However, birch pollen-specific IgE positivity was found together with positive skin prick tests for kiwi and banana commercial preparations and fresh melon, tomato, chestnut and pineapple and fx20-specific IgE.

In one patient both rf420 (LTP) and rk202 (bromelain)-specific IgE positivity were found. There was no relationship between rf420-specific IgE (peach LTP) and skin prick tests for grass, tree and weed pollens, but peach LTP-specific IgE positivity was found together with fx2, fx20, fx28, fx32-specific IgE.

In two patients, rk202 (bromelain)-specific IgE positivity was found. Rk202 (pineapple bromelain)-specific IgE was found neither with skin prick tests specific for pollens nor with prick to prick test for fresh foods that are cross-reactive with latex. Bromelain-specific IgE was found positive with fx1, fx2, fx5, fx20, fx28, fx32-specific IgE.

Combined Bromelain and profilin sensitivity; isolated latex allergy was not detected in our patients.

TABLE 8: Skin prick tests with latex cross-reactive foods in latex allergic patients.

Number of Patients	Skin tests performed with latex Cross-reactive foods	
	History	prick/prick to prick
10 (31%)	-	+
8 (25%)	-	-
4 (13%)	+	-
10 (31%)	+	+

TABLE 9: Skin prick and foods specific IgE tests with latex cross-reactive foods in latex allergic patients.

Patients Number	Skin tests and foods specific IgE test performed with latex Cross-reactive foods			
	History	prick/prick to prick	Foods specific IgE	Aeroallergen Sensitivity
P1	-	-	+	+
P 3	-	-	+	+
P 4	-	-	+	-
P 9	-	-	+	+
P 11	+	-	+	-
P 13	-	-	+	+
P 20	+	+	+	-
P 21	-	-	+	-
P 24	-	-	+	-
P 26	-	-	+	+

3 of 18 isolated latex allergic patients had with latex cross reactive food-specific IgE positivity. In 10 of 18 of this latex allergic patients, positivity was determined in prick and /or prick to prick tests with commercial kits and/or fresh samples of latex cross-reactive foods.

TABLE 10: Food allergy rate in latex allergic patients.¹⁴

References	Country	Number of latex allergic patients	Presence of food allergy history / Prick to prick test (PPT) /
			Skin prick test (SPT)/ food specific IgE
Blanco et al. 1994	Spain	25	52% (history+ PPT)
Makinen Killjunen 1994	Finland	31	52% (history), 35% (PPT)
Lavaud et al. 1995	France	17	58% (history + SPT)
Dellbourg et al. 1996	France	16	50% (history), 36% (SPT)
Bezhold et al. 1996	Canada	47	36% (history + SPT), 70% SPT
Blanco 1997	Spain	50	46% (history + PPT)
Brehler et al. 1997	Germany	136	43% (history), 69% (specific IgE), 14% (history + specific IgE)
Kim and Hussain 1999	USA	137	21% (history)
Our study 2013*	Turkey	32	44% (history), 31% (history + SPT), 31% (specific IgE)

* Our study has been added to the table for comparison.

In 14 patients (44%), latex sensitivities as well as grasses, weeds, tree pollen and house dust mites and mold fungi positivity were detected. In only 1 (7%) of these patients, the weed pollen mixture was found positive and in 13 (93%) of the patients positive for prick (grasses, tree, at least two from the weed or mold and/or house dust) against more than one group of aeroallergens. In these patients, tests with recombinant proteins (birch and latex profilin), lipid transfer protein (Pru p3; peach LTP) and bromelain (anasas CCD) were negative. Foods specific IgE positivity was found in 5 out of 14 patients. The prick test was positive with one or more foods with latex cross reactive foods in 10 out of 14 patients .

Latex prick and latex specific IgE were negative, but latex with nasal provocation test positive in 1 out of 2 patients with recombinants tests and aero-allergenic panel was negative. In the other patient, there was an addition of akkazayağı and house dust positivity. However, tests with recombinants were negative in this patient.

In 1999, Kim and Hussain identified a food allergy history in 21% of 137 latex allergic patients.²¹ In our study, this ratio was found to be 44% based on the history. Unlike, we did prick and prick to prick test with food in these patients. If only the prick test was taken into account, the food allergy rate rose to 62%. The positivity of the history and prick test was seen in 31% of the cases (Table 7). In 1994 and 1997, Blanco et al., were found 52% and

46% food allergies, respectively, by using history and prick to prick tests in latex allergic patients.²² 58% rate of food allergies were found in latex allergic patients by using history and prick test by Lavaud et al.²³

In 1994, Blanco et al. detected susceptibility in 50% of 25 latex allergic patients with one or more fruits (including chestnut avocado, banana, even kiwi and papaya).²² In 1997; Blanco et al. showed 46% food allergies in a study including 50 latex allergic patients.²² Sensitivity to bananas and avocados was detected in 28% of those patients. This was followed by kiwi with 24% chestnut and 20%. In addition, 20% of the patients had it to 3 or more foods.²²

In 1994, Machine Killjunen et al. detected symptoms in 52% of 31 latex allergic patients after banana intake.²⁴ The prick to prick test with banana was found to be positive in 35% of those patients.²⁴ In 1995, Lavaud et al. detected sensitivity to avocado and/or banana in 58% out of 17 latex allergic patients.²⁵

In 1996; Delbounge et al. confirmed symptoms in 50% of 16 latex allergic patients after banana intake.²⁶ In 14 patients, performed prick to prick test with banana was positive in 36% of them.²⁶ In 1996; Beezhold et al. found 36% clinical allergy history to at least one of bananas, potatoes and avocado fruits in 47 latex allergic patients in Canada.²⁷ Statisti-

cally, bananas, avocados, potatoes, tomatoes, chestnuts and kiwi were found to be more significant than controls.²⁷ In 1997; Brehler et al. detected allergic reactions after kiwi and banana intake in 42.6% out of 136 latex allergic patients.²⁸

In 1999; Kim and Hussain found 49 suspicious allergic reactions to food in 21 (29%) out of 137 patients.²¹ Suspicious foods not only included bananas, avocados and kiwi, but also shellfish and fish.²¹ Chestnut, kiwi and banana were the most common food allergies in our study, being consistent with the literature information. The rates of food allergies found in latex allergic patients ranged from 46 to 58% in their studies by Blanco et al., 1994 and 1997 and Makinen Killjunen et al., in 1994, Delbourge et al., 1996 and Lavaud et al. 1995.^{22,24-26}

In our study, one or more food-specific IgE was detected in 31% (10/32) individuals in latex allergic patients. In 69% of the patients (22/32), food-specific IgE tests were negative. In a study performed by Brehler et al. in 1997, food-specific IgE was detected in 69% out of 136 patients with latex allergy.²⁸ As a ratio, this is opposite to our study.

In our country, 7 cases with multiple food allergy diagnosed in Konya and started omalizumab treatment were presented by Atayık 5 of the diagnosed cases were male and 2 were female. The mean age was 32.4. House dust in 2 cases, pollen in 3, latex sensitivity in 2 were accompanied by multiple food allergies. In 1 case, there was no positive reaction to inhaled allergens. In general, the reaction to foods in those cases was urticaria and they benefited from Omalizumab. Urticaria was most frequently seen with nuts, peanuts, cereals, eggs, chicken and red meat.²⁹

Ozdemir and Ozguclu evaluated the characteristics of patients with Pollen-Food Allergy Syndrome (PGAS) by using a questionnaire. 254 consecutive patients (mean age 27, 154 female, 100 male) with pollen allergy were included in the study. Those with compatible histories were subjected to prick-to-prick tests with fresh food. Findings were observed in 49 patients (19.3%). Symptoms were limited to oropharynx in 45 patients (91.8%) and systemic symptoms in 4 patients

(8.2%). The most commonly responsible foods were kiwi, peach and tomatoes (19, 17 and 12 patients, respectively). In patients with PGAS, atopic disease history, accompanying asthma, tree pollen susceptibility was found to be higher in the family than in the non-PGAS patients ($p=0.05$). In 16 out of the 49 patients with PGAS, prick-to-prick tests were performed with the food previously, and 10 patients (62.5%) were positive.³⁰

Both studies were made with latex non-allergic patients. the study by Atayık includes 7 case reports. Latex prick positivity was detected incidentally in 2 cases with aeroallergens panel. It is a study with therapeutic purpose and the number of samples is small.

The studies by Ozdemir and Ozguclu were conducted in a questionnaire survey and prick tests were applied with fresh foods to which patients have a history. The most frequently responsible foods were kiwi, peaches and tomatoes. OAS was found in 45 of 49 patients and systemic symptoms were seen in 4 patients. 10 (62.5%) out of sixteen patients had positive results in prick-to-prick test with food in the past.

The purpose of this study is quite different from our work in terms of sample size and content. The basic method is the questionnaire survey and the prick to prick was performed with fresh food in 16 people who attended study.

CONCLUSION

In latex allergic people, latex and food allergies can be seen together. It is important to keep in mind that food allergies may be present in individuals who are known to be latex allergic, or vice versa, and that latex allergies may also accompany food allergy. Chestnut, kiwi and banana were the most common food allergies in our study, being consistent with the literature information.

In our study, the rate of food allergies in latex allergies was 62% in food prick tests and 31% in food-specific IgE tests. Food-specific IgE positivity is found more in latex specific IgE positive patients. Food-specific IgE positivity was more prevalent in

isolated latex allergics, but there was no difference in food prick tests between combined pollen and latex allergic and isolated latex allergics. As a result, there is a need for further studies in which double-blind nutritional provocation tests with a larger sample size are supplemented.

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Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

This study is entirely author's own work and no other author contribution.

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