

Food Sensitization Patterns of Infants with Food-Triggered Atopic Dermatitis

Besin ile Tetiklenen Atopik Dermatitli Bir Yaş Altı Çocukların Besin Duyarlılık Paternleri

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ABSTRACT

Objective: Food allergen sensitization patterns vary among patients with atopic dermatitis in different countries. The aim of this study was to determine the food sensitization patterns of infants with food-triggered atopic dermatitis.

Material and Methods: The study was a retrospective evaluation of atopic dermatitis patients who were followed at the Pediatric Allergy and Immunology Clinic of our hospital. Among these patients, those who had both positive skin prick test and positive serum specific IgE to a food were included in the study. The diagnosis of food sensitization was confirmed upon improvement with an elimination diet

Results: A total of 204(74.5% boys) atopic dermatitis patients less than 1 year of age were found to have food-triggered atopic dermatitis. Median age at diagnosis was 3 months(interquartile range: 1-5.8). When skin prick test and serum specific IgE results were analyzed, we found sensitivity to egg in 85.8%, milk in 35.5%, wheat in 3.9%, walnut in 1.5%, peanut in 2.5%, and fish in 2% of the patients. None of the patients showed sensitivity to soybean.

Conclusion: Our findings indicated that a large portion of our patients were male, egg was the most common food sensitivity, the prevalence of peanut sensitivity was less than other countries and none of the patients had soy sensitivity.

Key Words: Atopic dermatitis, Children, Food sensitization

ÖZ

Amaç: Atopik dermatitli hastaların besin alerjisi duyarlılık paternleri ülkeler arasında arasında değişiklik gösterir. Bu çalışmanın amacı, besin ile tetiklenen atopik dermatitli bir yaş altı çocukların gıda duyarlılık paternlerini belirlemektir.

Gereç ve Yöntemler: Çalışmamızda hastanemiz Çocuk Alerji ve İmmünoloji Kliniğinde takip edilen atopik dermatitli hastalar retrospektif olarak değerlendirildi. Bu hastalar arasında hem pozitif deri prik testi hem de gıdaya spesifik serum IgE pozitifliği olanlar çalışmaya dahil edildi. Besin duyarlılığının tanısı, eliminasyon diyeti ile düzelme olması ile doğrulandı.

Bulgular: İki yüz dört (% 74.5 erkek) 1 yaşından küçük atopik dermatit hastasında besin ile tetiklenen-atopik dermatit olduğu tespit edildi. Tanı sırasındaki ortanca yaş 3 aydı (çeyrekler arası aralık: 1-5.87). Deri prik testi ve serum spesifik



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Contribution of the Authors / Yazarların katkısı: **KULHAS CELİK I:** Constructing the hypothesis or idea of research and/or article, Planning methodology to reach the Conclusions, Organizing, supervising the course of progress and taking the responsibility of the research/study, Taking responsibility in patient follow-up, collection of relevant biological materials, data management and reporting, execution of the experiments, **CIVELEK E:** Constructing the hypothesis or idea of research and/or article, Planning methodology to reach the Conclusions, Organizing, supervising the course of progress and taking the responsibility of the research/study, Taking responsibility in the writing of the whole or important parts of the study. **BUYUKTIRYAKI B:** Constructing the hypothesis or idea of research and/or article, Taking responsibility in patient follow-up, collection of relevant biological materials, data management and reporting, execution of the experiments, **ALABOYUN ES:** Taking responsibility in patient follow-up, collection of relevant biological materials, data management and reporting, execution of the experiments, **GINIS T:** Taking responsibility in patient follow-up, collection of relevant biological materials, data management and reporting, execution of the experiments, **DİBEK MISIRLIOGLU E:** Planning methodology to reach the Conclusions, **TOYRAN M:** Planning methodology to reach the Conclusions, Organizing, supervising the course of progress and taking the responsibility of the research/study, Taking responsibility in the writing of the whole or important parts of the study. **KOCABAS CN:** Constructing the hypothesis or idea of research and/or article, Organizing, supervising the course of progress and taking the responsibility of the research/study, Taking responsibility in the writing of the whole or important parts of the study.

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IgE sonuçları incelendiğinde ;%85.8 oranında yumurta ,%35.5 oranında süt, %3.9 oranında buğday, % 1.5 oranında ceviz, %2.5 oranında fıstık ve %2 oranında balık duyarlılığı tespit edildi. Hiçbir hastada soya duyarlılığı gözlenmedi.

Sonuç: Bulgularımız hastalarımızın büyük bir kısmının erkek olduğunu, yumurtanın en yaygın besin duyarlılığı olduğunu, fıstık duyarlılığının prevalansının diğer ülkelere göre daha az olduğunu ve hiçbir hastamızın soya duyarlılığına sahip olmadığını gösterdi.

Anahtar Sözcükler: Atopik dermatit, Çocuklar, Besin duyarlılığı

INTRODUCTION

Atopic dermatitis (AD) is a chronic, recurrent, pruritic inflammatory skin disorder (1). Studies suggest that AD affects 10% to 30% of children (2-4). Onset of AD occurs in the first 6 months of life in 45%, the first year in 60%, and the first 5 years in 80% of patients (5).

The pathogenesis of AD is complex and multifactorial. It is caused by a combination of genetic predisposition, defects in skin barrier function, and exposure to environmental triggers such as allergens, irritants, and microorganisms. The stratum corneum is dysfunctional in AD due to certain defects. Reduced stratum corneum lipids, defective proteases and antiproteases, and genetic defects in structural proteins such as filaggrin and lorincrin cause increased transepidermal fluid loss through the skin barrier (6). In some children exhibiting early onset, AD develops without IgE-mediated allergic sensitization. Increased skin permeability allows easier penetration of allergens, leading to IgE-mediated sensitization (7, 8).

The prevalence of aeroallergen and food sensitivities, which are particularly common in children with AD, has increased over the last 20 years (9). Previous studies have shown that foods are triggers in approximately 20-30% of patients with moderate to severe AD (7-10).

Over 90% of food allergies in children with AD are to cow's milk, chicken egg, peanut, wheat, soy, nuts, and fish. The most common allergens in infants are cow's milk, chicken egg, peanuts, and soybean (11).

Food allergy in AD patients is diagnosed based on a combination of clinical history, including dietary history (or maternal dietary history if breastfed) and supportive laboratory tests such as specific IgE levels, skin-prick test (SPT), and standardized oral food challenge (OFC) tests. The diagnosis is confirmed upon improvement with an elimination diet (10).

Patterns of sensitization to food allergens in AD patients show regional variation. A multicenter, multinational study of AD revealed large variations between countries in food sensitivity patterns, indicating that results from one country cannot be generalized to other countries (12).

The aim of this study was to determine the food sensitization patterns of infants with food-triggered AD.

MATERIAL and METHODS

Patients

This retrospective chart review included children younger than 1 year of age who were diagnosed with food-triggered AD at the Pediatric Allergy and Immunology Department of the University of Health Sciences, Ankara Pediatric Hematology and Oncology Research and Training Hospital between January 2010 and December 2016. This study was approved by University of Health Sciences, Ankara Child Health and Diseases Hematology Oncology Training and Research Hospital Ethics Committee (Date:05.02.2018, Approval number: 2018/016). The study was conducted in accordance with the principles of the Declaration of Helsinki.

The patients' age, gender, personal and family history of allergic disease, physical examination results, SPT results, food-specific IgE levels, total IgE levels, and eosinophil counts in complete blood count were recorded.

Diagnosis of food-triggered AD:

In our clinic, the Hanifin and Rajka criteria is routinely used for the diagnosis of AD (13) and for the diagnose of food-triggered AD, the suspected food is eliminated from the diet (or from the mother's diet for exclusively breastfed patients) for at least 2 weeks while under optimal skin care. If symptoms regressed, the suspected food is reintroduced to patient's diet (or maternal diet if breastfed). Patients with symptom exacerbation upon exposure and supporting allergy test results (positive results for both SPT and specific IgE tests) are diagnosed with food-triggered AD.

Foods are selected for allergy testing based on clinical history (suspected food-induced allergy symptoms on previous ingestion of the food or maternal dietary history if breastfed) and to the most prevalent food allergies in infants (cow's milk, egg, fish, wheat, soy, and peanut). Patients with positive results for both SPT and specific IgE tests for the suspected food are included in the study; those with only one positive test are excluded.

SPT and Food-specific IgE Analysis:

Epidermal SPTs were performed with using allergen extracts (ALK-Abello, Madrid, Spain) along with a positive control (10 mg/dl of histamine phosphate) and a negative control (0.9% sterile saline). Diameters of the indurations were measured

horizontally and vertically. Indurations with an average diameter at least 3 mm greater than the negative control were considered positive. Skin prick test was performed with house dust mite [Dermatophagoides farina (DF), Dermatophagoides pteronyssinus (DP)], animal and insect derived [cat, dog, cockroach (Blatella germanica)] and mould allergens [aspergillus fumigatus, Cladosporium species (Cladosporium cladospories, Cladosporium herbarum) and Alternaria alternate] for evaluation of indoor allergen sensitivity in our patients

Food allergen-specific IgE antibody measurements were performed using ImmunoCAP (Thermo Fisher Scientific, Uppsala, Sweden) and were considered positive when levels were equal to or greater than 0.35 kU/L.

Statistical Methods:

Statistical analysis Data were examined using the SPSS 22 (IBM Corporation, Armonk, NY. Numbers and percentages are reported for discrete variables and means and standard

deviations for continuous variables. Values are presented as means and standard deviations for data demonstrating a normal distribution and as medians and interquartile ranges (IQR) for data not demonstrating a normal distribution. The χ^2 test was performed to compare nonparametric data,

the Mann-Whitney test for nonnormally distributed data, and the independent t test for normally distributed continuous data. A value of $p < 0.05$ was considered statistically significant.

RESULTS

Seven hundred fifty patients with AD before one year of age were evaluated and 204 (27.2%) of them had at least one food sensitization. A total of 204 (74.5% male) patients with food-triggered AD were included in our study. All patients were diagnosed within the first year of life and the median age at diagnosis was 3 months (interquartile range: 1-5.8 months). Family allergic disease history was present in 11.2% of the

Table I: The characteristics of the study patients.

Age at diagnosis (month)	
Median (IQR)	3 (1-5.8)
Sex, n (%)	
Male	152 (74.5)
Female	52 (25.5)
Time of birth, n (%)	
Term	191(93.6)
Preterm	13(6.4)
Period of only breastfeeding(month)	
Median (IQR)	5 (4-6)
History of allergic disease, n (%)	
Wheezing infant	4(2)
Allergic rhinitis	1(0.5)
Family history of allergic disease, n (%)	23 (11.2)
Allergic rhinitis	12(5.8)
Asthma	5(2.4)
Food allergy	
Egg	1(0.4)
Spice	1(0.4)
Cow's milk	1(0.4)
Atopic dermatitis	2(0.8)
Drug allergy	2(0.8)
Total IgE (IU/ml)	
Median (IQR)	32.9 (12.5-88)
Eosinophil count (mm³)	
Median (IQR)	300 (100-600)
Cow's milk specific IgE (kU/L)	
Median (IQR)	4.38 (1.32-10.8)
Cow's milk prick (mm)	
Mean±SD	5.43±2.16
Min-Max	3-16
Egg white specific IgE(kU/L)	
Median (IQR)	3.69 (1.12-9.94)
Egg white prick (mm)	
Median (IQR)	5 (4-6.5)

Table II: The frequencies of the patients' IgE-mediated reactions.

Skin symptoms, n (%)	
Urticaria	18 (6.6)
Angiodema	22 (8.1)
Maculopapular rash	6 (2.2)
Flushing	74 (27.3)
Itching	29 (10.7)
Respiratory symptoms, n (%)	
Shortness of breath	6 (2.2)
Wheezing	9 (3.4)
Gastrointestinal symptoms, n (%)	
Vomiting	12(4.4)
Anaphylaxis, n (%)	
	13 (4.8)

Table III: The characteristics of the different age groups.

	0-3 month	3-6 month	6-12 month	p
Sex (male) (%)	75.3	74.6	77.5	0.9
Eosinophil count (mm³)	556±734(0-5300)	378±457(0-2500)	283±214(0-900)	0.04
Total IgE (IU/ml)	112±217(4-1632)	144±325(5-2260)	105±120(8-543)	0.067

cases. The characteristics of the patients are shown in Table I.

Egg white [n=175 (85.8%)] was found to be the most common sensitizing food based on clinical history supported with SPT and specific IgE test.

Egg white sensitivity was followed by milk in 36.8% (n=75), wheat in 3.9% (n=8), peanut in 2.5% (n=5) and tree nuts 2.5% (n=5) of the patients; none exhibited soy sensitivity. The food sensitivity results of our patients are presented in Figure 1.

Of 5 patients (2.5%) with tree nut sensitivity, hazelnut (2%) and walnut (1.5%) sensitivities were most common. All patients with tree nut sensitivity had other food sensitivities except a single patient with only walnut sensitivity. These included egg white sensitivity in 3, cow's milk sensitivity in 2, wheat sensitivity in

1, red 2.5% (n=5) sensitivity in 1, peanut sensitivity in 1 of the children.

Of 8 patients among the patients with legume sensitivity, peanut (%2.5) and red lentil (1%) sensitivities were most common. All of those with legume sensitivity also had other food sensitivities; no patients exhibited legume sensitivity alone. These included egg white sensitivity in 8, cow's milk sensitivity in 4, wheat sensitivity in 3 of the children.

Household aeroallergen sensitivity analysis revealed sensitivity to *Dermatofagoides farinea* in 3 patients (2.2%), *Dermatofagoides pteronyssinus* in 2 patients (1%), and cat in 2 patients (1%). We found that 134 (65.6%) of the patients had 1 food sensitivity, 57(28%) had 2, and 13 (6.4%) had 3 or more food sensitivities (Figure 2).

Sixty six (36.4%) of the 204 patients had history of IgE-mediated reaction, the most common of which was flushing (23.5%). The frequencies of the patients' IgE-mediated reactions are shown in Table II.

Patients were grouped according to their age as less than 3 months (122 patients, 59.8%), 3-6 months (57 patients, 27.9%), and 6-12 months (25 patients, 12.3%). There was no difference in the diversity of food allergen sensitivities between the 3 age groups (Figure 3). Although there were no significant differences between the groups in terms of egg-specific IgE, milk-specific IgE, and total serum IgE levels, there was a significant difference in eosinophil counts (p=0.044). The characteristics of the different age groups are summarized in Table III.

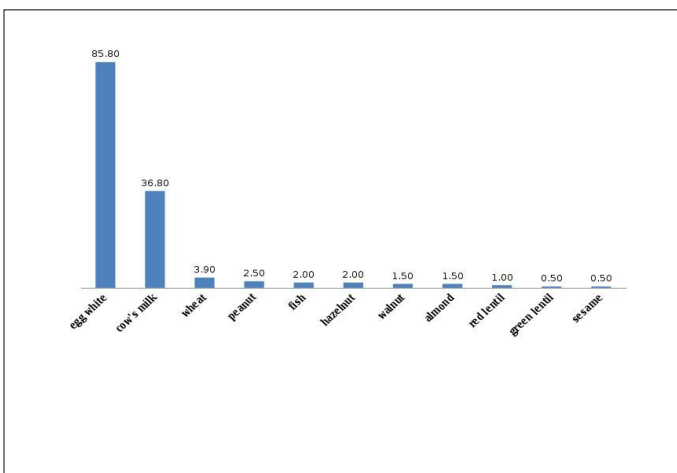


Figure1: The diversity of causative foods of patients

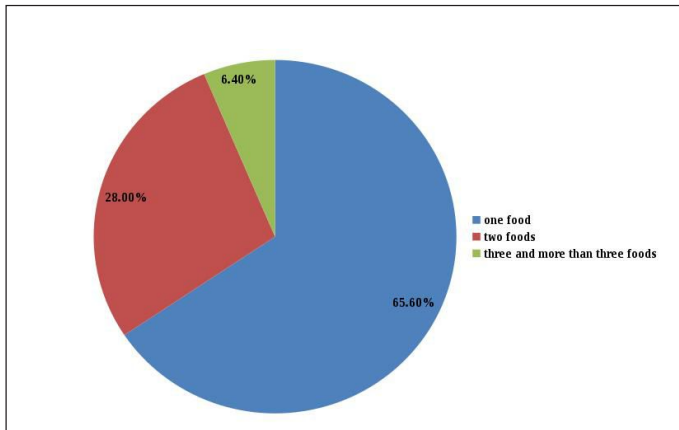


Figure 2: The number of allergic foods of patients.

DISCUSSION

Food sensitivity patterns of AD patients differ between countries (12). The present study aimed to show the food sensitization patterns of infants with food-triggered AD in our clinic. Our findings indicated that a large portion of our patients were male, egg white was the most common food sensitivity, the prevalence of peanut sensitivity was less than other countries and none of the patients had soy sensitivity.

Atherton et al. (14) first reported in 1978 that an egg and milk exclusion diet resulted in eczema regression in 14 of 20 children with AD. The numerous studies conducted on this subject since then have shown that food allergy has a key role in the pathogenesis of AD (15). Recent studies have suggested that early cutaneous exposure to food proteins through a disrupted skin barrier leads to allergic sensitization (16,17). Eggs, milk, wheat, peanuts, nuts, fish, and soy are responsible for more than 90% of food sensitivities in AD patients (18).

Of the 267 patients younger than 1 year of age included in our study, egg white sensitivity had the highest prevalence at 85.8%, followed by milk in 36.8%, wheat in 3.9%, and walnut in 1.5% of the patients. In a study conducted in the USA by Chang et al. (19), milk sensitivity was detected in 57.5%, egg sensitivity in 30.6%, and peanut sensitivity in 13.1% of 183 food-triggered AD patients under 2 years of age (mean age: 1.8 years). Another recent study in the USA by Knox et al. (20) showed that the most common sensitivities in food-triggered AD patients under 2 years of age were peanut (60.7%) and egg (60.7%), followed by milk (37.9%). In South Africa, Mahdavina et al. (21) detected sensitivity to egg in 70.5%, peanut in 41.1%, and milk in 5.8% of a small group of AD patients with food sensitivity (mean age: 2.08 years). In a multinational, multicenter study including AD patients with a mean age of 17.6 months, global evaluation of food sensitivity results showed that 48.6% of the patients exhibited food sensitivity; 41.9% of the patients had egg sensitivity, 27.4% had cow's milk sensitivity, and 24.4% had

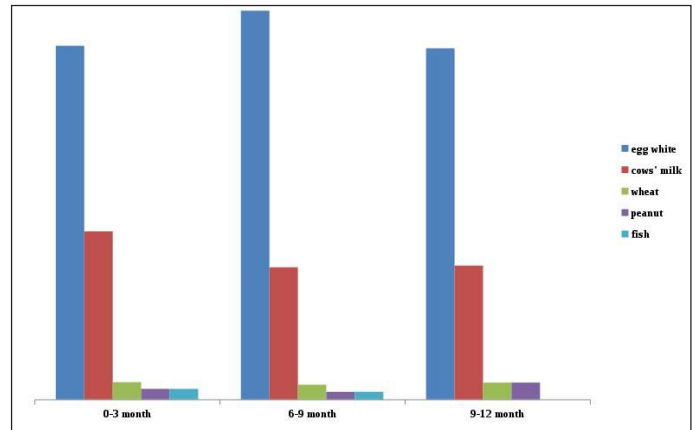


Figure 3: Age-related food allergy patterns of patients.

peanut sensitivity. The same study demonstrated differences in food sensitivity patterns when data from different countries were analyzed separately. While egg sensitivity was the most common in all countries, it was followed by milk sensitivity in some countries (Belgium, Italy, France, Poland, South America) and peanut sensitivity in other countries (Netherlands, Czech Republic, Germany, Australia, UK). The study also demonstrated large differences between countries in frequencies of food and aeroallergen sensitivities; patterns of aeroallergen sensitivity were comparable, whereas patterns of food sensitivity varied internationally (12). Consistent with that study, we also found that egg white sensitivity was most common among the patients in our study. However, the prevalence of peanut sensitivity was 2.5% in our study, considerably less than that reported in other studies. In a study of 23 food-triggered AD patients conducted in our country, Emeksiz et al. (22) found that egg sensitivity was most common (78.2%), followed by sensitivity to milk (52%) and hazelnut (39%), and none of the patients exhibited peanut sensitivity.

Soy sensitivity was not detected in any of our 267 patients. Chang et al. (19) reported soy sensitivity in 21% of their patients. In contrast, Knox et al. (20) did not detect soy sensitivity in their study, consistent with our findings.

Lack et al. (23) showed that the application of peanut oil to inflamed skin could cause sensitization without oral peanut ingestion. Similarly, Fox et al. (24) demonstrated a dose-dependent relationship between household peanut exposure and the development of peanut allergy. These findings indicate that even prior to oral intake, certain foods may lead to the development of food sensitivity and allergy through contact with inflamed skin.

We evaluated a large pediatric patient group. However, there are some limitations of our study. Our study are retrospective study and OFC were not performed in all of our patients. Because, most of our patients (87.7%) were under six months of age and exclusively breastfed.

Overall, the prevalence of egg white sensitivity in our study was somewhat comparable to rates reported in other countries, whereas the prevalence of peanut sensitivity was relatively lower (12,20,21). In addition, we did not detect soy sensitivity in any of our patients. We attribute the lower rates of peanut and soybean sensitivity in our study to have different traditional dietary habits. Soy and peanuts are less commonly consumed in our culture. Because they are not typically found in the household, we believe that children are less likely to be exposed to these foods (especially through epicutaneous exposure) and this influences the food sensitivity patterns of our patients with AD.

REFERENCES:

- Eichenfield LF, Ahluwalia J, Waldman A, Borok J, Jeremy Udkoff J, Boguniewicz M. Current guidelines for the evaluation and management of atopic dermatitis: A comparison of the Joint Task Force Practice Parameter and American Academy of Dermatology guidelines. *J Allergy Clin Immunol* 2017;139:49-S57.
- Beasley R. The International Study of Asthma and Allergies in Childhood (ISAAC) Steering Committee. Worldwide variation in prevalence of symptoms of asthma, allergic rhinoconjunctivitis, and atopic eczema: ISAAC. *Lancet* 1998;351:1225-32.
- Roduit C, Frei R, Loss G, Buchele G, Weber J, Depner M, et al. Development of atopic dermatitis according to age of onset and association with early-life exposures. *J Allergy Clin Immunol* 2012;130:130-136.e5.
- Shaw TE, Currie GP, Koudelka CW, Simpson EL. Eczema prevalence in the United States: data from the 2003 National Survey of Children's Health. *J Invest Dermatol* 2011;131:67-73.
- Kay J, Gawkrödger DJ, Mortimer MJ, Jaron AG. The prevalence of childhood atopic eczema in a general population. *J Am Acad Dermatol* 1994;30:35-9.
- Palmer CN, Irvine AD, Terron-Kwiatkowski A, Zhao Y, Liao H, Lee SP, et al. Common loss-of-function variants of the epidermal barrier protein filaggrin are a major predisposing factor for atopic dermatitis. *Nat Genet* 2006;38:441-6.
- Eigenmann P, Sicherer S, Borkowski T, Cohen B, Sampson H. Prevalence of IgE-mediated food allergy among children with atopic dermatitis. *Pediatrics* 1998;101:E8.
- Eigenmann PC, Calza AM. Diagnosis of IgE-mediated food allergy among Swiss children with atopic dermatitis. *Pediatric Allergy Immunol* 2000;11:95-100.
- Burks AW, James JM, Hiegel A, Wilson G, Wheeler JG, Jones SM, et al. Atopic dermatitis and food hypersensitivity reactions. *J Pediatr* 1998;132-6.
- Forbes LR, Saltzman RW, Spergel JM. Food allergies and atopic dermatitis: differentiating myth from reality. *Pediatr Ann* 2009;38:84-90.
- Bergmann MM, Caubet JC, Boguniewicz M, Eigenmann PA. Evaluation of food allergy in patients with atopic dermatitis. *J Allergy Clin Immunol Pract* 2013;1:22-8.
- de Benedictis FM, Franceschini F, Hill D, Naspitz C, Simons FE, Wahn U, Warner JO, de Longueville M; EPAAC Study Group. The allergic sensitization in infants with atopic eczema from different countries. *Allergy* 2009;64:295-303.
- Hanifin JM, Rajka G. Diagnostic features of atopic dermatitis. *Acta Dermato-Venereologica* 1980; 92:44-7.
- Atherton DJ, Sweel M, Soothill JF, Wells RS, Chilvers CE. A double-blind controlled crossover trial of an antigen-avoidance diet in atopic eczema. *Lancet* 1978;1:401-3.
- Bergmann MM, Caubet JC, Boguniewicz M, Eigenmann PA. Evaluation of food allergy in patients with atopic dermatitis. *J Allergy Clin Immunol Pract* 2013;1:22-8.
- du Toit G, Roberts G, Sayre PH, Bahnson HT, Radulovic S, Santos AF, et al. Randomized trial of peanut consumption in infants at risk for peanut allergy. *N Engl J Med* 2015;372:803-811.
- Perkin MR, Logan K, Tseng A, Raji B, Ayis S, Peacock J, et al. Randomized trial of introduction of allergenic foods in breastfed infants. *N Engl J Med* 2016;374:1733-43.
- Sisherer SH, Sampson HA. Food Hypersensitivity and atopic dermatitis: pathophysiology, epidemiology, diagnosis, and management. *J Allergy Clin Immunol* 1999 ;104:114-22.
- Chang A, Robison RA, Cai M, Singh AM. Natural History of Children with Food Triggered Atopic Dermatitis and Development of Immediate Reactions. *J Allergy Clin Immunol* 2015;2: 229-36.
- Knox SM, Erwin EA, Joy L, Mosser-Goldfarb, Rebecca Scherzer. Sensitization patterns among patients with atopic dermatitis evaluated in a large tertiary care pediatric center. *Ann Allergy Asthma Immunol* 2017; 629-47.
- Mahdavinia M, Rasmussen HE, Engen P, Van den Berg JP, Davis E, Engen K, et al. *Ann Allergy Asthma Immunol* 2017;118:742-3.
- Emeksiz ZS, Cavkaytar O, Aksoy I, Dallar Y, Soyer O. Food Hypersensitivity in Atopic Dermatitis During Infancy: skin Prick Testing for Whom? *Asthma Allergy Immunol* 2017;15:32-7.
- Lack G, Fox D, Northstone K, Golding J. Factors associated with the development of peanut allergy in childhood. *N Engl J Med* 2003;348:977-85.
- Fox AT, Sasieni P, du Toit G, Syed H, Lack G. Household peanut consumption as a risk factor for the development of peanut allergy. *J Allergy Clin Immunol* 2009;123:417-23.