

Research Paper



Investigating Allergies to Cow Milk, Peanut, and Egg in Children and Their Associations With the Severity of Atopic Dermatitis

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ABSTRACT

Objectives: Atopic dermatitis (AD) is a risk factor for children’s onset of food allergy. This study explores the frequency of food allergies among children with AD and their relationship with the severity of the disease.

Methods: This analytical and cross-sectional study was conducted on 48 children under the age of 14 years who were diagnosed with AD. The patients were divided into three groups according to age as follows: Younger than 2 years, between 2 and 7 years, and between 7 and 14 years. Serum immunoglobulin E level of food-specified allergen was measured. Then, the children were categorized into three groups for comparison based on AD severity, food allergy type, and frequency.

Results: The frequency of allergy to egg, peanut, and cow milk was 66.7%, 37.5%, and 18.8%, respectively, in the patients. Boys have more allergies to peanuts (46.2%) than girls (27.3%). Egg allergy is prevalent among both genders (girls 63.6% and boys 69.2%). Allergy to cow milk was higher in the age group under 2 years (23.1%). Half of the children between 7-14 years old had an allergy to peanuts (50%). Over half of the children in all age groups had egg protein allergies. The patients with mild and moderate AD had more allergies (25.0%) to cow milk compared to severe AD patients (6.2%).

Discussion: This study indicated that food allergy is common in patients with AD, and nearly two-thirds of the patients were allergic to one foodstuff. Meanwhile, allergy to eggs was more common among the patients compared to other foodstuffs.

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Introduction

In many countries, children are prone to experiencing food allergies regularly [1]. Atopic dermatitis (AD) is a long-lasting and recurring inflammatory skin condition that typically starts during infancy. It is commonly linked to a family history of allergic diseases and often affects children who have previously experienced other atopic disorders [2, 3]. This condition forms on dry skin and is characterized by intense itching [4]. It is identified by various symptoms, such as severe itching, redness, swelling, the presence of exudate, and flaking [5]. Around 90% of food allergies stem from common items such as cow milk, hen egg, soy, wheat, fish, and peanuts [6].

The majority of food allergies usually develop within the first or second year of a person's life [7]. During the first year of life, the incidence of food allergies is the highest at around 6% to 8%, decreasing gradually as the child enters late childhood [8]. Cow milk and egg are the most commonly cited substances responsible for food allergies and their prevalences are approximately 2.3% and 2.5%, respectively, in Europe [9]. If cow milk is the main source of nutrition for infants after breastfeeding, having a cow milk allergy reduces the quality of life for both children and their caregivers [10]. Eggs are a vital source of nutrients, such as fatty acids, vitamins, and proteins that play a crucial role in child nutrition and promoting brain development [11]. Even small traces of milk, egg, and peanut allergens can trigger allergic reactions in highly sensitive individuals [12], which happen through incidental contacts, such as opening packages, inhaling vapors from cooking, sharing utensils, or kissing someone who has consumed the allergenic food [13].

There is a strong correlation between food allergy and early-onset and severe atopic dermatitis during infancy, as reported in previous studies [14]. However, we have not found any studies examining the association between various food allergies and the severity of atopic dermatitis. As a result, this study explores the incidence of cow milk, egg, and peanut allergy onset among children with atopic dermatitis and its relationship with the severity of the disease.

Materials and Methods

This analytical, cross-sectional study was conducted on 48 children under 14 years of age with a definite diagnosis of atopic dermatitis [15] who were referred to the Allergy and Immunology Clinic in Children Medical Center Hospital from 2021 to 2022. By convenient sam-

pling, all patients were divided into three groups according to age: The first group=patients younger than 2 years (26 patients); second group=patients with the age of 2 to 7 years (14 patients); and third group=patients with the age of 7 to 14 years (8 patients).

To be eligible for the study, the participants were required to meet specific criteria, including a diagnosis of atopic dermatitis, which consisted of eczema in typical areas (such as the face and extensor areas in infants or flexor areas in older children), the presence of itching, and a history of atopic diseases in either the child or their family. However, individuals with underlying diseases, such as Type I and II diabetes, immunodeficiency, skin diseases other than atopic dermatitis, those taking immunosuppressive drugs, having active cancer, thyroid gland diseases, scabies, or individuals who were not willing to participate in the study were excluded from participation. The severity of atopic dermatitis was determined according to the severity scoring of atopic dermatitis index, established by the European task force on atopic dermatitis from 0–100 and divided into five groups (0–19, 20–39, 40–59, 60–79, and 80–100) [16].

All patients included in the study underwent thorough examinations by dermatologists and allergists. The research team also collected each patient's detailed history of potential food allergies. Blood samples were taken from the children, and a trained laboratory technician used the ELISA method with a standardized Euroline Kit to measure specific immunoglobulin E (IgE) levels against various food allergens, such as cow milk protein, egg, and peanut. If the IgE level was above 0.35 U/mL, it was positive. The children were categorized into three groups for comparison based on the severity of atopic dermatitis disease, food allergy type, and frequency.

For quantitative variables, central indices (Mean±SD), and for qualitative variables, frequency, and percentage frequency were calculated, and graphs and statistical tables were used as needed to display the data. Statistical tests were used to compare data distribution and parametric tests, such as the chi-square test and analysis of variance or their non-parametric equivalents. All analysis was done using the SPSS software, version 21, and the level of significance was considered $P < 0.05$ for all statistical tests. Table 1 indicates the study's variables.

Results

A total of 48 children (22 girls and 26 boys) with atopic dermatitis participated in this investigation. The mean age, weight, height, and BMI of the clients are provided

Table 1. Demographic characteristics of the studied population

Variables		Mean±SD/No. (%)
Sex	Male	26(54.2)
	Female	22(45.8)
Mean age (y)		3.28±1.43
<2		26(54.17)
2-7		14(29.17)
7-14		8(16.66)
Mean weight (kg)		16.04±4.73
Mean height (cm)		97.93±15.29
Mean BMI (Kg/m ²)		16.25±1.78
Cow milk allergy		9(18.8)
Egg allergy		32(66.7)
Peanut allergy		18(37.5)

in Table 1. The results indicated that 18.8% of the patients with atopic dermatitis were allergic to cow milk, 66.7% to eggs, and 37.5 % to peanuts. More than half (54.17%) of the patients with AD were younger than 2 years old, 29.17% were between 2-7 years, and 16.66% were between 7-14 years (Table 1).

Allergy to cow milk is not frequent among both genders, while boys have more allergies to peanuts (46.2%) compared to girls (27.3%). Egg allergy is more prevalent among both genders (girls=63.6% and boys=69.2%). However, no significant difference exists between the genders in allergy to cow milk, peanuts, and eggs (Table 2).

As Table 3 shows, allergy to cow milk was higher in the age group under 2 years (23.1%) compared to children aged between 2-7 and 7-14 years (14.3% and 12.5%, respectively). There was no statistically significant correlation between the age distribution of the examined children and sensitivity to cow milk (P=0.88).

Half of the children between 7-14 years old had an allergy to peanuts. The allergy to peanuts in children under 2 years old was 38.5%, and in children aged 2-7 years; it was 28.6%. No significant correlation was observed between allergy to peanuts and the age distribution of the examined children (P=0.6).

Table 2. Determining the relationship between gender and immunologic allergy to cow milk

Variables	No. (%)		P	
	Gender			
	Girl	Boy		
Allergy to cow milk	Having	4(18.2)	5(19.2)	0.61
	Not having	21(80.8)	18(81.8)	
Allergy to peanut	Having	6(27.3)	12(46.2)	0.14
	Not having	16(72.7)	14(53.8)	
Allergy to egg	Having	14(63.6)	18(69.2)	0.45
	Not having	8(36.4)	8(30.8)	

Table 3. Comparing the mean age of the children with or without allergies to cow milk, peanut, and egg

Variables		No. (%)			P*
		Mean Age (y)			
		<2	2-7	7-14	
Allergy to cow milk	Having	6(23.1)	2(14.3)	1(12.5)	0.88
	Not having	20(76.9)	12(85.7)	7(87.5)	
Allergy to peanut	Having	10(38.5)	4(28.6)	4(50)	0.60
	Not having	16(61.5)	10(71.4)	4(50)	
Allergy to egg	Having	14(53.8)	12(85.7)	6(75)	0.11
	Not having	12(46.2)	2(14.3)	2(25)	

More than half of the children in all age groups had an allergy to egg protein. In the age group of 2-7 years, the sensitivity to egg protein was higher (85.7%) compared to other age groups. There was no statistically significant correlation between the age distribution of the examined patients and sensitivity to egg protein ($P=0.11$).

As Table 4 displays, according to disease severity classification, the patients with mild and moderate AD had more allergies (25.0%) to cow milk than severe AD patients (6.2%). All patients with different disease degrees had the same peanut and egg allergy. Furthermore, the results showed no significant difference between allergy to cow milk, peanuts, and eggs and the disease severity.

Discussion

Atopic dermatitis is the most common skin disorder among children in advanced countries, involving 15% to 20% of children [17]. Several studies have shown a

correlation between the diagnosis of food allergy and more severe cases of AD [18, 19], which is opposite to our findings. For instance, one Japanese study found that individuals with atopic dermatitis were more likely to experience allergic rhinitis, bronchial asthma, and food allergy, with these conditions manifesting earlier in life [20]. Furthermore, another study revealed that 30% of patients with atopic dermatitis had additional allergies, such as food allergy, asthma, allergic rhinitis, and hives [21].

Cow milk and egg are the most common antigens involved in IgE-mediated food allergy [22]. Accordingly, in the present study, egg allergy was the most common, and cow milk was the least common one. Inconsistent with these results, a study by Alduraywish et al. [23] found that food allergy is most common in early childhood, and egg is the most common food allergen in children. It is suggested that consuming egg whites early on

Table 4. The relationship between immunologic allergy to cow milk, peanut, and egg with the severity of atopic dermatitis

Variables		No.(%)			P
		Disease Severity			
		Mild	Moderate	Severe	
Allergy to cow milk	Having	4(25.0)	4(25.0)	1(6.2)	0.51
	Not having	12(75.0)	12(75.0)	15(93.8)	
Allergy to peanut	Having	7(43.8)	6(37.5)	5(31.3)	0.24
	Not having	9(56.2)	10(62.5)	11(68.8)	
Allergy to egg	Having	11(68.8)	12(75.0)	9(56.3)	0.15
	Not having	5(31.25)	4(25.0)	7(43.7)	

can help prevent the development of allergies caused by IgE [24]. Similarly, introducing milk into an infant's diet between four to six months old can reduce the likelihood of developing cow milk allergy [25].

In the present study, there was no statistical correlation between the incidence of food allergies and gender in patients with AD, which is in line with the findings of the study by Onsoni et al. [21]. However, in the study of Fouladseresht, notable discrepancies in the occurrence of allergies to the beetle, egg yolk, egg white, and tomato between males and females were reported. Additionally, our research indicates that boys experience a higher frequency of allergies to eggs and peanuts than girls, which agrees with previous findings highlighting gender disparities in allergy prevalence [26].

According to population-based studies, infants with AD are up to six times more likely to develop an allergy to food by the time they reach three months of age compared to infants who do not have AD [27]. Our study showed a greater prevalence of cow milk allergy among children below two years of age, supporting previous research. In contrast, another study demonstrated that introducing milk into the diet between four to six months of age may reduce the occurrence of cow milk allergy [28]. According to Ahanchian et al. [29], food allergies are more prevalent in younger individuals, which aligns with our findings. Our findings displayed that half of the children between 7-14 years of age had an allergy to peanuts; children under 2 years old had 38.5% and children aged 2-7 years had 28.6% allergy. Furthermore, over half of the children in all age groups had egg protein allergies. In this regard, Earlier studies have demonstrated that incorporating solid foods into a child's diet decreases the likelihood of developing a food-related allergy and lowers the risk of developing any allergic condition [30]. Thus, it is suggested that children should consume eggs and peanuts early on to prevent the occurrence of an IgE-mediated allergy [31].

Several prior studies have indicated that having AD, especially in its advanced stage, is linked to a longer duration of milk and egg allergy [32, 33]. In this line, although a statistically significant association was not shown between AD severity and food allergy in our results, the patients with mild and moderate AD had more allergies to cow milk, and all the patients with different disease degrees had the same allergy to peanuts and eggs.

Conclusion

The current study indicates that the rate of allergy to foodstuffs among patients with atopic dermatitis is high, and two-thirds of the patients were allergic to at least one foodstuff. Meanwhile, allergy to eggs was more common among the studied patients. Moreover, there was no statistically significant difference in food allergy prevalence between genders. Food allergy prevalence did not correlate with age distribution or disease severity. Furthermore, we hope that these findings will be useful for designing policies and programs for the prevention and management of atopic dermatitis.

Study limitations

The study had a significant limitation relating to the possibility of memory bias, as parents of children allergic to peanuts may recall more accurately when they introduced peanuts into their child's diet. Moreover, no detailed analysis was conducted on breastfeeding duration or cow milk intake. Nonetheless, the findings indicated that neither the length of breastfeeding nor the amount of cow milk consumed at six months had any bearing on the proportion of cow's milk allergy (CMA) cases.

Ethical Considerations

Compliance with ethical guidelines

Research involving human subjects complied with all relevant national regulations, and institutional policies and is following the tenets of the Helsinki Declaration (as amended in 2013), and has been approved by the Ethics Committee of [Urmia University of Medical Sciences](#) (Code: IR.UMSU.REC.1401.035). All patients' parents or caregivers provided written informed consent before being included in the study.

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Authors' contributions

Conceptualization, investigation, project administration, formal analysis and writing the original draft: All authors; Supervision, review and editing: Hamidreza Houshmand and Mir Reza Ghaemi.

Conflict of interest

The authors declared no conflict of interest.

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