

Food hypersensitivity reactions in atopic dermatitis patients and analysis of contomitant diseases

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Only few population-based data exist on the association of food hypersensitivity reactions and atopic diseases. The objective of this study was to evaluate the dependence between the occurrence of food hypersensitivity reactions and other atopic diseases and parameters. Complete dermatological and allergological examination was performed. Statistical evaluation of the relations between the occurrence of food hypersensitivity reactions and the occurrence of asthma bronchiale, rhinitis, duration of atopic dermatitis, family history and onset of atopic dermatitis was performed. Two hundred and thirty-five patients were examined – 75 men and 160 women, average age 26.2 years (SD = 9.5). Patients suffering from food hypersensitivity reactions, in general, suffer significantly more often from rhinitis and from persistent eczematous lesions; the dependence was confirmed in patients with hypersensitivity reactions to nuts, kiwi, fishes and apple. Atopic march was confirmed in patients suffering from atopic dermatitis and from food hypersensitivity reactions.

Keywords: atopic dermatitis; food allergy; asthma bronchiale; rhinitis; onset of atopic dermatitis; persistent eczematous lesions; family history

Introduction

Increases in allergic diseases over the last 30–40 years have been well documented worldwide (Asher et al., 2006). Allergic march refers to a subset of allergic diseases that commonly begin in early childhood, such as food allergies, asthma bronchiale, allergic rhinitis and atopic dermatitis; patients diagnosed with a certain allergic disease have a greater likelihood of developing other allergic diseases (Kijima et al., 2013). The aim of this study is to evaluate whether there is some statistically important difference in the occurrence of allergic diseases and parameters (such as asthma bronchiale, rhinitis, onset of atopic dermatitis, duration of atopic dermatitis lesions and the family history of atopy) in patients with and without food hypersensitivity reactions. The term food hypersensitivity represents the umbrella term for food allergy and for food intolerance (non-allergic food hypersensitivity). The term food allergy is used to describe the clinical symptoms that are mediated by the immune system; a number of IgE-, cellular-, and mixed IgE- and cell-mediated disorders have been described (Bindslev-Jensen et al., 2004; Li et al., 2001) and food allergens can cause three different patterns of clinical reaction in patients with atopic dermatitis: (1) non-eczematous reactions, *immediate-type* reactions with cutaneous

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symptoms such as pruritus, urticaria and rashes and/or non-cutaneous gastrointestinal or respiratory symptoms or even anaphylaxis; (2) isolated eczematous reactions – late reactions, e.g., flare-up after hours to days; and (3) a combination of non-eczematous and eczematous reactions (Werfel & Breuer, 2004). Food intolerance is a non-allergic hypersensitivity to food that does not include the immune system even though the symptoms are similar to those of IgE-mediated allergic reactions. An impaired histamine degradation based on reduced diaminoxidase activity and the resulting histamine excess may cause numerous symptoms mimicking an allergic reaction. The ingestion of histamine-rich food or alcohol or drugs that releases histamine or blocks diaminoxidase activity may provoke *diarrhoea*, headache, rhinoconjunctival symptoms, asthma, hypotension, arrhythmia, urticaria, pruritus, flushing and other conditions in patients with histamine intolerance. Dermatologic sequels can be rashes, itch, urticaria, angioedema and atopic dermatitis. In addition to histamine-rich food, many foods such as citrus foods are considered to have the capacity to release histamine directly from tissue mast cells, even if they themselves contain only small amounts of histamine (Maintz & Novak, 2007; Maintz et al., 2006). It has been demonstrated that food hypersensitivity plays a pathogenic role in some children with atopic dermatitis and that appropriate diagnosis and exclusionary diets can lead to significant improvement in their skin symptoms (Sampson & McCaskill, 1985).

Asthma bronchiale is a chronic airway inflammatory disease with typical symptoms and is described as being episodic in nature, both from the standpoint of symptoms and lung function impairment. It is a rare manifestation of food-induced allergic reactions although acute bronchospasm often occurs together with food-induced symptoms (James, Bernhisel-Broadbent, & Sampson, 1994). Airway hyperreactivity deteriorating into life-threatening asthma may occur in sensitised patients following ingestion of a small amount of a food allergen. Vapours or steam containing proteins emitted from cooking food such as fish can induce an asthmatic reaction and anaphylaxis (Sampson, 1999). Food-induced asthmatic symptoms should be considered in patients who have refractory asthma and a history of atopic dermatitis, gastroesophageal reflux and food allergies (Sampson, 2004). Rhinitis is a heterogeneous disorder that despite its high prevalence is often undiagnosed. The presenting symptoms of allergic, non-allergic and mixed rhinitis are often indistinguishable from one another and are characterised by one or more symptoms including sneezing, itching, nasal congestion and *rhinorrhoea*. Many causative agents have been linked to allergic rhinitis including pollens, moulds, dust mites and animal dander (Malik, Ghosh & Woolford, 2007). The type of nasal symptoms manifested by the patient usually does not differentiate allergic from non-allergic rhinitis. Sensitisation to inhaled pollen proteins may result in cross-reactions with homologous fruit and vegetable proteins (Breiteneder & Mills, 2005). A study of egg allergy in children reported that the risk for developing rhinitis and asthma by 4 years of age was significantly increased in those who had an egg allergy as an infant (Tariq, Matthews, Hakin, & Arshad, 2000). Additionally, rhinitis induced by oral food challenges occurred more frequently in infancy and early childhood compared with adulthood (James et al., 1994). Rhinitis with rhinorrhoea that occurs after eating hot, spicy foods and autonomic stimulation by emotional and psychosomatic factors associated with food ingestion may be responsible for non-immunological rhinitis (Malik, Ghosh, & Woolford, 2007).

There is a lack of reports focusing on the course of atopic dermatitis in respect of its evolution and association with food hypersensitivity reactions. No reports demonstrate the comorbidity of food hypersensitivity reactions and atopic march in adults. The

occurrence of the food hypersensitivity reactions are given in correlation with the occurrence of asthma bronchiale, rhinitis, onset of atopic dermatitis, duration of eczematic lesions and family history of atopy in this study.

Method

In the period from January 2008 to January 2012, 235 patients who were 14 years or older and suffering from atopic dermatitis were examined – 75 men and 160 women, average age 26.2 years (SD = 9.5) and average SCORAD (Scoring Index of Atopic Dermatitis evaluating the severity of the disease; Kunz et al., 1997) was 32.9 points (SD = 14.1) at the Department of Dermatology and Venereology, Faculty Hospital and Medical Faculty of Charles University, Hradec Králové, Czech Republic. A complete dermatological and allergological examination was performed. The diagnosis of atopic dermatitis was made with the Hanifin–Rajka criteria (Hanifin & Rajka, 1980). The following parameters were examined: the occurrence of asthma bronchiale and rhinitis, duration of atopic dermatitis, family history and onset of atopic dermatitis. The patients were personally asked to describe all their food reactions. Statistical evaluation of the relations among individual parameters monitored was performed: the occurrence of the food hypersensitivity reactions was correlated with the occurrence of asthma bronchiale, rhinitis, the duration of atopic dermatitis lesions (persistent or occasionally in one last year); the occurrence of positive family history of atopy; and the onset of atopic dermatitis.

Evaluation of parameters monitored

The diagnosis of food hypersensitivity reactions was made according to the patient's history.

The patients answered whether they had suffered from immediate or late food reactions (oral allergy syndrome (OAS), gastrointestinal problems, the occurrence of skin problems, respiratory problems). The most frequent food allergens were mentioned and patients answered whether they had suffered from some reactions to these foods, potentially they should have mentioned other foods with recorded reactions. The answers concerning the possible food reactions reflect the patient's history and were not based on the results of examinations such as specific IgE, skin prick tests or challenge tests. The results of examinations with the patient's answers were collected and processed by the dermatologist.

The diagnosis of asthma bronchiale was made according to the results in spirometry at the allergological outpatients department.

The evaluation of rhinitis (seasonal or perennial) was made according to the anamnestic data.

The evaluation of duration of atopic dermatitis – the atopic dermatitis lesions were evaluated as persistent or occasional according to the dermatologist's examination and the patient's information relating to the previous year.

The onset of atopic dermatitis was evaluated according to the patient's history.

The family history of atopy – it was evaluated according to the patients information (the occurrence of allergy, atopic dermatitis, asthma bronchiale, rhinoconjunctivitis in parents, brothers, sisters or children).

Statistical analysis

We evaluated whether there was some dependence between atopic dermatitis patients at the age of 14 or older, who suffered from food hypersensitivity reactions, and the occurrence of other allergic diseases and parameters such as asthma bronchiale, rhinitis, duration of atopic dermatitis, family history of atopy and onset of atopic dermatitis. The data were evaluated to determine whether the frequently mentioned foods causing these hypersensitivity reactions *correlated* with the occurrence of asthma bronchiale, rhinitis, duration of atopic dermatitis, positive family history of atopy and onset of atopic dermatitis. Pairs of these categories were entered into contingency tables and the chi-square test for independence of these variables was performed with the level of significance set to 5%. The results were processed in the Department of Medical Biophysics of Medical Faculty of Charles University in Hradec Králové.

Results

Patients

Two hundred and thirty-five patients were examined, 75 men and 160 women, with the average age of 26.2 years (SD = 9.5) and with the average SCORAD of 32.9 points (SD = 14.1; Kunz et al., 1997).

One hundred and ninety-six patients (83%) out of the 235 described food hypersensitivity reactions; no reactions were recorded in 39 patients (17%). The characteristics of patients are shown in Table 1.

The food hypersensitivity reactions are described after the ingestion of nuts in 75 patients (32%) as OAS in 29%, gastrointestinal symptoms (GIT) in 3%, and pruritus in 2%; tomatoes in 44 patients (19%) as OAS in 15% and pruritus in 6%; kiwi in 41 patients (17%) as OAS in 12%, pruritus in 7%, and GIT symptoms in 5%; apples in 37 patients (16%) as OAS in 13%, pruritus in 2%, and GIT symptoms in 2%; spices in 31 patients (13%) as OAS in 12% and pruritus in 2%; tangerines in 42 patients (18%) as OAS in 9%, pruritus in 6%, rash in 2%, and worsening of atopic dermatitis in 4%; oranges in 34 patients (15%) as OAS in 11%, pruritus in 6%, rash and worsening of atopic dermatitis in 8%; capsidum in 28 patients (12%) as OAS in 11%, pruritus in 2%, and GIT symptoms in 2%; fish in 23 patients (10%) as OAS in 6%, pruritus in 7%, and GIT symptoms in 2%; celery in 17 patients (7%) as OAS in 6%, pruritus in 7%; and carrots in 11 patients (5% pruritus in all these patients). In another four patients (0.5%), the food hypersensitivity reactions after ingestion of sesame seeds, milk, almond, cherry, honey, strawberry, potatoes, wine, apricots, garlic, poppy seeds, cocoa, pineapple, banana, egg, gherkin, cucumber, pear, pulses, beer, cheese, beef, gooseberry, currants, melon, spinach, plum, rice, kohlrabi, ketchup, mustard, parsley, camomile, cauliflower, chicken and maize were recorded. The symptoms of food hypersensitivity are shown in Table 2. More than one kind of reaction was described in some patients (e.g., pruritus and OAS).

Table 1. Characteristic of patients.

Number of patients	235
Men	75
Women	160
Average age	26.2 (SD = 9.5) years
Number of patients suffering from food hypersensitivity	196 (83%)

Table 2. The recorded symptoms of food hypersensitivity.

Symptoms	Number of patients from 235 (%)
Oral allergy syndrome	142 (60)
Pruritus	98 (42)
Worsening of atopic dermatitis	65 (28)
Gastrointestinal problems	25 (11)
Urticaria	20 (9)
Rhinitis	21 (9)
Asthma	10 (4)
Contact allergic reaction	10 (4)

The occurrence of the following parameters asthma bronchiale, rhinitis, duration of atopic dermatitis, family history of atopy and onset of atopic dermatitis is recorded in Table 3.

Additionally, it was determined whether there is some correlation in patients who suffer from food hypersensitivity reactions to recorded foods in general (nuts, tomatoes, kiwi, apples, spices, tangerines, oranges, capsidum, fish, celery, chocolate and carrots) and other allergic diseases and parameters such as asthma bronchiale, rhinitis, duration of atopic dermatitis, family history and onset of atopic dermatitis. In the evaluation of food hypersensitivity reactions, in general, a statistically significant relationship was recorded between patients suffering from food hypersensitivity and the occurrence of rhinitis and persistent eczematic lesions. Data show no significant relationship to the occurrence of asthma bronchiale, positive family history of atopy and onset of atopic dermatitis (Table 4).

For patients with food hypersensitivity to *nuts*, data show a statistically significant relationship to the occurrence of rhinitis and asthma bronchiale and no significant relationship to the occurrence of other tested parameters. For patients with food hypersensitivity to tomatoes, spices, tangerines, oranges, capsidum, celery and carrots, data show no significant relationship to the occurrence of tested parameters. For patients with food hypersensitivity to *kiwi* and *fish*, data show a statistically significant relationship to the occurrence of persistent eczematic lesions and no significant relationship to the occurrence of asthma bronchiale, rhinitis, positive family history and onset of atopic dermatitis. For patients with hypersensitivity to *apple*, data show a statistically significant relationship to the occurrence of rhinitis. Data show no significant relationship to the occurrence of asthma bronchiale, duration of eczematic lesions, positive family history and onset of atopic dermatitis.

Table 3. Occurrence of monitored parameters in percents in 235 patients with atopic dermatitis.

Monitored parameter	Number of patients (%) from 235	
Asthma bronchiale	100 (42%) yes	135 (58%) no
Rhinitis	174 (74%) yes	61– (26%) no
Atopic dermatitis – the duration of lesion in one year	Occasionally 90 patients (38%)	Persistent 145 patients (62%)
Family history of atopy	132 (56%) positive	103 (44%) negative
Onset of atopic dermatitis	Under 5 years of age: 180 (77%)	Later than in 5 years of age: 55 (23%)

Table 4. The survey of examined patients with the occurrence of food hypersensitivity reactions and tested parameters.

Food hypersensitivity	AB+	AB–	RC+	RC–	Pers. AD	Occas. AD	Data+	Data–	Onset of AD under 5 years	Later onset
No. of patients	88	108	155	41	127	69	112	84	151	45
FH+	37%	47%	66%	18%	55%	29%	48%	36%	65%	19%
No. of patients	12	27	19	20	18	21	20	19	29	10
FH–	5%	12%	9%	8%	8%	9%	9%	8%	13%	4%
Total number	100	135	174	61	145	90	132	103	180	55
of patients	42%	58%	74%	26%	62%	38%	56%	44%	77%	23%
<i>P</i> value	0.079		0.0080 ^a		0.03 ^a		0.56		0.837	

Note: Pairs of these categories were entered in contingency tables and the Chi-square test for independence of these variables was performed with the level of significance set to 5%. AB, asthma bronchiale; RC, rhinoconjunctivitis; AD, atopic dermatitis. FH+: patients with food hypersensitivity reactions. FH–: patients without food hypersensitivity reactions. Pers. AD: persistent lesions of atopic dermatitis. Occas. AD: occasionally lesions of atopic dermatitis. Data+: positive family history. Data–: negative family history.

^aThe significant relationship.

The detailed survey of most commonly mentioned foods with hypersensitivity reactions (nuts, tomatoes, kiwi, apple, spices, citrus, oranges, capsicum, fish, celery and carrots) and comparison with the occurrence of asthma bronchiale, rhinitis, duration of eczematous lesions, positive data about atopy in family and onset of atopic dermatitis is shown in [Table 5](#).

Discussion

The aim of this study was to determine whether the occurrence of food hypersensitivity reactions in atopic dermatitis patients correlates with the occurrence of asthma bronchiale, rhinitis, family history of atopy, duration of atopic dermatitis lesions and onset of atopic dermatitis. There are no studies dealing with this question in adolescents and adults. The studied group represents patients suffering from atopic dermatitis older than 14 years of age and food hypersensitivity reactions are described in 83% of them. The recorded early allergic reactions (OAs, asthma, some GIT, such as spasm) have a high diagnostic importance because the early symptoms after ingestion of foods have a clear diagnostic connection with the ingested foods. The patients eliminated these foods, but they had recorded that these reactions are reproducible after a casual ingestion. The most frequent food hypersensitivity reactions were described after the ingestion of nuts with the symptom being OAS. Other recorded symptoms of food hypersensitivity reaction were pruritus and worsening of atopic dermatitis. Histamine is a classical inducer of pruritus in man (Ring & Thomas, 1989).

Asthma bronchiale and rhinitis are other atopic diseases which are common in some patients suffering from atopic dermatitis. According to Kijima et al. (2013), who retrospectively studied the development of allergic march from birth to late adolescence using postal questionnaires, atopic dermatitis associated with food allergy accelerates the subsequent progression of allergic march. In this study, the statistically significant relationship was recorded in all patients suffering from food hypersensitivity to the occurrence of rhinitis and persistent eczematous lesions. By evaluating single foods, it was confirmed that there is a significant relationship in patients suffering from food hypersensitivity to nuts to the occurrence of rhinitis and asthma bronchiale; another significant relationship was confirmed in patients suffering from food hypersensitivity to kiwi and fish to the duration of eczematous lesions; patients with hypersensitivity reactions to fish and kiwi suffer significantly more often from persistent eczematous lesions. Another significant relationship was confirmed between food hypersensitivity to apple and rhinitis. According to Crespo, nuts are a well-defined cause of food allergy, which affect approximately 1% of the general population in the UK and the USA (Crespo, James, Fernandez-Rodriguez, & Rodriguez, 2006). While the majority of nut allergens are seed storage proteins, other nut allergens are profilins and pathogenesis-related protein homologues considered to be panallergens because of their widespread distribution in plants. The presence of specific IgE antibodies to several nuts is a common clinical finding, but the clinical relevance of this cross-reactivity is usually limited (Crespo et al., 2006). The rising prevalence of allergy to nuts, coupled with the knowledge that allergic reactions to these foods have the potential to be severe or fatal and that accidental exposures are common, makes developing effective treatments to alter the natural history of peanut and tree nut allergies even more crucial for those who will not outgrow them (Fleischer, 2007). This study confirms that there is a significantly higher occurrence of asthma bronchiale in patients suffering from food hypersensitivity reactions to nuts. Another significant

Table 5. Food hypersensitivity reactions to single foods and the comparison with the occurrence of asthma bronchiale, rhinitis, duration of eczematous lesions, positive data about atopy in family and the onset of atopic dermatitis.

Tested parameters x food reactions	AB +	AB -	RC +	RC -	Persistent lesions	Occas. lesions	Data +	Data -	AD before 5 years	Later onset
<i>Nuts</i>										
Nuts +	40	35	67	8	53	22	44	31	64	11
Nuts -	60	100	97	53	92	68	88	72	116	44
P value	0.012		0.0015		0.108		0.795		0.059	
<i>Tomatoes</i>										
Tomatoes +	16	28	33	11	31	13	22	22	37	7
Tomatoes -	84	107	141	50	114	77	110	81	143	48
P value	0.39		0.98		0.296		0.267		0.27	
<i>Kiwi</i>										
Kiwi +	21	20	29	12	31	10	23	18	31	10
Kiwi -	79	115	145	49	114	80	109	85	149	45
P value	0.19		0.33		0.034		0.847		0.700	
<i>Apple</i>										
Apple +	19	18	34	3	21	16	21	16	33	4
Apple -	81	117	140	58	124	74	111	87	147	51
P value	0.215		0.031		0.405		0.926		0.07	
<i>Spices</i>										
Spices +	14	17	25	6	15	16	16	15	26	5
Spices -	86	118	149	55	130	74	116	88	154	50
P value	0.71		0.686		0.074		0.48		0.387	
<i>Tangerines</i>										
Tangerines +	16	26	32	10	25	17	21	21	31	11
Tangerines -	84	109	142	51	120	73	111	82	149	44
P value	0.559		0.916		0.62		0.28		0.483	
<i>Oranges</i>										
Oranges +	16	18	23	11	24	10	19	15	29	5
Oranges -	84	117	151	50	121	80	113	88	151	50
P value	0.528		0.507		0.31		0.84		0.259	
<i>Capsidum</i>										
Capsidum +	13	15	24	4	17	10	18	10	23	5
Capsidum -	87	120	150	57	128	80	114	93	157	50
P value	0.623		0.207		0.987		0.435		0.56	
<i>Fishes</i>										
Fishes +	12	11	19	4	20	3	15	8	20	3
Fishes -	88	124	155	57	125	87	117	95	160	52
P value	0.304		0.580		0.011		0.427		0.26	
<i>Celery</i>										
Celery +	9	8	13	4	14	3	13	4	15	2
Celery -	91	127	161	57	131	87	119	99	165	53
P value	0.348		0.795		0.083		0.099		0.28	
<i>Carrots</i>										
Carrots +	7	4	10	1	8	3	9	2	10	1
Carrots -	93	131	164	60	137	87	123	101	170	54
P value	0.138		0.445		0.486		0.094		0.286	

Note: Pairs of these categories were entered in contingency tables and the Chi-square test for independence of these variables was performed with the level of significance set to 5%.

The correlation is shown in extra bold.

AB: asthma bronchiale; RC: rhinoconjunctivitis; AD: atopic dermatitis; Occas. lesions: occasionally lesions of atopic dermatitis. Data+: positive family history of atopy; Data-: negative family history of atopy. Nuts+: number of patients with food hypersensitivity to nuts; Nuts-: number of patients without food hypersensitivity to nuts.

relationship was confirmed in patients suffering from food hypersensitivity to apple and the occurrence of rhinitis. In pollen food syndrome, also known as OAS, a cross-reaction occurs between a pollen allergen and a homologous protein allergen in raw fruits or vegetables (e.g., birch pollen protein Bet v 1 and the homologous Mal d 1 protein in apple or Dau d 1 in carrot). The initial route of sensitisation is respiratory exposure to the pollen proteins. Oral exposure to the food proteins is usually well tolerated because they are unstable in the presence of digestive enzymes (Breiteneder & Mills, 2005). But according to Lombardi, in the case of birch-apple syndrome, eating apple does not functionally or clinically affect the respiratory tract. (Lombardi, Passalacqua, & Canonica, 2012). Patients with food hypersensitivity reactions to fish and kiwi suffer significantly more often from persistent eczematous lesions. Fish and its derived products play an important role in human nutrition, but they may also be a potent food allergen. Fish can be an ingested, contact and inhalant allergen. Gad c I, a parvalbumin, the major allergen in codfish, is considered as a fish and amphibian panallergen (Pascual et al., 2008). An adverse reaction to fish may be of non-allergic origin due to food contamination or newly formed toxic products, but the most frequent type of adverse reactions to fish is immunologic-mediated reactions; such allergic reactions may be both IgE-mediated and non-IgE-mediated. Most cases are IgE-mediated due to ingestion or contact with fish or as a result of inhalation of cooking vapours. The clinical symptoms related to IgE-mediated fish allergy are most frequently acute urticaria and angioedema as well as mild oral symptoms, worsening of atopic dermatitis, respiratory symptoms such as rhinitis or asthma, and GIT such as nausea and vomiting. Anaphylaxis may also occur (Pascual et al., 2008). But according to Magnusson et al. (2013), regular fish consumption in infancy may reduce the risk of allergic disease up to age of 12. Another correlation in this study was confirmed in patients with food reactions to kiwi; these patients with hypersensitivity to kiwi also have persistent eczematous lesions. According to Asero, reactions to kiwi are frequent and can be the result of the sensitisation to a number of allergens showing different physicochemical characteristics. Component-resolved diagnosis of kiwi allergy is still unavailable in routine clinical practice (Asero, 2012). Alemán et al. sought to assess kiwi allergy on the basis of a challenge test and identify the patterns of allergen recognition in sensitised patients from a birch-free area. The most frequent clinical manifestation was OAS. They concluded that the results provide evidence that kiwi allergy is not a homogeneous disorder because several clinical subgroups can be established. (Alemán et al., 2004). In this study it was confirmed that food hypersensitivity reactions are common finding in atopic dermatitis patients – 83% suffer from these reactions. Rhinitis and persistent eczematous lesions are recorded significantly more often in these patients. For single foods, the hypersensitivity to nuts correlates with the occurrence of asthma bronchiale and rhinitis. Persistent eczematous lesions correlate with hypersensitivity to kiwi and fish. The food hypersensitivity to apple correlates with the occurrence of rhinitis.

Conclusion

Atopic march was confirmed in patients suffering from atopic dermatitis and from food hypersensitivity reactions – rhinitis and persistent eczematous lesions are recorded significantly more often in these patients; foods as nuts, kiwi, fishes and apple are the most important in atopic march.

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