

# Patch Testing of Thai Children with Eczema

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## ABSTRACT

**Objective:** To detect contact allergy rate and common allergens in Thai children presented with eczema.

**Materials and Methods:** A total of 124 children, aged 1-15 years, were patch tested using a pediatric screening series of 16 allergens and relevant additional allergens. Data on clinical presentation, atopic history and test results were collected.

**Results:** Contact allergy was found in 51 of 124 children (41.1%) presented with all forms of eczema. The common allergens were lanolin alcohol (8.9%), cocamidopropyl betaine (8.1%), nickel sulfate (7.3%), fragrance mix I (5.6%), formaldehyde (5.6%), thimerosal (5.6%), fragrance mix II (4.8%), cobalt chloride (4.0%), methylchloroisothiazolinone/methylisothiazolinone (2.4%), methylisothiazolinone (2.4%) and thiuram mix (2.4%). Nineteen of 50 atopic dermatitis patients (38%) showed positive patch test reactions.

**Conclusion:** Allergic contact dermatitis is common in children. Both atopic and non-atopic patients can develop contact dermatitis. Patch testing should be performed in children presented with eczema regardless of contact dermatitis history.

**Keywords:** Patch test; children; pediatric; eczema; allergic contact dermatitis (Siriraj Med J 2023; 75: 70-75)

## INTRODUCTION

Allergic contact dermatitis (ACD) is a cell-mediated hypersensitivity (type IV) reaction of the skin. The prevalence of ACD increases with age. Both ACD and irritant contact dermatitis in children seems to be important problems over the last years. The diagnosis of ACD is obtained with history, physical examination, and patch testing. The dermatitis observed can be both flare of the existing dermatitis and difficult-to-treat eczema. The location may be not only the direct contact sites, but also distal skin areas from 'secondary spread'.

From a systematic review, studied the data from January 1997 to May 2012, the common allergens in children and adolescents were nickel, thimerosal, cobalt, fragrance mix I, lanolin, neomycin, potassium dichromate and *Myroxylon pereirae*.<sup>1</sup> Frequent sources of allergens in children and adolescents are fragrances, creams, makeup,

toys, hair dyes, nail polish, henna tattoos, and piercings. Therefore, the sensitization rate among these age groups can be significantly rising.<sup>1</sup> Previous studies showed prevalence rates of 13.3-24.5%.<sup>2</sup>

Nowadays, there is a wide selection of personal products that are used by children. Beauty trends in teenagers depend on cultures, social media, and influencers. Children and teenagers use cosmetics earlier and more than in the past. The contact allergens at present may not be the same.

Patch testing is an uncomfortable procedure for both children and parents. At least 3 visits are needed and patients have to avoid water on the patch test sites. These inconvenient factors might cause the clinicians being reluctant to refer patients for patch testing. Moreover, ACD can be easily misdiagnosed particularly in children who have existing atopic dermatitis. Patch testing is the

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gold standard to identify this hidden second diagnosis. If the patients appropriately avoid the causative contact allergens, the recalcitrant dermatitis can improve leading to better quality of life.<sup>3</sup>

The aims of this study were to detect the frequency of contact sensitization in Thai children diagnosed with all forms of eczema regardless of the contact dermatitis history and to find the common contact allergens.

## MATERIALS AND METHODS

This prospective study was conducted at the Occupational and Contact Dermatitis Clinic, Institute of Dermatology, Bangkok, Thailand over 19 months. Children, aged 1-15 years, diagnosed with all forms of eczema for more than 1 month were enrolled. Children who have contraindication to patch test procedure such as active widespread eczema or taking oral corticosteroid were excluded. Demographic data: age, sex, triggered factors, history of atopy, location and duration of lesions were recorded.

All patients were patch tested with the pediatric screening series of 16 allergens. (Table 1) Screening allergens, provided by AllergEAZE®, in AllergEAZE patch test chamber® and supplemental relevant allergens (in selective cases), provided by Chemotechnique Diagnostics, Sweden, were applied on the upper back. Patch test results were interpreted at day (D) 2 and D4 according to International Contact Dermatitis Research Group (ICDRG) criteria. The number of positive patch test reactions and clinical relevance were recorded.

## RESULTS

One hundred and twenty-four children, 61 females and 63 males, were included. The average age was 8 years. Forty-eight cases (38.7%) were 1–7 years old, 76 cases (61.3%) were 8-15 years old. The mean duration of eczema before patch testing was 28.5 months (1-144 months). The mean recurrent episodes of eczema flares were 5 times per year. The legs and arms were the most common site involved (Table 2). The most commonly reported trigger factors in subjects with positive patch test reaction were heat, dust, and seafood. Insomnia was reported by 20.2% of cases.

The results showed 84 positive patch test reactions in 51 patients (41.1%). Current or past relevance was detected in 18 of 75 positive patch test reactions (24%). Lanolin alcohol was the most common contact allergen in our cohort, followed by cocamidopropyl betaine, nickel sulfate, fragrance mix I, formaldehyde, thimerosal, fragrance mix II, cobalt chloride, methylchloroisothiazolinone/methylisothiazolinone (MCI/MI), methylisothiazolinone (MI) and thiuram mix. (Fig 1 and Table 3) There were 21 irritant patch test reactions from cocamidopropyl betaine, formaldehyde, cobalt chloride, MI, potassium dichromate and MCI/MI.

The additional relevant positive allergens found in 9 patients were house dust mite, benzalkonium chloride, an unknown topical corticosteroid cream and personal care products. Ten patients were patch tested with house dust mite allergen and 5 patients had a positive result (50%).

**TABLE 1.** Pediatric baseline series.

Substances	Concentration and vehicle
Nickel sulfate	2.5 % Petrolatum
Balsam of peru	25 % Petrolatum
Fragrance mix I	8 % Petrolatum
Fragrance mix II	14 % Petrolatum
p-tert-Butylphenol formaldehyde resin	1 % Petrolatum
Formaldehyde	1% Water
Colophony	20 % Petrolatum
Potassium dichromate	0.25 % Petrolatum
Cobalt (II) chloride	1 % Petrolatum
Thimerosal	0.1 % Petrolatum
Lanolin alcohol	30 % Petrolatum
Methylchloroisothiazolinone/methylisothiazolinone	0.02 % Water
Methylisothiazolinone	0.2 % Water
Cocamidopropyl betaine	1 % Water
Thiuram mix	1 % Petrolatum
Mercapto mix	2 % Petrolatum

**TABLE 2.** Anatomic sites of involvement.

Anatomic sites of involvement	Frequency
Leg	60 (48.4%)
Arm	44 (35.5%)
Hand	30 (24.2%)
Cubital fossa	29 (23.4%)
Foot	28 (22.6%)
Abdomen	19 (15.3%)
Back	18 (14.5%)
Face	15 (12.1%)
Neck	12 (9.7%)
Elbow	12 (9.7%)
Eyelid	8 (6.5%)
Lip	7 (5.6%)
Knee	4 (3.2%)
Axillae	4 (3.2%)

In addition, two or more positive allergic reactions were found in 24 children (19.4%). Of these, 7 patients had positive reaction to 3 allergens and 1 patient had positive reactions to 4 allergens (formaldehyde, thimerosal, nickel and personal product).

History of atopic dermatitis was presented in 50 of 124 subjects (40.3%), followed by allergic rhinitis (35.5%), asthma (3.2%) and allergic conjunctivitis (1.6%). Among patients with positive patch test reaction, allergic rhinitis and atopic eczema were found in 48.7% and 46.1% respectively. According to family history, allergic rhinitis was found in 46.8%, followed by atopic dermatitis 15.3%, asthma 8.1% and allergic conjunctivitis 5.6%.

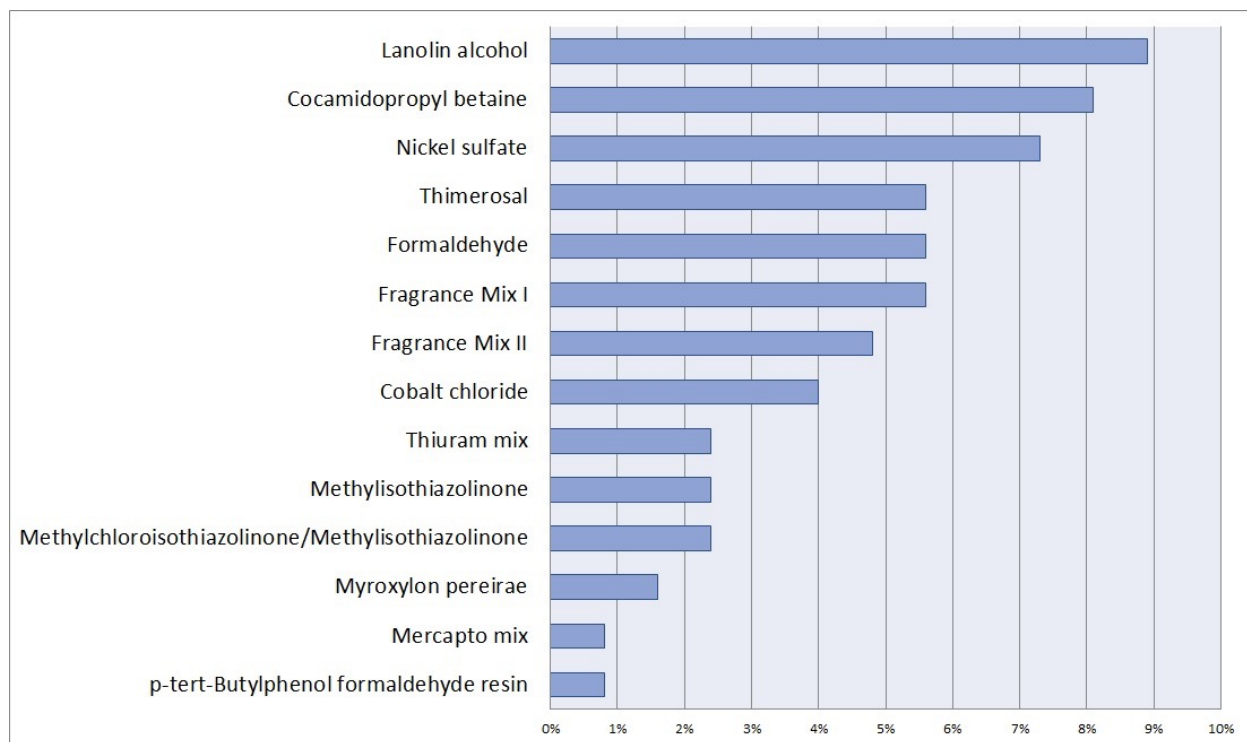
Among 50 children who had atopic dermatitis history, 19 cases (38%) showed at least one positive patch test reactions. The common contact allergens in atopic dermatitis group were nickel (15.8%), lanolin alcohol (15.8%), cocamidopropyl betaine (10.5%).

## DISCUSSION

ACD in children has been estimated as being uncommon. This study shows that contact sensitization

**TABLE 3.** Patch test reactions in children with eczema (N=124).

Allergens	Positive reaction (Total = 84)	Percent	Relevance (Total = 18)	Irritant reaction (Total = 21)
Lanolin alcohol	11	8.9	0	0
Cocamidopropyl betaine	10	8.1	2 (20%)	8
Nickel sulfate	9	7.3	4 (44.4%)	0
Fragrance mix I	7	5.6	2 (28.6%)	0
Formaldehyde	7	5.6	1 (14.3%)	6
Thimerosal	7	5.6	0	0
Fragrance mix II	6	4.8	2 (33.3%)	0
Cobalt chloride	5	4.0	2 (40%)	3
Methylchloroisothiazolinone/methylisothiazolinone	3	2.4	2 (66.7%)	1
Methylisothiazolinone	3	2.4	3 (100%)	2
Thiuram mix	3	2.4	0	0
<i>Myroxylon pereirae</i>	2	1.6	0	0
Mercapto mix	1	0.8	0	0
<i>p-tert</i> -butylphenol formaldehyde resin	1	0.8	0	0
Colophonium	0	0	0	0
Potassium dichromate	0	0	0	1
<b>Allergens tested in selective cases</b>				
House dust mite	5			
Personal care products	2			
Benzalkonium chloride	1			
Topical corticosteroid cream (unknown)	1			



**Fig 1.** Percentage of positive patch test reactions in 124 children with eczema.

was found in 51/124 children (41.1%) corroborating the results reported in a study from the UK which has shown the prevalence of positive patch test reaction in 110 children with eczema aged 2-18 years to be 44%.<sup>4</sup> The rates were 59.2% of 125 children and 51% of 79 children in Brazil and The Netherlands respectively.<sup>5,6</sup>

Patch test reaction rate in current study is lower than the literature that revealed 26.6-95.6%.<sup>6</sup> The reported clinical relevance of 51.7-100%<sup>7</sup> was also higher than the in this study (24%). This could be because our study carried out in unselected children with eczema regardless of contact dermatitis history while most previous studies performed in patients suspected ACD and tested a larger number of allergens than in this study. Zug et al. reported 62.3% positive patch test results in North American children aged 18 years or younger during 2005 and 2012. These patients were suspicious of ACD and were patch tested with up to 70-allergen series.<sup>8</sup>

Our results highlight the significance of patch testing as an investigation of a child with chronic atopic dermatitis. Contact allergy coexists in 38% of children with atopic dermatitis (AD), most commonly to nickel sulfate (15.8%). Cattani et al.<sup>9</sup> recently patch tested 54 Brazilian children, 4 -18 years old, with recalcitrant atopic dermatitis, positive reactions were found in 27.7%, most commonly to nickel sulfate, disperse blue, and fragrance mix I. ACD occurrence in children with atopic eczema

can be described by the impaired epidermal barrier that could enhance allergen penetration and the exposure to sensitizing chemicals in personal care products.<sup>10</sup> Boonstra et al. reported that concomitant contact dermatitis may be a cause of AD becoming a difficult-to-treat disease.<sup>11</sup>

A retrospective study by Boonchai et al. showed a positive patch test reaction rate of 35.5% among 112 Thai children, aged less than 18 years, suspected ACD. The common allergens were nickel, potassium dichromate, methylisothiazolinone. These results may not be used to compare with our study because there are many differences in the study methodology: retrospective chart review vs prospective study, mean ages (14.5 vs 8 years), inclusion criteria (suspected ACD vs all forms of eczema) and the allergens routinely tested that did not include our common allergens such as cocamidopropyl betaine and thimerosal.<sup>12</sup>

In this study, the most common allergen was lanolin alcohol. Exposure to lanolin can come from emollients, ointments, cosmetics, toiletries and topical medicaments.<sup>7</sup> In a previous study in North America, prevalence of lanolin allergy was 4.6%.<sup>13</sup> The results of TRUE (Thin-layer Rapid Use Epicutaneous Test) showed lanolin allergy rate of 15.8% in 101 children and adolescents aged 6-18 years who were patch tested on suspicion of having ACD.<sup>14</sup> Lanolin allergy was reported being more common in children than in adults (4.5% vs 3.2%).<sup>9</sup> In our center,

the sensitization rate of lanolin alcohol in all age group including adults is approximately 1.5%. However, Uldahl et al. reported that patients allergic to lanolin may use lanolin-containing products on intact skin without problem<sup>15</sup>, but may develop allergic contact dermatitis after applying lanolin-containing topical medicaments to damaged or ulcerated skin. This phenomenon is called 'lanolin paradox'. The difficulty in determining clinical relevance of a positive patch test reaction can cause by lanolin paradox. Moreover, it can be difficult to distinguish between true allergic reactions and irritant reaction.

Exposure sources of cocamidopropyl betaine include shampoos, cleansers, toothpaste, detergents, liquid soaps, bath gels, skin care products and antiseptics.<sup>16</sup> Cocamidopropyl betaine was noted to be an important allergen in younger age group.<sup>17</sup> In a retrospective study of 1142 children aged less than 18 years, there was a higher frequency of positive patch test reactions to cocamidopropyl betaine in patients with AD when compared to non-AD group.<sup>18</sup>

Nickel was high in our child cohort (7.3%). Most previous studies reported that nickel is the most common allergen causing ACD in children.<sup>5,6,7,19</sup> Sensitization to nickel may begin in infancy. One patient was related to wearing necklace with metal sacred pendant amulet since birth. It is also a common practice to pierce ears at a very young age in Thailand, especially in girls.

One of our cases presented with upper lip dermatitis. Patch test revealed positive reactions to fragrance mix I, fragrance mix II and *Myroxylon pereirae* which possibly present in her favorite bottled soft drink. Very young children can be sensitized to contact allergen such as fragrance. Apart from direct contact in relation to the use of perfumed products, airborne contact of volatile perfume used by a family member can cause recurrent eyelid dermatitis. The mother of a young child bought a flameless stone burner that heats and diffuses aromatic oils containing fragrance in order to clean air in the home. Eyelid dermatitis improved after the mother stop using the burner. However, airborne dermatitis recurred when the child's grandmother used perfume on herself in the same room.

A 7 year-old atopic boy presented with recalcitrant conjunctivitis and photophobia showed a relevant positive patch test to benzalkonium chloride. Benzalkonium chloride is a preservative in several eye medicaments for allergic conjunctivitis. Avoidance of benzalkonium chloride containing eye drops resulted in dramatic improvement.

## CONCLUSION

This study indicates that allergic contact dermatitis is common in children. Lanolin, cocamidopropyl betaine and nickel are the top three common contact allergens in Thai pediatric population. Both atopic and non-atopic patients can develop contact dermatitis. Patch testing should be performed in children presented with eczema regardless of contact dermatitis history.

## Limitation

The small number of allergens in our pediatric screening series could partly decrease the sensitivity of patch test. Further study testing with larger number of screening allergens for children is recommended.

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