

Allergic Contact Dermatitis in Children: The Ottawa Hospital Patch-Testing Clinic Experience, 1996 to 2006

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Background: Allergic contact dermatitis in children is a significant clinical problem. Patch testing is a diagnostic tool for the evaluation of patients with suspected allergic contact dermatitis.

Objectives: To determine the frequency and relevance of positive patch-test results in children and to identify the most common allergens in children at our clinic.

Methods: Retrospective chart review of 100 children and adolescents, aged 4 to 18 years, who were patch-tested at the Ottawa Hospital patch-testing clinic between 1996 and 2006. The children were patch-tested with the North American Contact Dermatitis Group (NACDG) standard series, supplementary series if indicated, and their own products if available.

Results: Seventy percent of children had at least one positive patch-test reaction; 55.8% of positive patch-test reactions were relevant. The ratio of females to males was 62:38. The most common allergens were nickel sulfate (26%), cobalt (14%), fragrance mix (7%), neomycin (7%), colophony (6%), formaldehyde (4%), lanolin (4%), quaternium-15 (4%), and para-phenylenediamine (4%). Nickel co-reacted with cobalt (68%) and palladium (100%). Of children tested, 41% had a history of atopic dermatitis.

Conclusions: The frequency of positive and relevant allergens in children is similar to that in adults as compared with data from the NACDG 2001–2002 study period. Differences between the top 10 allergens in children and adults were seen. Nickel and cobalt were more common allergens in children, and colophony, lanolin, and para-phenylenediamine ranked in the top 10 allergens among children.

THE INCIDENCE AND PREVALENCE of contact allergy and allergic contact dermatitis in children and adolescents in the general population are largely unknown because few systematic studies in unselected populations have been performed.¹

A point prevalence of 15.2% of eighth-grade students having allergic contact dermatitis was found when 1,501 students were patch-tested.² A number of studies, the majority of which were in Europe, have evaluated the most common allergens in children by performing retrospective reviews of their selected populations at patch-testing clinics.

Allergic contact dermatitis has been thought to be less common in children than in adults; however, recent reports suggest that rates of sensitization in children may be higher than previously thought.^{3–5} Rates of sensitization in children may be increasing owing to more frequent exposure to allergens at a younger age, associated with new

trends in body piercing, the use of cosmetic products, and participation in hobbies and sports. Improved recognition of allergic contact dermatitis and increased patch testing of children leading to improved detection of allergens could be other reasons for this observation.

The primary objective of this study was to assess the most common allergens in children at our patch-testing clinic and to determine the frequency and relevance of these allergens.

Materials and Methods

At the Division of Dermatology patch-testing clinic in Ottawa, 122 children were screened for patch testing between 1996 and 2006. Clinicians obtained information about the site of dermatitis, patient history compatible with allergic contact dermatitis and potential sources of allergens, and patient history of atopic dermatitis, according to the Hanifin and Rajka criteria.⁶ One hundred children and adolescents aged 4 to 18 years with suspected allergic contact dermatitis were patch-tested. A child was excluded if (1) the child had a history that was not compatible with a type IV hypersensitivity reaction (eg, urticaria), (2) the child had poison ivy, (3) the child had an obvious nickel allergy, or (4) it was felt that the child

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was too young to be tested. There were 38 boys and 62 girls; the mean age was 13.7 ± 3.4 years. The children were tested with the North American Contact Dermatitis Group (NACDG) standard series of 65 allergens (Chemotechnique Diagnostics AB, Malmö, Sweden).⁷ They were also tested with supplemental series (such as Chemotechnique's cosmetics, shoe, or plant series) and their own products if indicated. Patch testing was performed with a standardized technique using Finn Chambers (Epitest Ltd Oy, Tuusula, Finland) on Scanpor tape (Norgesplaster, Alparma A/S, Vennesla, Norway).⁸ The patches remained in place for 48 hours, and test sites were evaluated at 48 hours and again at 96 to 120 hours according to NACDG guidelines. The concentrations of allergens used were the same as those used for adults at our center. Data were entered with Microsoft *Excel* (Microsoft Corporation, Redmond, WA) and *SPSS* (SPSS Inc., Chicago, IL) software.

Results

Of 100 children and adolescents, 70% had positive patch-test results; 55.8% of patch-test results were considered clinically relevant. Nickel sulfate was the most frequent allergen, 26% of subjects having positive reactions. The next most common reactions were to cobalt (14%), fragrance mix (7%), neomycin (7%), gold (6%), and colophony (6%) (Table 1). Although more girls than boys were patch-tested and had positive patch-test results, there were no striking differences in allergens across gender or age. A history of atopic dermatitis was found in 41% of those tested. Children and adolescents with atopic dermatitis were as likely as those without atopic dermatitis to have positive patch-test results (74% vs 67%). The most common sites of dermatitis were the arms, face, hands, scattered generalized areas, lips, and feet. Polysensitization

was common and occurred in 42% of children; 15% of children had positive reactions to two allergens, 20% were positive for three to five allergens, and 7% reacted to six or more allergens.

Discussion

A relatively high frequency of 70% had at least one positive patch-test reaction in our study. Other pediatric studies have reported frequencies of 27 to 66%.⁹⁻¹¹ Our numbers may be higher because the children were tested with the NACDG standard series of 65 allergens whereas some studies tested with special pediatric series that contained fewer allergens or used the T.R.U.E. Test (Mekos Laboratories A/S, Hillerød, Denmark).¹² Our study also consisted of older children (youngest was 4 years old) and adolescents, which may have skewed the results as some studies including infants have found lower rates of sensitization.¹³ Although infants are occasionally seen in our clinic, they are usually not tested because of practical difficulties, such as not having enough skin surface area for the application of patches and adherence of the patches.

There were no striking differences in allergens in regard to gender or age.

Nickel sulfate, not surprisingly, was the most common positive allergen (26%). This is consistent with other studies.^{9,14} The true frequency of sensitization to nickel is likely even higher in our clinic population because children and adolescents presenting with classic periumbilical eczematous eruptions corresponding to their metal belt buckles or jewelry are usually diagnosed clinically to have a nickel allergy and are not necessarily patch-tested because the cause of their allergic contact dermatitis is clinically obvious. Ear piercing is thought to be a common cause of nickel sensitization, and the risk of nickel allergy rises with the number of piercings.¹⁵ In contrast to a previous pediatric study that found an increased frequency of nickel allergy in girls, there was little difference between boys and girls; 23.7% of boys and 27.4% of girls tested positively to nickel in our study.¹⁶ Fernandez and colleagues reported a similar population aged 10.57 ± 0.67 years and found that thimerosal was a more frequent allergen than nickel but that with increasing age, nickel takes over as the most frequent allergen.⁵ In our study population, thimerosal was found to be more of past relevance, having a frequency of 4%.

Of patients with cobalt allergy, 68% were also found to be positive to nickel. Therefore, these positive patch-test reactions were regarded as cosensitization because of primary nickel allergy. Several patients did have sources

Table 1. Frequency and Percentage of Positive Patch-Test Results

Allergen	Positive Patch-Test Results (%)
Nickel	26
Cobalt	14
Fragrance	7
Neomycin	7
Gold	6
Colophony	6
Formaldehyde	4
Lanolin	4
Quaternium-15	4
para-Phenylenediamine	4

of sensitization to cobalt, such as eyelid dermatitis due to cobalt-containing blue eye shadow. In addition to co-reacting with cobalt, patients allergic to nickel also co-reacted to palladium.

Fragrances are common contact allergens in the general population, and this was also the case in our study population. The main sources of fragrance allergies were patients' personal care products containing fragrance.

Neomycin allergy frequently corresponded to a history of using over-the-counter antibiotic creams and ointments containing neomycin, as well as eye and ear drops containing aminoglycosides such as neomycin in combination with other antibacterials, antifungals, and corticosteroids.¹⁷

Comparing our results to that of the NACDG top 10 allergens during the 2001–2002 study period, we noted that positive patch-test reactions to cobalt, colophony, lanolin, and para-phenylenediamine were more common in our study population than in the NACDG population. Sources of allergens included adhesive bandages containing colophony (historically present in Elastoplast [Beiersdorf AG, Canada, St. Laurent, QC] bandages in Canada), colophony present in eyebrow wax, emollients containing lanolin, para-phenylenediamine in temporary tattoos (which consisted of a mixture of henna with para-phenylenediamine), and permanent hair color.¹⁸ Frequencies of positive patch-test results were similar for fragrance mix, neomycin, formaldehyde, quaternium-15, and gold. Common sources of quaternium-15 and formaldehyde were body lotions and facial cosmetics. Sensitization to balsam of Peru, thimerosal, and bacitracin was less frequent in our selected group.¹⁹

Sources of allergens were detected from the history of many patients. Thirteen children were evaluated for suspected allergic contact dermatitis (ACD) from their hockey pads or soccer shin guards; 23% had relevant positive reactions (to p-tert-butylphenol formaldehyde resin and carba mix in hockey pads and to thiourea rubber accelerators in soccer shin pads). After patch testing, the remainder of the children suspected of having ACD from their sports equipment were diagnosed as having irritant contact dermatitis (23%) or an exacerbation of atopic dermatitis (54%). This is in contrast to a study of eight patients evaluated for dermatitis under their soccer shin guards who were all found to have irritant contact dermatitis.²⁰ Contact dermatitis due to urea formaldehyde resin in soccer shin pads has been previously reported.²¹

The site of ACD on the body did not correspond to any specific allergen. With our small sample size, it was difficult to detect differences with allergens and sites of

dermatitis, even for nickel. A recent study found that no correlation could be detected between the presenting pattern of dermatitis and a positive patch-test reaction.¹³ Therefore, children with persistent eczema should be investigated for ACD. In our study, 41% of children had a history compatible with atopic dermatitis. In other studies, 43 to 78% of children who were patch-tested had atopic dermatitis.^{22,23}

Conclusion

Patch testing is a useful diagnostic procedure in children with eczematous dermatitis, both in those with and those without a history of atopic dermatitis. Identifying significant contact allergens in children and adolescents can lead to the prevention of allergic contact dermatitis through avoidance of those allergens.²⁴

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