Original Article

Clinico-allergological pattern of allergic contact dermatitis among 70 Indian children

Nilendu Sarma, Sanjay Ghosh

Institute of Allergic and Immunologic Skin Disease

Address for correspondence:
Dr. Nilendu Sarma,
P.N. Colony, Sapuipara,
Bally, Howrah - 711 227,
WB, India.
E-mail: nilendusarma@yahoo.co.in

ABSTRACT

Background: Rapid urbanization, westernization of lifestyles, poor quality of objects available and extremely relaxed vigilance on adherence to 'product safety guidelines' make any developing country like India highly susceptible to allergic contact dermatitis (ACD) even in children. There has been no previous attempts to assess the magnitude of childhood ACD in India. **Aims:** To assess the clinico-allergological profile of ACD in Indian children. **Methods:** All consecutive children up to 15 completed years of age who were patch tested over the last 3 years were analyzed from the records. **Results:** A total of 70 children were studied (average age of disease onset 8.39 ± 3.59 years [SD], range 1-15 years and average age of presentation 10.8 ± 2.99 years [SD], range 5-15 years). Relevant allergy was noted in 48.6% of the patients. Age and sex had no significant role on the prevalence of ACD. Common allergens were paraben (43%), potassium dichromate (27%) and fragrance mix (26%). Most relevant allergens were potassium dichromate, paraben and fragrance. Foot was the most commonly involved site (25.7% of patients). Atopy was present in 18 patients (25.7%). A total of 22 irritant reactions were noted in 13 patients. **Conclusion:** This study reflects the current status of childhood ACD of this region.

DOI: 10.4103/0378-6323.58677
PMID: 20061729

Key words: Allergic contact dermatitis, children, patch testing, India

INTRODUCTION

Progressively increasing prevalence of allergic contact dermatitis (ACD) has been reported in children during the last decade.[1] Reported prevalence of ACD in childhood has risen from 13.3%[2] to 67% during the last decade.[3] This alarming increase in prevalence could have been due to either a true increase in ACD or an increased rate of diagnosis.[4] Probably the suspicion of ACD has increased resulting in more frequent use of patch tests.[5] Definition of ACD has also widened to encompass various newly described clinical entities under the umbrella of allergic contact dermatitis syndrome (ACDS).

In the perspective of developing countries like India, westernization of life style has resulted in an increase in exposure to cosmetics, hair and other dyes and packed foods. With the overall increased exposure to these allergens, direct and indirect transfer of allergen from parents or care-givers (hetero-transfer) to children have also increased. The rapid process of urbanization and construction works have resulted in a noticeable increase in the incidences of air-borne contact dermatitis (ABCD).

Geographical, economical and educational parameters affect the prevalence and etiology of ACD. To the best of our knowledge, there has been no such study from this part of the globe to elucidate the clinical and allergological patterns of ACD in children. With this background, we performed this retrospective study on children up to 15 years of age with suspected contact dermatitis to examine the correlation of age, sex, pattern and site of presentation with the allergen profile or the sources of allergy.

METHODS

All the children up to 15 completed years of age who attended our allergy clinic from April 2005 to March 2008 with suspected ACD were included. Patients and parents were counselled and advised patch testing. Consent was taken from the attending

How to cite this article: Sarma N, Ghosh S. Clinico-allergological pattern of allergic contact dermatitis among 70 Indian children. Indian J Dermatol Venereol Leprol 2010;76:38-44.

Received: January, 2009. **Accepted:** August, 2009. **Source of Support:** Nil. **Conflict of Interest:** None declared.

guardian. The allergy panel used was the Indian standard battery approved by the 'Contact and Occupational Dermatoses Forum of India' (CODFI) in all [Table 1]. Propylene glycol (additional) and mercapto mix was tested only in the last 28 patients. The allergens were occluded for 48 h by an aluminum chamber in the conventional closed patch test method. Reactions were noted on the day of patch removal (after 48 h/second day), then at 96 h/fourth day and again on the seventh day, when required. Doubtful reactions showing persistent reactions of the same or an increased grade (crescendo) in the second visit (second day) or later (seventh day) reading were considered allergic and counted.

Each positive test was assessed for relevance, which could be of three types- 'not relevant or unexplained positive', 'past relevance' and 'present relevance', primarily the assessment was dependent on establishing the existence of true exposure and whether the dermatitis is explainable by the exposure. Comprehensive clinical history in the light of the test result, evaluation of the patient's chemical environment and, rarely, more specialized tests were crucial in the correct assessment of relevance. Irritant reactions (IR) were diagnosed by the standard clinical criteria like glazed appearance or pustular eruption and decrescendo reaction pattern etc. and were excluded.

In addition to the basic data like age, sex, family history etc., the clinical presentation was noted in detail. Personal as well as parents' habits of cosmetic usage were noted. The pattern of allergy profile was correlated with sex, sites of involvement, atopy and age groups. For the purpose of age-wise analysis, the patients were grouped into three age groups: 1-5 years, 6-10 years and 11-15 years.

Chi-square test was used to test the significance of the role of sex on allergy and the grade of reaction on the relevance of allergy. Regression analysis was performed to test the correlation of age with the positive patch test.

Table 1: List of allergens tested with the relevance rate

Name of allergen	Total positive	Total relevant allergy	Percentage of relevance (of all positive)
Petrolatum	0	0	
Potassium dichromate	19	11	57.9
Neomycin sulfate	9	1	11.11
Cobalt chloride	16	3	18.8
Benzocaine	3	0	0
4-para phenylene-diamine (PPD)	11	6	54.5
Parabens	30	11	36.7
Nickel sulphate-hexahydrate 5%	7	3	42.9
Colophony	7	5	71.4
Gentamicin sulfate	7	1	14.3
Mercapto mix	0	0	0
Epoxy resin	5	3	60
Fragrance mix	18	8	44.4
Mercaptobenzothiazole (MBT)	4	2	50
Nitrofurazone	1	0	0
4-chloro-3-cresol (chlorocresol)	1	1	100
Wool alcohol (lanolin)	3	2	66.7
Balsum of Peru	4	3	75
Thiuram mix	2	2	100
Chinoform	3	0	0
Black rubber mix	4	1	25
p-tert butyl phenol formaldehyde resin	2	1	50
Formaldehyde	3	1	33.3
Polyethylene glycol 400	0	0	0
Propylene glycol	1	1	100
Parthenium	4	1	25
Xanthium	1	0	0

RESULTS

A total of 70 patients were recruited. The age at disease onset was 8.39 ± 3.59 years (SD), with a median of 8 years (range 1-15 years). The average age at presentation was 10.8 ± 2.99 years (SD), with a median of 11 years (range 5-15 years). Clinical presentation of the patients were varied and included eczematous disease at various sites like face, eye lid, hand, feet or other areas [Figures 1-3]. Some non-eczematous diseases were also included with presentations like lichenoid dermatoses, chemical leucoderma and glossitis.

Positive allergic reactions were noted among 56 patients (80%). Among these patients, 34 (60.7% of all positive test, 48.6% of all patients) had relevant reactions. Total number of positive reactions was 166 (average 2.96 reactions per patient). Total number of IR was 22 in 13 patients. No reaction was noted with polyethylene glycol 400 [Table 1].

Mean age with the positive test was 11.036 ± 2.93 years (SD) and that with the negative test was 10.07 ± 3.22 years (SD). Higher the age group more was the prevalence of positive allergy (74% in the 6-10 years age group vs 83% in the 11-15 years age group). However, regression analysis showed that age had no significant role on the prevalence of positive patch test. Allergy to paraben was highest in all the three age groups. Fragrance allergy was more common in the higher age group (18.5% in the 6-10 years age group vs 31% in the 11-15 years age group).

Females were higher in number than males (females 41, males 29). Age at presentation as well as age at onset were both lower in males than in females. However, chi-square analysis showed that sex had no significant role on the prevalence of allergy. Comparative data on demographic, clinical and allergologic profiles between males and females is presented in Table 2.

Chromate allergy was higher in females (34.1% in females vs. 17.2% in males) and neomycin sulfate allergy was nearly twice as frequent in males (17.2%) than in females (9.8%). Nickel allergy was however nearly equally distributed in males and females (M:F:3:4). Metal allergy (cobalt and nickel) was more frequent in girls (n = 17, 41.5%) than in boys (n = 9, 31%). Clinically, allergic dermatitis of hand, hand-foot and foot (male: female- 13.8%:2.4%) were more frequent in males whereas allergy to cosmetics and facial skin allergy (male: female- 6.9%:9.8%) were higher in females.

The four most common allergens were paraben (n = 30, 43%), potassium dichromate (n = 19, 27%),

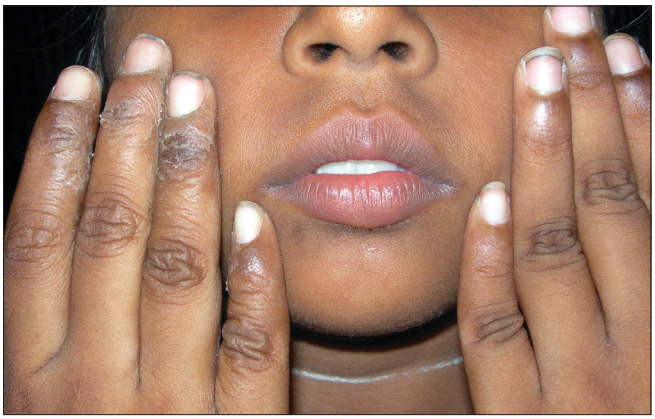

Figure 2: Eczematous lesions over the dorsal fingers of the right hand in a girl

Figure 1: Facial eczema, mostly on lower face along with mild eye lid lesion

Figure 3: Dry scaly lesions over the dorsum of the foot due to allergic contact dermatitis from footwear

fragrance mix (n = 18, 26%) and cobalt chloride (n = 16, 23%). The most relevant allergens were potassium dichromate and paraben (both in 11 patients, 15.7%). High relevance was also noted for fragrance (n = 8, 10%), paraphenylene diamine (PPD) (n = 6, 8.6%) and colophony (n = 5, 7.1%).Area-wise, feet was the most common site of involvement, being involved in 25.7% of the patients. Clinico-allergological correlation between site and sources is presented in Table 3.

The most common source was cosmetics (n = 16, 22.8%), followed by footwear (n = 11, 15.7%). The most common allergens in cosmetics were paraben (nine patients) and fragrance mix (eight patients). Among footwear, the common allergens were PPD (5 patients), chromate (4), colophony (3), epoxy resin (3) and thiurum mix (2).

Atopy was present in 18 patients (25.7%). Atopic dermatitis (AD) was present in 13 and other atopy in 10 patients. Only AD was present in eight patients, atopy without AD in five and both in five patients. Average age with atopy (10.4 years) was marginally lower than that without atopy (11 years). Average age at presentation (10.4 years) and average age of onset

Table 2: Allergy profile in males and females

	Male	Female
Total patients	29	41
Age at presentation (years)	9.81	11.57
Age of onset (years)	7.47	9.05
Patients with positive allergy (% of all patients)	75.86 (22)	34 (82.9)
Patients with relevant allergy (% of all patients)	13 (59)	21 (61.8)
Most common allergens (% of all patients)	Paraben (44.8) Fragrance mix (24.1) Cobalt (20.7) Potassium dichromate (17.2) PPD (17.2) Neomycin sulfate (17.2) Nickel (10.3)	Paraben (41.5) Fragrance mix (26.8) Cobalt (24.4) Potassium dichromate (34.1) PPD (14.6) Neomycin sulfate (9.8) Nickel (17.1)
Most common source (% of all patients)	Footwear (20.7) Cosmetics (13.8)	Footwear (14.6) Cosmetics (29.3)
Most common presentation (% of all patients)	Eczema (58.6)	Eczema (29.3) Pompholyx (29.3)
Most common site (% of all patients)	Foot - 4 (13.8) Hand-foot - 3 (10.3) Face - 2 (6.9) Hand - 1 (3.4) Flexure - 1 (3.4)	Foot - 1 (2.4) Hand-foot - 9(22) Face - 4 (9.8) Hand - 6 (14.6) Flexure - 1 (2.4)

Table 3: Clinico-allergological correlation on the basis of site and sources

Predominant site	Without any other areas	With other areas	Total patients	Patients with positive allergy (%)	Patients with relevant allergy (%)	Source with number of patients
Exposed/predominantly exposed	2	1	3	2 (66.7)	2 (100)	ABCD from parthenium and cement (1 each)
Face	1	7	8	7 (87.5)	6 (85.7)	Cosmetics - 4, ABCD (cement) - 3
Feet	15	3	18	9 (50)	5 (55.6)	Footwear
Flexural	7	0	7	7 (100)	2 (28.6)	Cosmetics (hetero in 1)
Hand-feet	15	1	16	15 (93.8)	12 (80)	Footwear - 7, cosmetics - 5, metal - 2
Hand		1	10	10 (100)	7 (70)	Cosmetics - 5
Neck	2	1	3	1 (33.3)	1 (100)	Cement
Multiple			9	8 (88.9)	5 (62.5)	Hetero-transfer - 4

of disease (8.7 years) among atopics was slightly lower than the corresponding ages among non-atopics (11 and 8.3 years, respectively).

Percentage of people showing positive test among atopics was higher than a similar ratio among non-atopics (positive test vs negative test among atopics was 94.4% vs. 5.6% and among non-atopics was 75% vs. 25%). Patients showing relevant allergy among those with positive allergy was however higher among non-atopics than among atopics (47% vs. 66.5%, respectively). A higher number of patients showed IR among atopics than among non-atopics (44.4% vs. 11.5%, respectively). Prevalence of allergy to neomycin and cobalt was much higher in atopics than in non-atopics. Neomycin allergy was found in 30% of atopic and 6% of non-atopic patients. The same for cobalt was 40% and 17.3%.

Allergy due to transfer of allergens from parents or care-giver was found in nine patients (16.1%). Among them, transfer due to body contact was seen in four patients (7.1%) and due to direct handling of the parent's cosmetics was found in five patients (8.9%). Females (7 patients) outnumbered males (2). Allergens thus transmitted were fragrance in two patients, PPD, colophony, lanolin and p-tertiary butylphenol formaldehyde resin in one patient each.

DISCUSSION

Patch testing in children is difficult to perform and interpret[5] because of poor compliance, small area for application and higher incidence of irritant dermatitis with the standard concentration of allergens.[5] However, patch testing is still regarded as the standard, evidence-based method for diagnosis of ACD.[6]

There are controversies regarding the role of age on the prevalence of allergy. Studies have shown a positive[2] as well as an inverse relationship[7] between age and the total prevalence of allergy. However, we found age to have a statistically insignificant role in predicting a positive patch test.

Girls were a majority in our study, similar to the study by Wantke *et al*.,[8] unlike other studies[9] wherein boys predominated. Although sex had an insignificant predictive role on the overall prevalence of positive allergy, it played a role in the following: clinical manifestations were noted more in females and the distribution and allergy profile were different. Higher metal allergy among girls in our study matched earlier reports.[10]

In contrast to the past studies where atopy was shown to have an inverse relationship with ACD,[11] recent studies have indicated that atopics can have a similar[6] or even higher rate[12] of ACD. In our series, prevalence of ACD was higher among atopics than among non-atopics (94.4% vs. 75%). However, relevance was less in atopics. Higher allergy to neomycin sulfate among atopics most probably indicated a higher frequency of usage of topical antibiotics. Like many other past observations, IR was also much higher among the atopics.

Despite the fact that paraben is the most widely used preservative in cosmetics, drugs and foods,[13] allergy to this is considered to be rare[14] and the reported range of allergy is remarkably constant, within 0.5-1% of the patch-tested patients in many large-scale trials.[15-17] Interestingly, paraben was the most common allergen in this series. Concomitant allergy to fragrance (33.3%) and chromate (26.8%) was common. Probably the concentration of paraben used in Indian goods is higher than the standard level (0.1-0.3%). This finding needs to be validated in a larger trial.

Prevalence of nickel allergy among our children was nearly similar to the rates (11-24%) observed in the past.[12,18,19] However, the same for cobalt in our study grossly exceeded the previously reported rates that ranged from 5% to 8%.[20] It is possible that cobalt could be present in a much higher concentration and is easily released from the metal or even plastic materials,[21] those that are frequently used here.

Allergy to another metal chromate was also high in this study. Relevant allergy to potassium dichromate developed from footwear, cement and metals in 54.5%, 36.4% and 27.3% of the cases, respectively. A high incidence of potassium dichromate allergy could be due to the frequent use of leather footwear in bare feet without socks due to poverty by Indian children accompanied by hot, humid climate leading to enhanced percutaneous absorption of the allergen. Massive urbanization played an important role in causing ABCD to cement. In Scandinavian countries, Denmark and Sweden, this problem has been successfully solved by the addition of iron sulfate, which reduces hexavalent chromate to trivalent chromium that is precipitated as insoluble chromium

hydroxide in the alkaline condition of cement.[22] Unfortunately, no such steps seemed to be initiated in India.

Reasons for the high prevalence of overall metal allergy, including many cases of non-relevant allergy, could be the result of early life sensitization from using cheaper-quality metal utensils, widely prevalent practices of wearing multiple and various metal lockets and chains from even neonatal periods on religious grounds and obviously ear piercing, which is reported to be a source of nickel allergy.[23]

Concomitant allergy among the metal allergens was common. All (100%) patients with nickel allergy, 56.25% of cobalt allergies and 47.6% of all chromate allergies had other metal allergies. Rate of relevance increased with multiple metal allergies. Patients with positive allergy to all the three metal allergens had relevant allergy in 50% of the cases. It was 30% when two allergens were positive and nil when only a single allergen was positive.

Although less common than nickel, rubber chemicals has always been among the most common allergens in children as reported from many other countries.[3,24,25] The true prevalence of rubber allergy was probably higher than that found as the mercapto mix could not be tested in many. Relevance of rubber allergy to current dermatitis was found in 50% of these patients, with highest relevance for thiuram mix and lowest for black rubber mix. Interestingly, 80% of these allergies originated from footwear.

Individually, fragrance mix was the third most frequent allergen and second most relevant allergen in this study. Perfumes (fragrance mix and balsam of Peru) were the most common type of allergens closely followed by preservatives, making cosmetics as the most frequent source of allergy. Few years back, Kohl[26] predicted that cosmetics could be the most common allergen in the near future and our study proved that his prediction was correct and relevant in the Indian context also. Nine cases of heterotransfer of allergen indicated that children of this region were quite at risk to the exposure to parents' cosmetics. Higher prevalence of fragrance allergy in older age groups proved their higher chance of exposure.

An observation that clearly pointed towards the local trends in the footwear industry where stitching is mostly replaced by adhesives, allergy to adhesives was very high, even higher than rubber chemical in this study. It was noticeably different from the western world where rubber was a more common footwear allergen.[4-5] In a previous Indian study on patients of all ages with hand-foot ACD, leather was found to be a more common allergen than rubber.[27]

Site of predominant clinical involvement had a predictive role on the chance of relevance. Neck, although rarely affected, had the highest rate (100%) of relevance. On the other hand, all patients with flexural area involvement had a positive test but were mostly non-relevant.

In contrast to plantar dermatitis on the whole, in none of our patients (n = 6) with juvenile plantar dermatoses (JPD), there was any allergy to the allergens tested. Results supported the findings of Weston *et al*.[28] However, other workers found a strong correlation of rubber chemical allergy with JPD and other plantar dermatitis.[5] Excessive sweating and atopy were also reported to have some role in JPD.

All patients with vesicular hand and feet dermatitis (n = 12) except one had relevant allergy. Chromate and paraben were the two most common allergens.

Finally, the diagnosis of ACD in early life is vital not only for improvement of the current dermatitis and to stop recurrence but it can provide valuable guidance in choosing the right occupation in the future and, most importantly, it may guide the parents to change those personal habits that may be harmful to their children. This first Indian study was planned to elucidate the patterns of childhood ACD of this geographical region with many purpose. In the recent years, India has witnessed a tremendous hike in the process of urbanization and a shift towards westernized lifestyle, leading to a much higher chance of exposure to cement and different new cosmetic allergens. The risk of ACD is further increased due to poor restriction on the entry of a newer chemical in the market, widespread practice of poor adherence to a maximal permissible limit for these chemicals by the manufacturers and, finally, the relaxed vigilance by the government on these. Absence of strict government policy on disclosure of ingredients had nourished malpractices. Even multinational companies often showed a tendency toward an improper disclosure strategy, which is in sharp contrast to the marketing strategy by the same company in some other developed countries. The study highlighted that ACD in children was a highly

prevalent disease in this region. It also reflected the necessity for a more frequent use of patch testing for the diagnosis of ACD.

REFERENCES

1. Seidenari S, Giusti F, Pepe P, Mantovani L. Contact sensitization in 1094 children undergoing patch testing over a 7-year period. Pediatr Dermatol 2005;22:1-5.
2. Mortz CG, Andersen KE. Allergic contact dermatitis in children and adolescents. Contact Dermatitis 1999;41:121-30.
3. Roul S, Ducombs G, Taieb A. Usefulness of the European standard series for patch testing in children. A 3-year single-centre study of 337 patients. Contact Dermatitis 1999;40:232-5.
4. Beattie PE, Green C, Lowe G, Lewis-Jones MS. Which children should we patch test? Clin Exp Dermatol 2007;32:6-11.
5. Clayton TH, Wilkinson SM, Rawcliffe C, Pollock B, Clark SM. Allergic contact dermatitis in children: Should pattern of dermatitis determine referral? A retrospective study of 500 children tested between 1995 and 2004 in one U.K. centre. Br J Dermatol 2006;154:114-7.
6. Vender RB. The utility of patch testing children with atopic dermatitis. Skin Therapy Lett 2002;7:4-6.
7. Wöhrl S, Hemmer W, Focke M, Götz M, Jarisch R. Patch testing in children, adults and the elderly: Influence of age and sex on the sensitization patterns. Pediatr Dermatol 2003;20:119-23.
8. Wantke F, Hemmer W, Jarisch R, Götz M. Patch test reactions in children, adults and the elderly. Contact Dermatitis 1996;34:316-9.
9. Barros MA, Baptista A, Correia TM, Azevedo F. Patch testing in children: A study of 562 schoolchildren. Contact Dermatitis 1991;25:156-9.
10. Albert MR, González S, González E. Patch test reactions to standard series in 608 patients tested from 1990 to 1997 at Massachusetts General Hospital. Am J Contact Dermat 1998;9:207-11.
11. Rystedt I. Atopic background in patients with occupational hand eczema. Contact Dermatitis 1985;12:247-54.
12. Manzini BM, Ferdani G, Simonetti V, Donini M, Seidenari S. Contact sensitization in children. Pediatr Dermatol 1998;15:12-7.
13. Rastogi SC, Schouten A, de Kruijf N, Weijland JW. Contents of methyl-, ethyl-, propyl-, butyl- and benzylparaben in cosmetic products. Contact Dermatitis 1995;32:28-30.
14. Andersen KE, White IR, Goosens A. Allergens from standard series. In: Frosch PJ, Menne T, Lepoittevin JP, editors. Contact Dermatitis. 4th ed. Berlin: Springer; 2006. p. 453-92.
15. Menné T, Hjorth N. Routine patch testing with paraben esters. Contact Dermatitis 1988;19:189-91.
16. Goossens A, Claes L, Drieghe J, Put E. Antimicrobials: Preservative, antiseptics and disinfectants. Contact Dermatitis 1998;39:133-4.
17. Wilkinson JD, Shaw S, Andersen KE, Brandao FM, Bruynzeel DP, Bruze M, *et al*. Monitoring levels of preservative sensitivity in Europe. A 10 year overview (1991-2000). Contact Dermatitis 2002;46:207-10.
18. Stables GI, Forsyth A, Lever RS. Patch testing in children. Contact Dermatitis 1996;34:341-4.
19. Shah M, Lewis FM, Gawkrodger DJ. Patch testing in children and adolescents: Five year's experience and follow-up. J Am Acad Dermatol 1997;37:964-8.
20. Fowler JF Jr. Allergic contact dermatitis to metals. Am J Contact Dermat 1990;1:212-23.
21. Goossens A, Morren M. Contact allergy in children. In: Frosch PJ, Menne T, Lepoittevin JP, editors. Contact Dermatitis. 4th ed. Berlin: Springer; 2006. p. 811-30.
22. Fregert S, Gruvberger B, Sandahl E. Reduction of chromate in cement by iron sulfate. Contact Dermatitis 1979:5;39-42.
23. Larsson-Stymne B, Widström L. Ear piercing- a cause of nickel allergy in schoolgirls? Contact Dermatitis 1985;13:289-93.
24. Veien NK, Hattel T, Justesen O, Nørholm A. Contact dermatitis in children. Contact Dermatitis 1982;8:373-5.
25. Sevila A, Romaguera C, Vilaplana J, Botella R. Contact dermatitis in children. Contact Dermatitis 1994;30:292-4.
26. Kohl L, Blondeel A, Song M. Allergic contact dermatitis from cosmetics. Dermatology 2002;204:334-7.
27. Chowdhuri S, Ghosh S. Epidemio-allergological study in 155 cases of footwear dermatitis. Indian J Dermatol Venereol Leprol 2007;73:319-22.
28. Weston WL, Weston JA. Allergic contact dermatitis in children. Am J Dis Child 1984;138:932-6.