

## Original Research Article

# Trends of common contact sensitizers in tandem with increased hair dye dermatitis in Shimla, a sub-Himalayan region: a study of 521 patients

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## ABSTRACT

**Background:** Skin is exposed to a vast variety of chemicals, organic or biological products among fashion seeking community of today's world. This put them at risk of contact sensitization. Rapid industrialization, westernization of the society and poor labeling laws of cosmetics put us to the threat of "contact sensitization explosion" in near future. To know the drift of common contact sensitizers in the region, patch testing provides an insight into the cause of allergic contact dermatitis. The objective of the study was to determine the commonest allergen responsible for allergic contact dermatitis among patients attending contact dermatitis clinic in a tertiary care hospital.

**Methods:** This retrospective study was conducted in the Department of Dermatology of our institution. We reviewed the medical records of all patients who were patch tested over a period of 6 years, using Indian standard series.

**Results:** A total of 521 patients who were patch tested in the contact dermatitis clinic were included in the study. Nine patients with angry back were excluded. There were 269 males and 243 females. The commonest provisional diagnosis was allergic contact dermatitis secondary to hair dye in 172 (33.3%) patients followed by air borne contact dermatitis to parthenium in 88 (17.3%) patients. The paraphenylenediamine (PPD) being the most common sensitizer in 92 (17.9%) patients was followed by nickel in 86 (16.7%) patients, potassium dichromate in 36 (7%), parthenium in 32 (6%) and fragrance mix in 31 (6%) patients.

**Conclusions:** This study revealed higher prevalence of hair dye dermatitis. Paraphenylenediamine was the most common allergen.

**Keywords:** Allergic contact dermatitis, Hair dye, Parthenium, Nickel, Dichromate, PPD, Patch test

## INTRODUCTION

Patch test was first employed in 1847 by Staedler to test idiosyncrasy. However, the "father of patch testing" Jadassohn first scientifically established the role of patch testing in dermatitis medicamentosa.<sup>1</sup> Patch testing provides an insight into the cause of allergic contact dermatitis. When applied and interpreted properly, it is the only scientific proof of allergic contact dermatitis.<sup>2</sup>

Sensitization rates as high as 35.4% in women and 14.8% in men have been reported in literature.<sup>3</sup> Allergic contact dermatitis (ACD) develops in only a small proportion of sensitized individuals and population estimates vary from 1.7% to 6% of patients.<sup>4</sup> Common sensitizers do vary with place, patient profile and over a period of time. In this retrospective review the commonest provisional diagnosis was allergic contact dermatitis to hair dye. Paraphenylenediamine (PPD) being the most common

sensitizer on patch test results. Hair dyes, belonging to the broad group of aryl amines, are one of the most frequently used hair cosmetics. They are used not only to hide graying hair but also to change one's hair color to enhance beauty. It is supposed that Oscar Wilde may well have been one of the first documented cases of allergic contact dermatitis to hair dyes.<sup>5</sup> In the 1930's, Bonnevie suggested that PPD should be included in patch test standard series.<sup>6</sup> Since the mainstay in the management of patients with allergic contact dermatitis is avoidance of causative factors. Identification and establishing relevance of that factor by patch testing is of paramount importance. By this manuscript, we hereby present the data analysis of six years from this tertiary care institute of the sub-Himalayan region of India with increased risk of hair dye dermatitis among consumers.

### Objective

The objective of the study was to determine the commonest allergen responsible for allergic contact dermatitis among patients attending contact dermatitis clinic in a tertiary care hospital.

### METHODS

This retrospective study was conducted in the Department of Dermatology, Venereology and Leprosy, Indira Gandhi Medical College, Shimla. All patients w.e.f. April 2011 to March 2017 i.e. over a period 6 years, who had been subjected to patch test were included in the study. As per standard protocol, demographic variables, clinical history, pattern of dermatitis and clinical provisional diagnosis were recorded in detail. We reviewed and studied their medical records. The Indian Standard Series (Table 1) approved by Contact and Occupational Dermatoses Forum of India was (Systopic India Ltd., Bangalore, India) used for patch testing by Finn Chamber method. As per protocol followed in our department; the patches were applied over upper back using the antigen loaded on Finn chambers and mounted on micropore adhesive tape. They were removed after 48 hours and readings were recorded at 30 minutes after removal and again at 72 hours. Observation interpretations were graded in accordance to International Contact Dermatitis Research Group (ICDRG) Guidelines.<sup>7</sup> Reactions persisting till 72 hours were considered as positive. The clinical relevance of patch test results was determined according to criteria recommended by Fisher's Contact Dermatitis. Followed with post patch test detailed interview of patients.

### RESULTS

A total of 521 patients were included in this study. Nine patients exhibiting angry back phenomenon were excluded, leaving 512 patients for final analysis. These comprised of 269 males and 243 females. Male to female ratio was 1.1: 1. The age of these patients ranged from 14 years to 87 years with a mean of 45.92 years. The

duration of dermatitis varied from 20 days to 30 years with relapses and remissions before being patch tested. A total of 400 positive reactions to one or more allergen of the Indian Standard Series were observed in 264 (51.5%) patients. A majority of them, 172 (33.5%) patients revealed sensitivity to one allergen, 56 (10.9%) patients to two antigens, 28 (5.4%) patients to three allergens and 8 (1.5%) patients had positive reactions to 4 antigens. An additional 46 (8.9%) positive reactions were observed to patient's own products, which they were using. The most common allergen was paraphenylenediamine (PPD) in 92 (17.9%) patients followed by nickel in 86 (16.7%) patients, potassium dichromate in 36 (7%), parthenium in 32 (6%), fragrance mix in 31 (6%) patients (Figure 1). The commonest allergen in males was PPD seen in 55 patients i.e. 20.4% of males followed by potassium dichromate in 33 (12.2%) patients. The commonest allergen seen in females was nickel in 73 (30%) female patients followed by PPD in 37 (15.2%) cases. Patients developed positive reactions to almost all antigens in the patch test series except for two antigens formaldehyde and polyethylene glycol.

Among the 172 patients with clinical impression of allergic contact dermatitis to hair dye, we observed 92 positive reactions giving a positivity rate of 53.4%. Among these 39 (22.6%) patients even tested positive to their own hair dye samples. There were only 3 patients who did not elicit any positive reaction to PPD antigen in standard series, but were only positive to their own hair dye products. Patch test positivity was 36.3% among patients tested for parthenium dermatitis (32 out of 88 patients).

The commonest provisional diagnosis was allergic contact dermatitis secondary to hair dye in 171 (33.3%) patients followed by air borne contact dermatitis to parthenium in 88 (17.1%), hand eczema in 56 (10.9%) cases (Figure 2).

Among 12 patients with dermatitis medicamentosa, clinical impression of allergic contact dermatitis to eyedrops and neomycin in 3 patient each, parabens in 2, betadine and fusidic acid in one patient each and ayurvedic medications in 2 patients was observed. Among patients tested positive for their own products, positive patch tests were seen with betadine ointment, clotrimazole cream and neomycin ointment.

Most of our patients belonged to rural background with rural to urban ratio of 2.2:1. History of atopy was present in 4.3% of patients. Most of our patients were housewives (26.8%) followed by farmers (15.7%), masons (7%), hospital employees (6.3%) and students (6.3%). No one was from hairdressing profession although our study revealed hair dye dermatitis (PPD sensitization) as the commonest pattern of dermatitis or sensitization, indicating the now frequent use of hair dye by significant number of cases is the real threat as allergen to sensitive consumers.

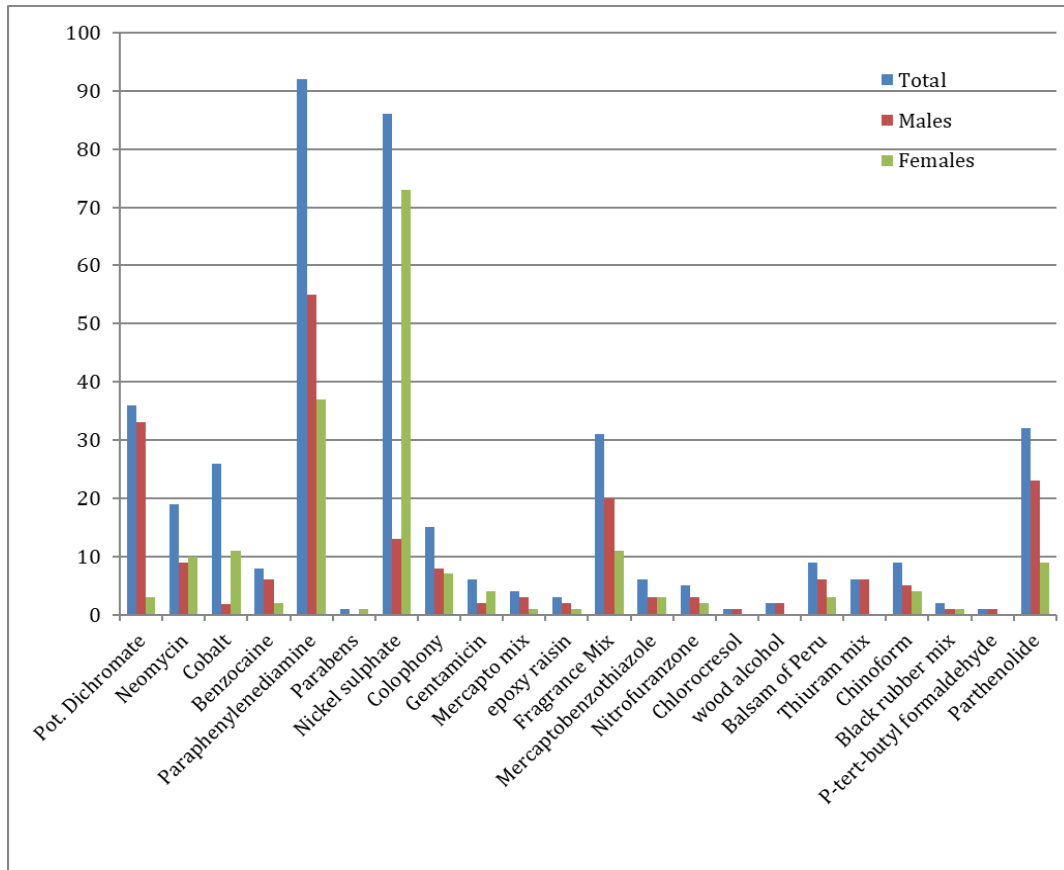


Figure 1: Positive patch test results to different antigens with Indian standard series.

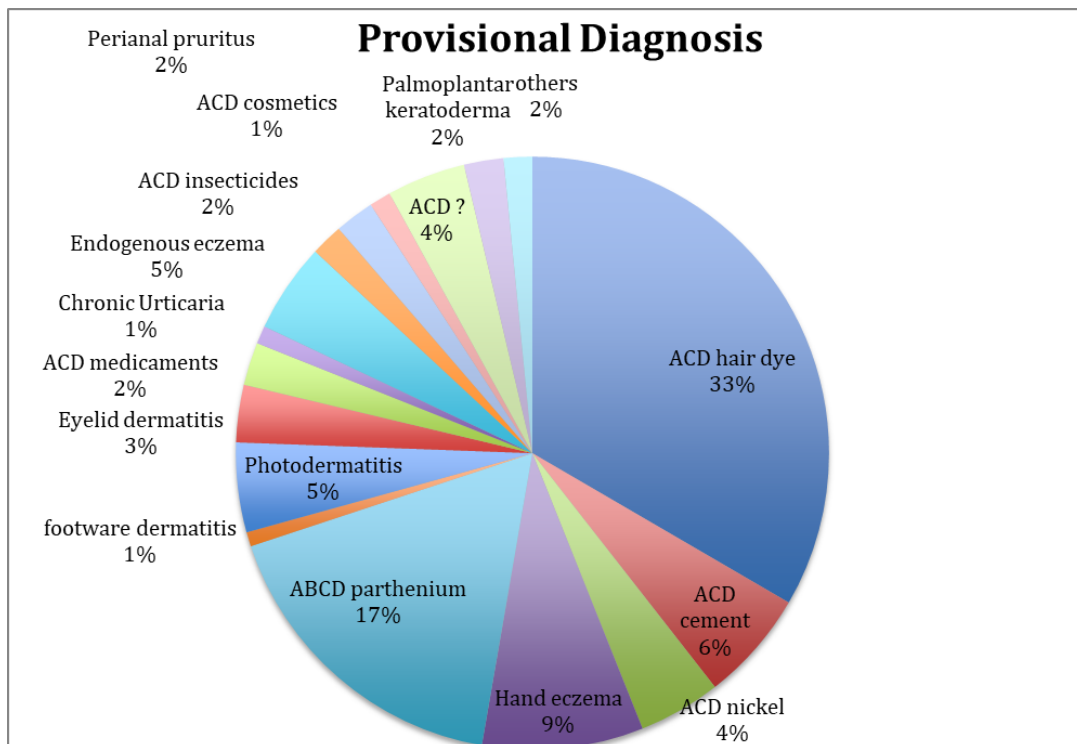


Figure 2: Clinical provisional diagnosis of the study group patients.

**Table 1: List of patch test allergens with concentrations.**

Allergens	Concentration (%)
1. Petrolatum	100
2. Potassium dichromate	0.5
3. Neomycin sulphate	20
4. Cobalt chloride – hexahydrate	1
5. Benzocaine	5
6. 4-phenylenediamine (PPD)	1
7. Parabens	15
8. Nickel sulphate – hexahydrate	5
9. Colophony	20
10. Gentamycin sulphate	20
11. Mercapto mix	2
12. Epoxy resin	1
13. Fragrance mix	8
14. Mercaptobenzothiazole	2
15. Nitrofurazone	1
16. 4-chloro-3-cresol	1
17. Wood alcohol	30
18. Balsam of peru	25
19. Thiuram mix	1
20. Chinoform	3
21. Black rubber mix	0.6
22. P-tert-butylphenol-formaldehyde resin	1
23. Formaldehyde	1.1
24. Polyethylene glycol	100
25. Parthenium hysterophorus (parthenolide)	0.1

## DISCUSSION

Patch test analysis in our study revealed a positivity of 52.9% to one or more allergens. It is comparable to (52.78%) a study from Pondicherry by Laxmisha et al and smaller study from rural India area by Mehta et al (51.33%).<sup>8,9</sup> Whereas, previous studies from other parts of India have reported patch-test positivity rates varying from 60 to 65%.<sup>10,11</sup> Positivity rates in our study are higher as compared to the positivity rate of 32.3% in other study from Turkey.<sup>12</sup> Tropical climate may be responsible for higher positivity enhancing more penetration of antigen and manifestation of contact dermatitis.

There was no statistically significant difference in the sensitization rates between males and females in our patients which was seen in 134 males versus 130 females comparable to previous study.<sup>4</sup> If we compare sensitivities of some common antigens like nickel and chromium, we noticed a higher rate of nickel positivity reaching up to 84.8% among our female patients i.e. 73 out of total 86 positive nickel reactions. This disparity favoring females can be attributed to the custom of ear piercing and jewelry traditions followed in our area. On

the other hand, 91.2% positive reactions to potassium dichromate were almost exclusively seen in males (33 out of 36). More exposure to cement works, non-availability of hypoallergenic cement, lack of protective measures while handling cement and leather accessories among males may be responsible.

The commonest clinical provisional diagnosis in our study was allergic contact dermatitis to hair dye contrary to previous studies where footwear dermatitis, hand dermatitis, parthenium dermatitis were predominant.<sup>4,11,13</sup> It may be attributed to the increased use of hair dye by both males and females. The widespread use of hair dyes, lack of public awareness about PPD allergy, prolonged use of dye by the patient without symptoms in past is responsible for this problem.

The commonest allergen in our study was PPD in 92 (17.2%) patients as compared to nickel in previous studies with similar sample size and study period.<sup>12,14,15</sup> Some studies have reported parthenium as the commonest antigen. PPD being the prominent antigen may be due to the commonest clinical diagnosis of our study. Patients also tested positive to their own hair dye preparations in 39 patients. PPD is the commonest component of hair dyes. Oxidative hair dyes and dark henna temporary tattoos also contain this antigen. Individuals may be sensitized to PPD by temporary henna tattooing in addition to application of hair dye. PPD may show cross-sensitization with other compounds that also contain an amine group in their benzene ring at the para position for example para-aminobenzoic acid, sulfonamides, sulfonylureas, para-toluenediamine sulfate, azo dyes, benzocaine, tetracaine, procaine, para-aminosalicylic acid. For acute, severely affected patients with hair dye dermatitis, the scalp and hair should be washed thoroughly with a soap substitute to remove any excess dye. Theoretically, oxidation of PPD by applying hydrogen peroxide or potassium permanganate solutions may solve the problem. Potent topical corticosteroid or a short course of oral corticosteroids may be required for the management including oral antibiotics for secondary skin infections, if any. Oral antihistamines to counter the pruritus may also be considered.<sup>16</sup>

Newly introduced hair dyes in the market are advertised as “hypoallergenic,” “para-phenylenediamine free,” or “non-allergenic.” However, some of these products do not clearly state the contents of the hair dye. Moreover, sometimes even so-called “safe” hair dyes can trigger contact dermatitis. In a study it was established that these so-called safe dyes can also contain PPD and other allergen responsible for ACD to hair dyes.<sup>17</sup>

Nickel (16.7%) was the second commonest antigen and rates are comparable to previous studies.<sup>12</sup> Sensitization to nickel is common due to frequent contact with alloys, artificial jewelry, coins, keys, buttons, zippers, utensils, spectacle frames, kitchenware etc. Nickel also appears to

be a common contaminant of foods leading to a chronic allergic like dermatitis syndromes. Avoiding sources of nickel contact and low-nickel content diet have been seen to achieve complete or near complete recovery in affected patients.<sup>18</sup>

Parthenium dermatitis though kept as second commonest diagnosis but positivity achieved was only 6% among all. This is quite less as compared to previous studies.<sup>9</sup> However, 30% of those tested were found to be positive. It may be due to fact that most of the patients with a classical air borne dermatitis pattern could not be patch tested. Only few patients turned up for the testing as three days attendance for patch testing attributes to three days of loss of wages too. There were some other ones, where the doses of steroids could not be lowered to a dose considered optimal for patch testing due to aggravation and erythrodermic episodes.

Fragrance mix was positive in 6% patients. This is concordance with previous study from Pakistan.<sup>19</sup> Rates are much higher in other countries. Variations in the frequency of fragrance mix allergy between countries are related to differences in use of cosmetics and toiletries.

In our study over 6 years period and including over 500 patients, we found no positivity for formaldehyde and polyethylene glycol, although a study from northern India reported high incidence of sensitivity to formaldehyde (12.5%) and polyethylene glycol (7.5%), where as in another study they were reported as uncommon sensitizer, formaldehyde (5.3%) and polyethylene glycol (0.6%) positivity respectively.<sup>20,21</sup>

## CONCLUSION

Our study revealed higher prevalence of hair dye dermatitis as compared to other studies. Paraphenylenediamine was the most common allergen and most of patients were positive to their own products including hair dyes. Hence, we recommend use of patients own products. itself for patch testing. Colman in 1982 warned that the greatest abuse of patch testing is failure to use the test. Hence, this valuable tool should be used wherever feasible and applied and interpreted correctly.

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## REFERENCES

1. Ghosh S. Patch testing: broadened spectrum of indications. *Indian J Dermatol.* 2006;51(4):283-85.
2. Fisher AA. Contact dermatitis. 2<sup>nd</sup> ed. Philadelphia: Lea and Febiger; 1986: 31-108.
3. Dotterud LK, Smith-Sivertsen T. Allergic contact sensitization in the general adult population: A population-based study from Northern Norway. *Contact Dermatitis.* 2007;56:10-15.
4. Bajaj AK, Saraswat A, Mukhija G, Rastogi S, Yadav S. Patch testing experience with 1000 patients. *Indian J Dermatol Venereol Leprol.* 2007;73(5):313-8.
5. Nater JP. Oscar Wilde's skin disease: Allergic contact dermatitis? *Contact Dermatitis.* 1992;27:47-9.
6. Bonnevie P. Aetiologie und Pathogenese der Ekzemkrankheiten. *Klinische Studien über die Ursachen der Ekzeme unter besonderer Berücksichtigung des diagnostischen Wertes der Ekzempuben.* Busch, Copenhagen / Barth, Leipzig; 1939.
7. Lazzarini R, Duarte I, Ferreira AL. Patch tests. *An Bras Dermatol.* 2013;88(6):879-88.
8. Laxmisha C, Kumar S, Nath AK, Thappa DM. Patch testing in hand eczema at a tertiary care center. *Indian J Dermatol Venereol Leprol.* 2008;74:498-9.
9. Mehta MJ, Diwan NG, Nair PA, Vora RV. Experience and feasibility of patch testing in allergic contact dermatitis in rural population. *Indian J Allergy Asthma Immunol.* 2015;29:40-45.
10. Singhal V, Reddy BS. Common contact sensitizers in Delhi. *J Dermatol.* 2000;27:440-5.
11. Sharma VK, Sethuraman G, Garg T, Verma KK, Ramam M. Patch testing with the Indian standard series in New Delhi. *Contact Dermatitis.* 2004;51:319-21.
12. Hillenbrand AE, Bayazit OE. Patch test results in 542 patients with suspected contact dermatitis in Turkey. *Contact Dermatitis.* 2002;46(1):17-23.
13. Al-Sheikh OA, Gad el-Rab MO. Allergic contact dermatitis: Clinical features and profile of sensitizing allergens in Riyadh, Saudi Arabia. *Int J Dermatol.* 1996;35:493-7.
14. Taheri AR, Farmanbar MA, Kiafar B, Khajedaluee M, Javidi Z, Nahidi Y, et al. Patch test results in patients with suspected allergic contact dermatitis: a study from Mashhad, Iran and a review of literature. *Iran J Dermatol.* 2014;17:1-7.
15. Majid I. Contact allergens in Kashmiri population: Results from a 6-year patch testing experience in 550 patients. *Indian J Dermatol Venereol Leprol.* 2014;80:61-4.
16. Mukkanna KS, Stone NM, Ingram JR. Paraphenylenediamine allergy: current perspectives on diagnosis and management. *J Asthma Allergy.* 2017;10:9-15.
17. Lee HJ, Kim WJ, Kim JY, Kim HS, Kim BS, Kim MB, et al. Patch tests with commercial hair dye products in patients with allergic contact dermatitis to para-phenylenediamine. *Indian J Dermatol Venereol Leprol.* 2016;82:645-50.
18. Antico A, Soana R. Nickel sensitization and dietary nickel are a substantial cause of symptoms provocation in patients with chronic allergic-like



- dermatitis syndromes. *Allergy Rhinol*. 2015;6:56–63.
19. Hussain I, Rani Z, Rashid T, Haroon TS. Suitability of the European standard series of patch test allergens in Pakistani patients. *Contact Dermatitis*. 2002;46:50-1.
20. Jain A, Chander R, Mendiratta V. Contact dermatitis in nurses and paramedicals in a tertiary care hospital of northern India. *Indian J Dermatol*. 2010;76:566-7.
21. Thilak S, Govindaraju M, Thangarajet B. A study of 300 cases of allergic contact dermatitis. *Int J Res Dermatol*. 2017;3:13-9.

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