Clinical, Occupational and Allergological Profile of 455 Patients with Occupational Contact Dermatitis: A 5-Year Study from a Tertiary Care Center of North India

Abstract

Objectives: To evaluate clinical and occupational profile and common allergens in patients with occupational contact dermatitis (OCD). Materials and Methods: The records of 455 (M:F 2:1) patients aged 18-85 years with allergic contact dermatitis were analyzed retrospectively. The diagnosis of OCD and patterns of dermatitis were defined by standard criteria. Indian standard series comprising 20 allergens and when suspected patient’s own products were patch tested by Finn chamber method as per European Society of Contact Dermatitis guidelines and relevance of positive results was defined clinically. Results: Airborne contact dermatitis (27.7%), acral dermatitis (14.1%), hand dermatitis (12.9%), acrofacial dermatitis (12.7%), and facial dermatitis (10.5%) were the common patterns. Agriculturists (51.2%), homemakers (27.9%), office workers (24.6%), and construction workers (4.6%) comprised the majority. Positive patch test results in 58% cases were from parthenium (31.7%), p-paraphenylendiamine (PPD) (22.9%), nickel (16%), fragrance mix (11%), potassium dichromate (10.7%), cobalt (7.6%), and mercaptopbenzothiazole (4.9%). Hair colorants, shoe chips, and shaving cream also produced relevant positive reactions. Parthenium, PPD, fragrance mix, and potassium dichromate in agriculturists; nickel, parthenium, PPD, fragrance mix, and potassium dichromate in women, and potassium dichromate and parthenium in construction workers elicited the most positive reactions. PPD and hair colorants elicited positive reaction mainly in office workers. Conclusions: The agriculturists, homemakers, and construction workers have OCD most frequently. Parthenium in farmers, potassium dichromate in construction workers, nickel in women, and PPD in office workers were the major contact allergens. The study is limited by its retrospective design, small number of patients, and limited number of patch test allergens.

Keywords: Airborne contact dermatitis, allergic contact dermatitis, facial dermatitis, hand dermatitis, Indian standard series, occupational contact dermatitis, parthenium, patch testing

Introduction

The prevalence of allergic contact dermatitis (ACD) ranges from 1.7% to 6% of the general population and accounts for 4% to 7% of the dermatology outdoor attendees.[1,2] Exposure to an allergen in most instances is occupational and 40-60% of occupational absenteeism is attributed to some form of occupational contact dermatitis (OCD).[3,4] The commonly affected are personnel involved in household work (cooking, washing, cleaning, child care), agriculture and cattle rearing, construction, cleaning, salons, health care, handling of food materials (cooks, bakers) or plants and plant material (farmers, gardeners, foresters), and metal or other industrial work. An exposure to products of daily use (apparels, skin and hair care products, medications, equipments, and tools) may also result in contact sensitization.[5] However, nature of contactants varies over a period of time and across geographies as some common and potential allergens become uncommon sensitizers due to discontinuation or their infrequent use (e.g., multifungin and nitrofurazone) while on the other hand some new potent allergens are introduced into the environment or daily life (e.g., Parthenium hysterophorus, pesticides, cosmetics, and toiletries) with ever increasing requirements.[6,7] Legal restrictions to use certain chemicals can also alter the pattern of contact allergens. For instance, in Denmark

How to cite this article: Mahajan VK, Mehta KS, Chauhan PS, Sharma R, Sharma A, Verma YR, et al. Clinical, occupational and allergological profile of 455 patients with occupational contact dermatitis: A 5-year study from a tertiary care center of North India. Indian Dermatol Online J 2021;12:541-8.

Received: 19-Sep-2020. Revised: 04-Mar-2021. Accepted: 06-Mar-2021. Published: 14-Jul-2021.

© 2021 Indian Dermatology Online Journal | Published by Wolters Kluwer - Medknow
and Singapore changing the composition of cement by adding ferrous sulfate has significantly reduced chromate sensitivity in construction workers.[8,9] Similarly, the use of p-paraphenylenediamine (PPD) has been discontinued in some countries while in India it is still a common constituent of hair colorants. Climatic conditions may also affect the pattern of contact dermatitis. For instance, contact dermatitis from footwear, jewelry, or clothing is common that usually worsens during hot and humid climates in tropical countries like India.[10] Patch testing is a standard method of investigating patients with ACD of any origin and especially when a careful history and clinical examination fail to identify the offending allergen(s).

The prevalence of OCD varies across ethnicities, countries and at a given period of time depending upon index of clinical suspicion, facility for patch testing, socioeconomic and demographic profile of population, and industrial development in the region. The spectrum of OCD also differs significantly across occupations depending upon nature and the extent of exposure to different allergens specific to the work and use of protective measures.[11,12] Himachal Pradesh, a small hill state of north India situated at 30°N and 75°E in Western Himalayas, has more than 95% of its population involved primarily in agriculture/horticulture/cattle rearing or related occupations despite rapid urbanization. There has been also an increased thrust on industrial and infrastructure development in the region leading to changing socioeconomic and demographic profile of population during past few years. Thus, identification of professions at risk for OCD and putative allergens may help in the development and implementation of targeted prevention strategies. We retrospectively analyzed data of patch testing from our clinic to delineate prevailing clinical and occupational profile, patterns of contact dermatitis, and common contact allergens in view of complete lack of such data.

Materials and Methods

The medical records of patients with ACD and patch tested in dermatology outpatient clinic between Jan 2014 to Dec 2018 were analyzed retrospectively for this hospital based descriptive observational study. The study was approved by Institutional Ethics Committee. The demographic profile, occupations, clinical patterns and duration of dermatitis, and detailed medical history were recorded. Depending upon specific sites involved the clinical patterns of ACD were defined as airborne contact dermatitis (ABCD), acral dermatitis, hand dermatitis, acrofacial dermatitis, facial dermatitis, and feet dermatitis, and undefined pattern. Mathias’ criteria [Table 1] were used to diagnose OCD.[13]

The Indian standard patch test series comprising 20 allergens approved by Contact and Occupational Dermatoses Forum of India and marketed by Systopic India Ltd, New Delhi (India), was used for patch testing. Patients were also patch tested “as is” with products of daily use such as hair colorants, shaving creams, or shoe chips brought by them when they were suspected to have caused ACD. The patch testing was performed by Finn chamber® method according to European Society of Contact Dermatitis guidelines.[14] The Finn chambers (8 mm) with test allergens were applied on non-hairy upper back after gentle cleansing with ethyl alcohol. The patches were removed after 48 h and the (D2) reading of results was made 1 h after the skin regained its normal contours. Second reading was made at 72 h (D3). The results were graded according to the International Contact Dermatitis Research Group criteria.[15] The positive reactions persisting on D3 were considered for final analysis only. The relevance of positive patch test results was determined clinically as definite, probable, past, and unknown.[16] Children aged <18 years, pregnant and lactating women, and patients on systemic corticosteroids were not patch tested. Patients with active dermatitis were patch tested after 3 weeks when they were free of dermatitis and off systemic/topical corticosteroids. All patients were informed about the cause of their dermatitis and provided with standard treatment and counseling for avoidance of putative allergen(s).

| Clinical criteria* |
|-------------------|
| 1 Is the clinical appearance consistent with contact dermatitis? |
| 2 Are there workplace exposures to potential cutaneous irritants or allergens? |
| 3 Is the anatomical distribution of dermatitis consistent with cutaneous exposure in relation to the job task? |
| 4 Is the temporal relationship between exposure and onset consistent with contact dermatitis? |
| 5 Are non-occupational exposures excluded as possible causes? |
| 6 Does dermatitis improve away from work exposure to the suspected irritant or allergen? |
| 7 Do patch or provocation tests identify a probable causal agent? |

*Presence of four of seven criteria indicates a reasonable probability (>50%) of occupational contact dermatitis

Results

Table 2 depicts baseline characteristics of 455 patients comprising 303 (66.6%) males and 152 (33.4%) females (M:F 2:1) aged between 18 and 85 years (mean ± SD 46.95 ± 14.4 years). The majority, 358 (78.7%) patients
Table 2: Baseline characteristics of patients and frequency of positive patch test results

| Baseline characteristics | Number of patients(%) n=455 |
|--------------------------|-----------------------------|
| Gender                   |                             |
| Males (M)                | 303 (66.6)                  |
| Females (F)              | 152 (33.4)                  |
| M:F                      | 2:1                         |
| Age in years             |                             |
| Range                    | 18-85                       |
| Mean±SD                  | 46.95±14.4                  |
| ≤20                      | 19 (4.2)                    |
| 21-40                    | 147 (32.3)                  |
| 41-60                    | 211 (46.4)                  |
| 61-80                    | 75 (16.5)                   |
| >80                      | 3 (0.6)                     |
| Duration of dermatitis   |                             |
| Range                    | 1-40                        |
| Mean±SD                  | 3.7±4.9                     |
| <5 years                 | 331 (72.7)                  |
| 5-10 years               | 86 (18.9)                   |
| >10 years                | 38 (8.4)                    |
| Occupations*             |                             |
| Home makers              | 127 (27.9)                  |
| Agriculture              | 233 (51.2)                  |
| Office workers           | 112 (24.6)                  |
| Construction workers     | 21 (4.6)                    |
| Students                 | 18 (3.9)                    |
| Business/shopkeepers     | 17 (3.7)                    |
| Medical personnel        | 13 (2.8)                    |
| Auto Mechanics           | 4 (0.9)                     |
| Chefs/waiters            | 4 (0.9)                     |
| Others                   | 33 (7.3)                    |
| Clinical patterns        |                             |
| Dermatitis (ABCD)        | 126 (27.7)                  |
| Acral (Hands & Feet)     | 64 (14.1)                   |
| Dermatitis               | 59 (12.9)                   |
| Hand dermatitis          | 58 (12.7)                   |
| Acrofacial dermatitis    | 48 (10.5)                   |
| Facial dermatitis        | 33 (7.3)                    |
| Feet dermatitis          | 67 (14.7)                   |
| Unclassified pattern     | 262 (58.0)                  |
| Poly-sensitivity         | 79 (17.4)                   |
| Excited skin syndrome    | 8 (1.7)                     |

*Note: Among women, 11 were students, 14 were office workers, and 127 were involved in agriculture related work in addition to household work.

Table 3 shows frequencies of positive reactions from various allergens and the common sources and occupations for their exposure and contact sensitization. The majority of positive reactions were from parthenium in 83 (31.7%), PPD in 60 (22.9%), nickel sulfate in 42 (16%), fragrance mix in 29 (11%), potassium dichromate in 28 (10.7%), cobalt sulfate in 20 (7.6%), and mercaptobenzothiazole (MBT) in 13 (4.9%) patients, respectively. Nine (3.4%) reactions each were from Myroxylon pereirae and thiuram mix. Parabens, benzocaine, and colophony each elicited 8 (3%) reactions. Neomycin sulfate 6 (2.3%), formaldehyde 5 (1.9%), wool alcohol 4 (1.5%), chlorocresol 3 (1.1%), and epoxy resins 2 (0.8%) positive reactions, respectively, in order of frequency. All positive reactions were clinically relevant. Eight (1.7%) patients had developed excited skin syndrome.

Table 4 shows clinical patterns and common allergens eliciting positive reactions in order of frequencies. Relevant positive reactions from personal hair dyes in 23 and shaving cream in four patients, respectively, occurred among 26 patients along with positive reactions to PPD, parthenium, nickel, fragrance mix, colophony, formaldehyde, potassium dichromate, parabens, and Myroxylon pereirae among antigens from Indian standard patch test series. PPD was also the major allergen in acrofacial dermatitis. Of the 33 patients with feet dermatitis, 22 patients were suspected to have footwear dermatitis and 8 of them showed positive patch test reactions from their shoe chips. Whereas, MBT was the major allergen in 4 patients with feet dermatitis, and black rubber mix, PPD, and nickel were additional contact allergens in one patient each. Parthenium in patients with ABCD, nickel in patients with hand dermatitis, and potassium dichromate in patients with acral dermatitis elicited most positive reactions.

Table 5 depicts occupations and common allergens eliciting positive reactions in order of frequencies. Among women and home makers, nickel, parthenium, PPD, fragrance mix, and potassium dichromate were the most prominent allergens while parthenium, PPD, fragrance mix, and potassium dichromate elicited most
Table 3: Indian Standard Series allergens and frequency of positive reactions

| Patch test allergen                        | Patch test conc. used | Number of patients (%) n=262 | Common sources of contact sensitization/occupations                                                                 |
|-------------------------------------------|-----------------------|------------------------------|---------------------------------------------------------------------------------------------------------------------|
| Wool alcohol (lanolin)                    | 30% pet.              | 4 (1.5)                      | Emulsifier in cosmetics, topical medications, leather, textiles, furniture polish, waxes, emulsions, inks, cutting oils |
| *Myroxylon pereirae* (Balsam of Peru)     | 25% pet.              | 9 (3.4)                      | Flavor in tobacco, pastries, cakes, drinks, wines, topical medications, spices, perfume. Cross reacts with colophony, cinnamates, benzoates, bees wax, eugenols, propolis |
| Formaldehyde                              | 1% pet.               | 5 (1.9)                      | Used in cosmetics, shampoos, antiperspirant, tanning, glues, wood composites, adhesives, textiles, paints, disinfectants, deodorizers, metal working fluids, fertilizers in agriculture |
| MBT                                        | 2% pet.               | 13 (4.9)                     | Rubber products (shoes, gloves, medical devices, toys, tires, tubes), greases, adhesives, tick and flea sprays, antifreeze mixtures, used as fungicide in agriculture |
| Potassium dichromate                      | 0.5% pet.             | 28 (10.7)                    | Cement, leather tanning, textile dyes, alloys, welding, glues, paints, automobiles, ceramics |
| Nickel sulphate                           | 5% pet.               | 42 (16.0)                    | Trinkets, watches, coins, instruments, buttons, tools, zippers, alloys, kitchenware, batteries, metal cutting fluids, keys, scissors, razors, specs, door handles, etc. |
| Cobalt sulphate                           | 1% pet.               | 20 (7.6)                     | Paints, trinkets, zippers, instruments, buttons, tools, utensils, hair dyes, cosmetics, construction work |
| Colophony                                  | 20% pet.              | 8 (3.0)                      | Varnishes, polish, waxes, cosmetics, dental material, topical medications, glues, printing inks, adhesives |
| Epoxy resin                               | 1% pet.               | 2 (0.8)                      | Adhesives, electrical insulation, plasticizers, paints, inks, laminates, PVC products, construction work |
| Paraben                                    | 15% pet.              | 8 (3.0)                      | Preservative in foods, cosmetics, medications, oils, fats, glues, textiles, shoe polish. Cross reacts with other para compounds |
| PPD                                        | 1% pet.               | 60 (22.9)                    | Hair colorants, fur dyes, rubber and plastic, oils, gasoline. Cross reacts with PABA, parabens |
| Parthenium                                | 1% aq.                | 83 (31.7)                    | A wild weed, Compositae plant growing in vacant lots and around roadsides, fields, and open spaces. Trichomes and dried plant debris are airborne and main direct or indirect source of contact dermatitis in all persons particularly plant handlers, farmers, construction workers, etc. |
| Neomycin sulphate                         | 20% pet.              | 6 (2.3)                      | Topical antibiotic formulations, growth promoter in veterinary. Cross reacts with gentamicin, fraymucetin, kanamycin, tobramycin, bacitracin, streptomycin |
| Benzocaine                                | 5% pet.               | 8 (3.0)                      | Anesthetic gels/creams for burns, hemorrhoids, oro- gingivitis. Cross reacts with procainamide, other para compounds, PABA, PPD, hydrochlorothiazide |
| Chlorocresol                              | 1% pet.               | 3 (1.1)                      | Preservative (fungicide) in adhesives, glues, inks, paints, varnishes, topical medications, antiseptics, shampoos, creams, cosmetics, cooling fluids |
| Fragrance mix                             | 8% pet.               | 29 (11.0)                    | Cosmetics (after shave, perfumes, cologne, soaps, skin care products) food items (chewing gums, ice creams, sweets), household products (room fresheners, waxes, polishes, insect repellents), metal working fluids |
| Thiuram mix                               | 1% pet.               | 9 (3.4)                      | Rubber, latex gloves, soap bacteriostatic, agriculture (fungicide, disinfectant for seeds, animal repellent) |
| Nitrofurazone                              | 1% pet.               | 2 (0.8)                      | Topical antibacterial in human and veterinary medicines, in animal feeds |
| Black rubber mix                          | 0.6% pet.             | 1 (0.4)                      | Rubber products (tires, gloves, boots, shoe soles and cushions, tubes, pipes, gaskets, handles), eyelash curlers |

Notes: 79 (17.4%) patients had positive reaction to two or more allergens. Aq., aqueous; Conc., concentration; MBT, mercaptobenzothiazole; pet. petrolatum; PPD, paraphenylenediamine
### Table 4: Clinical patterns of contact dermatitis and patch test allergens

| Clinical patterns                                      | Definition                                                                 | Number of patients (%) | Common patch test allergens (number of positive reactions) | Remarks                                                                                   |
|--------------------------------------------------------|---------------------------------------------------------------------------|------------------------|-------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| Airborne Contact Dermatitis (ABCD) with or without photo-aggravation | Dermatitis particularly of exposed body parts, including deep creases of face, upper eyelids, Wilkinson’s triangle, V area of neck, cubital and popliteal fossae, and other body folds caused by the allergens released in the atmosphere. | 86 (32.8)              | Parthenium (68), PPD (10), Potassium dichromate (10), Nickel (8), fragrance mix (7), Cobalt (6), Myroxylon pereirae (5), Thiuram mix (3), Colophony (3), Benzocaine (3), Chlorocresol (3), Parabens (2), Formaldehyde (2), Neomycin (1), Wool alcohol (1) | Four patients had Angry back phenomenon. Poly sensitivity occurred in 28 patients. |
| Acral (Hands & Feet) Dermatitis                        | Dermatitis simultaneously involving hands, feet and distal extremities.    | 25 (9.5)               | Potassium dichromate (6), Fragrance mix (4), Nickel (4), Cobalt (4), PPD (2), Myroxylon pereirae (2), Epoxy resin (1), Parthenium (1), Neomycin (1), Wool alcohol (1), Parabens (1), Formaldehyde (1), Thiuram mix (1), | Poly sensitivity occurred in 9 patients. |
| Hand dermatitis                                        | Dermatitis predominantly involving hands, fingers, and up to wrists with or without dorsal surface. | 17 (6.5)               | Nickel (10), Potassium dichromate (5), Fragrance mix (4), Cobalt (4), Parabens (2), PPD (1), Colophony (1), MBT (1), Formaldehyde (1), Thiuram mix (1), Benzocaine (1), | Two patients had Angry back phenomenon. Poly sensitivity occurred in 8 patients. |
| Acrofacial dermatitis                                  | Dermatitis predominantly affecting face and distal extremities            | 29 (11.1)              | PPD (11), Parthenium (6), Nickel (3), Neomycin (2), Cobalt (2), MBT (1), Potassium dichromate (1), Parabens (1), Fragrance mix (1), Myroxylon pereirae (1), Nitrofurazone (1) | Two patients had Angry back phenomenon. Poly sensitivity occurred in 4 patients. |
| Facial dermatitis                                      | Dermatitis affecting face predominantly and neck but sparing creases and deep recesses of face | 26 (9.9)               | PPD (26), Nickel (9), Parthenium (3), Fragrance mix (3), Colophony (3), Formaldehyde (1), Potassium dichromate (1), Parabens (1), Myroxylon pereirae (1) | 23 patients with PPD sensitivity also showed positive reaction to hair dye. 4 patients had positive reactions to shaving cream. Poly sensitivity occurred in 7 patients. |
| Feet dermatitis                                        | Dermatitis predominantly involving feet up to ankles with or without dorsal surface. | 13 (5.0)               | MBT (4), Potassium dichromate (3), Nickel (1), Thiuram mix (1), Cobalt (1), PPD (1), Black rubber mix (1), Benzocaine (1), Fragrance mix (1) | Nine patients had positive reactions to shoe chip (one patient each along with Nickel and Black rubber mix). One patient had Angry back phenomenon. Poly sensitivity occurred in 6 patients. |
| Undefined pattern                                      | No above identified pattern. Dermatitis is localized to one area or is widespread and multiple non-contiguous skin sites are involved | 56 (21.4)              | PPD (4), Parabens (2), Nickel (1), Parthenium (1), Myroxylon pereirae (1), Wool alcohol (1) | Three patients with PPD sensitivity also showed positive reaction to hair dye. Poly sensitivity occurred in 2 patients. One patient had Angry back. |

79 (17.4%) patients had positive reaction to two or more allergens. MBT, mercaptobenzothiazole; PPD, paraphenylenediamine
Table 5: Occupations and spare time activities and common patch test allergens

| Occupation/spare time activities | Number of patients (%) n=262 | Patch test allergens (number of positive reactions) | Remarks |
|---------------------------------|-----------------------------|--------------------------------------------------|---------|
| Home makers                     | 68 (25.9)                   | Nickel (34), Parthenium (16), PPD (16), Fragrance mix (7), Potassium dichromate (6), Parabens (4), Cobalt (4), MBT (3), Neomycin (3), Formaldehyde (2), Benzocaine (2), Thiuram mix (2), Chlorocresol (1), *Myroxylon pereirae* (1) | All these women were also actively involved in cattle rearing, agriculture and other farming activities. |
| Agriculture                     | 123 (46.9)                  | Parthenium (44), PPD (14), Fragrance mix (12), Potassium dichromate (11), Nickel (7), *Myroxylon pereirae* (5), Cobalt (5), MBT (4), Neomycin (3), Colophony (3), Formaldehyde (2), Parabens (2), Chlorocresol (1), Thiuram mix (1), Black rubber mix (1), Nitrofurazone (1), Benzocaine (1) | Five patients with suspected footwear dermatitis also showed positive reactions to their shoe chips. |
| Office workers                  | 65 (24.8)                   | PPD (24), Parthenium (11), Fragrance mix (8), Nickel (8), Potassium dichromate (5), Colophony (4), *Myroxylon pereirae* (4), Benzocaine (3), MBT (2), Cobalt (1), Thiuram mix (1), Formaldehyde (1), Epoxy resin (1), Wool alcohol (1) | Twelve patients with PPD reactions also showed positive reaction with hair dye. |
| Business/shopkeepers            | 15 (5.7)                    | PPD (6), Parthenium (3), Parabens (2), Cobalt (1), Fragrance mix (1) | Four patients with PPD sensitivity also showed positive reaction to hair dye. |
| Construction workers            | 12 (4.6)                    | Potassium dichromate (9), Parthenium (5), Cobalt (1), Nickel (1), Epoxy resin (1), Fragrance mix (1), MBT (1), Wool alcohol (1) | The patient with Black rubber mix sensitivity also showed positive reaction to his shoe chip. |
| Students                        | 8 (3.0)                     | Parthenium (3), Nickel (2), Potassium dichromate (2), Cobalt (1), Nickel (1), Fragrance mix (1) | Eight patients with PPD sensitivity also showed positive reaction to hair dye. |
| Health care workers             | 7 (2.7)                     | Fragrance mix (4), PPD (2), Nickel (2), Parabens (2), MBT (1), Colophony (1), Thiuram mix (1), Black rubber mix (1) | Four males also had positive reaction to Shaving cream and Colophony |
| Auto Mechanics                  | 1 (0.4)                     | PPD (1) | | |
| Waiter                          | 1 (0.4)                     | PPD (1), Fragrance mix (1) | One patient with PPD sensitivity also showed positive reaction to hair dye. |

Notes: 79 (17.4%) patients had positive reaction to two or more allergens. MBT, mercaptobenzothiazole; PPD, paraphenylenediamine

The majority, 358 (78.7%) patients were aged between 21 and 60 years, the most active years of life having high chances of occupational exposure to contact allergens. It is suggested that OCD affects women two times more often than men. However, we had males outnumbering women by two times perhaps from their involvement relatively for long hours in agriculture, construction work, and related activities. The other possible reasons for a smaller number of women could be their low health seeking behavior in general.

**Discussion**

All our patients including women were involved in agriculture and related activities primarily or during sowing and harvesting time. The majority, 358 (78.7%) patients were aged between 21 and 60 years, the most active years of life having high chances of occupational exposure to contact allergens. It is suggested that OCD affects women two times more often than men. However, we had males outnumbering women by two times perhaps from their involvement relatively for long hours in agriculture, construction work, and related activities. The other possible reasons for a smaller number of women could be their low health seeking behavior in general.

Overall patch test positive reactions in our 58% patients corroborates with reported positivity between 40% and 80% among patients with OCD. The clinical patterns of ABCD (27.7%), acral dermatitis (14.1%), hand dermatitis (12.9%), acrofacial dermatitis (12.7%),
and feet dermatitis (7.3%) observed in our patients are well reported.\textsuperscript{[18,19,23]} ABCD, acral, or hand dermatitis is expectedly more common as the contactants (airborne parthenium detritus/trichomes, PPD in hair colorants, potassium dichromate, nickel, and cobalt in cement or metal tools) come directly in contact with these body parts. Facial dermatitis (10.5%) was observed more frequently from PPD, fragrance mix, hair colorants, and shaving cream whereas MBT, rubber mix, and potassium dichromate used in leather tanning and shoe materials were common allergens in feet dermatitis (5%) patients in this study.

Farmers remain at a highest risk for OCD worldwide and the prevalence varies between 55% and 90% in India and 86% internationally.\textsuperscript{[18,20]} Plants, plant materials and weeds, animals or animal feeds, metals (chromates, nickel), rubber chemicals, and pesticides account for most cases.\textsuperscript{[7,19,20,24-26]}\textit{Parthenium hysterophorus} due to its ubiquitous presence remains the commonest reported contact allergen eliciting positive reactions in 50% to 70% cases in India and 50% of them were in agriculture workers in one series as was also observed in this study.\textsuperscript{[19,20,24]} The other major allergens in order of frequency eliciting positive reactions were PPD (n=14), fragrance mix (n=12), potassium dichromate (n=11), nickel (n=7), Myroxylon pereirae (n=5), cobalt (n=5), MBT (n=4), neomycin (n=3), colophony (n=4), thiuram mix (n=4), and black rubber mix (n=1) in our patients and are well described occupational allergens among agriculture workers.\textsuperscript{[19,20,24]}

Since all the eight students were also involved in agriculture activities, they also showed most positive reactions from parthenium, nickel, and potassium dichromate.

Housewives constitute a major group at risk of getting affected due to wet work and exposure to household irritants/contactants. Prevalence of positive patch test reactions is high and ranges from 50% to 72% and rubber (20%), nickel (18%), cosmetics and fragrances (10%) are the common allergens in them.\textsuperscript{[19,27,28]} However, parthenium, PPD, and potassium dichromate were expectedly additional relevant allergens among them due to occupational (agriculture activities) exposure in this study.

The reported prevalence of hair dye dermatitis is 16% and 84% among rural and urban population, respectively, and is usually from desire among town dwellers/office goers to look younger among peers.\textsuperscript{[6,29]} Similarly, the PPD was the commonest contact allergen in our 24.8% office goers, 5.7% shopkeepers, and 2.7% health care workers eliciting 24, 6, and 4 positive reactions, respectively. The commonest source of PPD sensitization among them was evidently from their personal hair colorants which also elicited positive reactions. Apart from hair colorants, sensitization may also occur from PPD in photocopying and printing inks in office workers. Fragrance mix, thiuram mix, nickel, paraben mix, colophony, and rubber chemicals noted by us are other known constituents and contact allergens in cosmetics or rubber products.\textsuperscript{[19,29]} However, we could not test for latex sensitivity in health care workers.

Among construction workers, occupational exposure to chromates and cobalt (in cement), rubber and leather (gloves, boots), epoxy resins, glues (phenol and urea-formaldehyde), woods, acrylates, varnish (urea-formaldehyde), and polyurethanes usually occurs while digging, building, bricklaying, tiling, repairing, and/or demolishing existing structures, mixing and spreading of concrete, use of tools, machines and equipments, and wood work. Exposure to parthenium or other weeds usually occurs while cleaning and preparing the vacant lots for construction. Potassium dichromate (92%), cobalt chloride (42%), \textit{Parthenium hysterophorus} (30%), mercaptobenzothiazole (10%), fragrance mix (8%), thiuram mix (8%), mercapto mix (6%), cobalt, and nickel were the frequent contact allergens in a recent Indian study.\textsuperscript{[30]} Potassium dichromate, parthenium, epoxy resins, MBT, nickel, and cobalt elicited most positive reactions in our 12 (4.6%) patients involved in construction work is in conformity.

Polysensitivity in our 17.4% patients is apparently from concurrent exposure to various allergens eliciting multiple positive patch test reactions or is perhaps from non-specific hyper-reactivity as cross reactions between them are not documented.

\textbf{Limitations}

The study is limited by small number of patients, its single center and retrospective design. Indian standard patch test series has only a limited number of test allergens. Patch testing with pesticides, cosmetic series, bakery series, hairdressing series, or shoe series was not performed. Long-term follow up for clinical improvement was not a part of the study.

\textbf{Conclusions}

Parthenium in farmers, potassium dichromate in construction workers, nickel in women, and PPD in office workers were the major contact allergens. PPD caused facial dermatitis and positive reactions frequently among office workers and hair colorants remain the major source of sensitization. Nickel was a major allergen among homemakers/women and frequently caused hand dermatitis whereas potassium dichromate caused acral dermatitis and elicited positive reactions frequently among construction workers. However, parthenium with its ubiquitous presence understandably remains the major allergen across all occupations manifesting with all clinical patterns of OCD in our study. Patch testing with hair colorants, shaving creams, or shoe chips brought by patients helped in detecting additional source(s) of sensitization. The development of prevention strategies is particularly important for agriculturists, housewives, and construction workers as they are at an increased risk to develop OCD.
Statement of ethics
The study was approved by the Institutional Ethics Committee (Registration no. ECR/490/Inst/HP/2013/RR-16). All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2013. All patients were provided with standard treatment and counseling.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

References
1. Goh CL. Prevalence of contact allergy by sex, race and age. Contact Dermatitis 1986;14:237-40.
2. White JR. ABC of work related disorders: Occupational dermatitis. BMJ 1996;313:487-9.
3. Diepgen TL. Occupational skin disease data in Europe. Int Arch Occup Environ Health 2003;76:3318.
4. Hassan I, Akhtar S, Zeerak S, Rather PA, Bhat YJ, et al. Clinicopidemiological and patch test profile of patients attending the contact dermatitis clinic of a tertiary care hospital in north India: A 7-year retrospective study. Indian Dermatol Online J 2019;10:669-75.
5. Marks JG Jr, Anderson BE, DeLeo VA. Occupations commonly associated with contact dermatitis. In: Marks JG Jr, Anderson BE, DeLeo VA, editors. Contact and Occupational Dermatology. New Delhi (India): Jaypee Brothers Medical Publishers (P) Ltd.; 2016. p. 282-316.
6. Gupta M, Mahajan VK, Mehta KS, Chauhan PS. Hair dye dermatitis and p-phenylenediamine contact sensitivity: A preliminary report. Indian Dermatol Online J 2015;6:241-6.
7. Sharma A, Mahajan VK, Mehta KS, Chauhan PS, Sharma V, Sharma A, et al. Pesticides contact dermatitis in agricultural workers of Himachal Pradesh (India). Contact Dermatitis 2018;79:213-7.
8. Fregert S, Gruuberger B, Sandahl E. Reduction of chrome in cement by iron sulfate. Contact Dermatitis 1979;5:39-42.
9. Roto P, Sainio H, Reunala T, Laippala P. Addition of ferrous sulfate to cement and risk of chromium dermatitis among construction workers. Contact Dermatitis 1996;34:43-50.
10. Bajaj AK, Saraswat A, Mukhiya G, Rastogi S, Yadav S. Patch testing experience with 1000 patients. Indian J Dermatol Venereol Leprol 2007;73:313-8.
11. Bensfa-Colas L, Telle-Lamberton M, Paris C, Faye S, Stocks SJ, Luc A, et al. Occupational allergic contact dermatitis and major allergens in France: Temporal trends for the period 2001-2010. Br J Dermatol 2014;171:1375-85.
12. Pesonen M, Jolanki R, Larese Filon F, Wilkinson M, Kreckez B, Kiec-Świerczyńska M, et al. Patch test results of the European baseline series among patients with occupational contact dermatitis across Europe-analyses of the European Surveillance System on Contact Allergy network, 2002-2010. Contact Dermatitis 2015;72:154-63.
13. Mathias CGT. Contact dermatitis and workers’ compensation: Criteria for establishing occupational causation and aggravation. J Am Acad Dermatol 1989;20:842-8.
14. Johansen JD, Aalto-Korte K, Agner T, Andersen KE, Bircher A, Bruze M, et al. European Society of Contact Dermatitis guideline for diagnostic patch testing - recommendations on best practice. Contact Dermatitis 2015;73:195-221.
15. Wilkinson DS, Fregert S, Magnusson B, Bandmann HJ, Calnan CD, Cronin E. Terminology of contact dermatitis. Acta Derm Venereol 1970;50:287-92.
16. Jindal N, Sharma NL, Mahajan VK, Shanker V, Tegta GR, Verma GK. Evaluation of photopatch test allergens for Indian patients of photodermatitis: Preliminary results. Indian J Dermatol Venereol Leprol 2011;77:148-55.
17. Thyssen JP, Linneberg A, Menné T, Johansen JD. The epidemiology of contact allergy in the general population- Prevalence and main findings. Contact Dermatitis 2007;57:28799.
18. Duarte I, Rotter A, Lazzarani R. Frequency of occupational contact dermatitis in an ambulatory of dermatologic allergy. An Bras Dermatol 2010;85:455-9.
19. Bhatia R, Sharma VK, Ramam M, Sethuraman G, Yadav CP. Clinical profile and quality of patients with occupational contact dermatitis from New Delhi, India. Contact Dermatitis 2015;73:172-81.
20. Mahajan VK, Sharma VK, Chakrabarti A. Contact dermatitis in agriculture workers: Role of crops, fodder and weedic. Contact Dermatitis 1996;35:373-4.
21. Sarma N. Occupational allergic contact dermatitis among construction workers in India. Indian J Dermatol 2009;54:137-41.
22. Bock M, Schmidt A, Bruckner T, Diepgen TL. Occupational skin disease in the construction industry. Br J Dermatol 2003;149:1165-71.
23. Schwensen JF, Friis UF, Menné T, Johansen JD. One thousand cases of severe occupational contact dermatitis. Contact Dermatitis 2013;68:259-68.
24. Spiewak R. Occupational dermatoses among Polish private farmers. Am J Ind Med 2003;43:647-55.
25. Verma G, Sharma NL, Shanker V, Mahajan VK, Tegta GR. Pesticide contact dermatitis in fruit and vegetable farmers of Himachal Pradesh (India). Contact Dermatitis 2007;57:316-20.
26. Sharma SC, Kaur S. Contact dermatitis from compositeae plants. Indian J Dermatol Venereol Leprol 1990;56:27-30.
27. Singh G, Singh KK. Contact dermatitis of hands. Indian J Dermatol Venereol Leprol 1986;52:152-4.
28. Meyer JD, Chen Y, Holt DL, Beck MH, Cherry NM. Occupational contact dermatitis in the UK: A surveillance report from EPIDERM and OPRA. Occup Med 2000;50:265-73.
29. Dogra A, Minocha YC, Kaur S. Adverse reactions to cosmetics. Indian J Dermatol Venereol Leprol 2003;69:165-7.
30. Sharma V, Mahajan VK, Mehta KS, Chauhan PS. Occupational contact dermatitis among construction workers: Results of a pilot study. Indian J Dermatol Venereol Leprol 2014;80:159-61.

Indian Dermatology Online Journal | Volume 12 | Issue 4 | July-August 2021