Original Article

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*-paraphenylenediamine (PPD) (22.9%), nickel (16%), fragrance mix (11%), potassium dichromate (10.7%), cobalt (7.6%), and mercaptobenzothiazole (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*

Vikram K. Mahajan, Karaninder Singh Mehta, Pushpinder Singh Chauhan, Reena Sharma, Anuj Sharma, Yog Raj Verma, Monika Chandel, Hitender Sharma, Jyotshna Sharma, Vijay Karan Singh, Sheenam Hooda

Department of Dermatology, Venereology and Leprosy, Dr. Rajendra Prasad Govt. Medical College, Kangra (Tanda), Himachal Pradesh, India

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.

Address for correspondence:
Dr. Vikram K. Mahajan, Department of Dermatology, Venereology and Leprosy, Dr. Rajendra Prasad Govt. Medical College, Kangra (Tanda)- 176 001, Himachal Pradesh, India.
E-mail: vkm1@rediffmail.com

Access this article online

Website: www.idoj.in

DOI: 10.4103/idoj.IDOJ_768_20

Quick Response Code:

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.[6] 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).

Table 1: Clinical criteria for occupational and work-related skin disease

S.no	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

Statistical methods

The files of 16 patients were found incomplete and excluded from final analysis. The data obtained was tabulated by using MS Office™ Excel® software and analyzed statistically. The continuous data are presented as means and standard deviation (SD), and categorical variables are calculated as frequencies and percentages.

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	03 (0.6)
Duration of dermatitis	Range	1w-40 y
	Mean±SD	3.7±4.9 y
	<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 (Masons, laborers, plumbers, carpenters)	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	Airborne Contact Dermatitis (ABCD)	126 (27.7)
	Acral (Hands & Feet) Dermatitis	64 (14.1)
	Hand dermatitis	59 (12.9)
	Acrofacial dermatitis	58 (12.7)
	Facial dermatitis	48 (10.5)
	Feet dermatitis	33 (7.3)
	Unclassified pattern	67 (14.7)
Patch test results	Positive results	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

were between 21 and 60 years of age. The duration of dermatitis varied between 1 week and 40 years (mean ± SD 3.7 ± 4.9 years). The majority, 331 (72.7%) patients had dermatitis for <5 years at presentation. The clinical patterns of dermatitis in order of frequency comprised ABCD in 126 (27.7%), acral dermatitis in 64 (14.1%), hand dermatitis in 59 (12.9%), acrofacial dermatitis in 58 (12.7%), facial dermatitis in 48 (10.5%), and feet dermatitis in 33 (7.3%) patients, respectively. Hair colorants or shaving creams were implicated by 28 of 48 patients with facial dermatitis.

Among males, 233 (51.2%) were primarily agriculturists, 112 (24.6%) were office workers, and 21 (4.6%) patients were involved in construction related activities. The seven male students were also involved in agriculture activities during their spare time. Among females, 127 (27.9%) homemakers and 11 students were additionally involved in agriculture related activities. Fourteen women homemakers were also employed office workers. Shopkeepers (*n*=17), health care workers (*n*=13), auto mechanics (*n*=4), and food handlers (chefs 1, waiters 3) comprised only a small number. Most of the office workers, shopkeepers, auto mechanics, and health care workers were staying in towns and visiting home during sowing/harvesting time.

Positive patch test reactions from at least one or more allergens occurred in 262 (58%) patients. 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%), 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 the 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, fraymicetin, 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 (aftershave, 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

positive reactions among agriculture workers. The majority of the positive reactions among office workers were from PPD, parthenium, fragrance mix, and nickel. Among construction workers potassium dichromate and parthenium elicited most positive reactions. Parthenium, nickel, and potassium dichromate were the major allergens among students. PPD, parthenium, and parabens elicited most positive reactions among shopkeepers. The health care workers had positive reactions from fragrance mix, PPD, nickel, parabens, black rubber mix, MBT, and thiuram mix in order of frequency. An auto mechanic had positive reaction from PPD and his hair dye, and one waiter developed positive reactions from PPD, fragrance mix, and his hair dye. Both had implicated their dermatitis to their hair colorants.

Polysensitivity, positive reaction to two and more allergens, was seen in 79 (17.4%) patients. Fifty-three patients developed positive reactions from two allergens while 26 patients had positive reactions from three or more allergens apparently because of concurrent contact sensitization. Most polysensitivity reactions were from

Table 4: Clinical patterns of contact dermatitis and patch test allergens

Clinical patterns	Definition	Number of patients (%) *n*=262	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 predominately 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. Five patients with suspected footwear dermatitis also showed positive reactions to their shoe chips. Twelve patients with PPD reactions also showed positive reaction with hair dye
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)	Four patients with PPD sensitivity also showed positive reaction to hair dye. The patient with Black rubber mix sensitivity also showed positive reaction to his shoe chip
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),	Eight patients with PPD sensitivity also showed positive reaction to hair dye. Four males also had positive reaction to Shaving cream and Colophony
Business/shopkeepers	15 (5.7)	PPD (6), Parthenium (3), Parabens (2), Cobalt (1), Fragrance mix (1)	One patient with PPD sensitivity also showed positive reaction to hair dye. One male also had positive reaction to his shaving cream and Parabens
Construction workers (masons 6, laborers 4, plumbers 1, carpenters 1)	12 (4.6)	Potassium dichromate (9), Parthenium (5), Cobalt (1), Nickel (1), Epoxy resin (1), Fragrance mix (1), MBT (1), Wool alcohol (1)	-
Students	8 (3.0)	Parthenium (3), Nickel (2), Potassium dichromate (2), Cobalt (1), Nickel (1), Fragrance mix (1)	They were also helping in agriculture work.
Health care workers (doctors 2, nurses 2, lab technicians 1, ward boys 2)	7 (2.7)	Fragrance mix (4), PPD (2), Nickel (2), Parabens (2), MBT (1), Colophony (1), Thiuram mix (1), Black rubber mix (1)	Two patients with PPD sensitivity also showed positive reaction to hair dye.
Auto Mechanics	1 (0.4)	PPD (1)	Also showed positive reaction to hair dye
Waiter	1 (0.4)	PPD (1), Fragrance mix (1)	Also showed positive reaction to hair dye

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

parthenium plus potassium dichromate, cobalt, PPD, nickel, and/or thiuram mix, or PPD plus cobalt, nickel, parabens, potassium dichromate, cobalt, and/or fragrance mix, and potassium dichromate plus MBT, thiuram mix, nickel, cobalt, MBT, and/or parabens. One patient, an agriculturist, developed multiple positive reactions to seven allergens: parthenium, potassium dichromate, cobalt, fragrance mix, thiuram mix, *Myroxylon pereirae*, and formaldehyde.

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.[17] 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.[18,19] 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.[10,19-23] 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.[19,20] Plants, plant materials and weeds, animals or animal feeds, metals (chromates, nickel), rubber chemicals, and pesticides account for most cases.[7,19,20,24-26] *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.[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=1), and black rubber mix(n=1) in our patients and are well described occupational allergens among agriculture workers.[5,19,20,24] 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.[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.[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.[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%), *Parthenium hysterophorous* (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.[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.

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.

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 IR. ABC of work related disorders: Occupational dermatitis. BMJ 1996;313:487-9.
3. Diepgen TL. Occupational skindisease data in Europe. Int Arch Occup Environ Health 2003;76:3318.
4. Hassan I, Akhtar S, Zeerak S, Rasool F, Rather PA, Bhat YJ, *et al*. Clinicoepidemiological 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, Gruvberger B, Sandahl E. Reduction of chromate in cement by iron sulfate. Contact Dermatitis 1979;5:39-42.
9. Roto P, Sainio H, Reunalaj 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, Mukhija G, Rastogi S, Yadav S. Patch testing experience with 1000 patients. Indian J Dermatol Venereolo Leprol 2007;73:313-8.
11. Bensefa-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, Kręcisz B, Kieć-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 weeds. 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 compositae 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.