



## Original Research Article

## A detailed study of allergic contact dermatitis, clinical patterns, allergens and patch testing

M Madhumitha<sup>1</sup>, P Gunalan<sup>1,\*</sup>, S Gunaseelan<sup>2</sup>, T Arun Kumar<sup>3</sup><sup>1</sup>Dept. of Dermatology, Karpagan Faculty of Medical Science and Research, Othakalmandapam, Tamil Nadu, India<sup>2</sup>Dept. of Anaesthesiology, Karpagan Faculty of Medical Science and Research, Othakalmandapam, Tamil Nadu, India<sup>3</sup>Dept. of Pediatrics, Karpagan Faculty of Medical Science and Research, Othakalmandapam, Tamil Nadu, India

## ARTICLE INFO

## Article history:

Received 24-07-2020

Accepted 28-07-2020

Available online 03-10-2020

## Keywords:

Allergic contact dermatitis

Patch testing

Allergens

## ABSTRACT

**Background:** Allergic contact dermatitis (ACD) is a common skin condition that causes significant disruption of a country's economy as a result of rising school and work-related absenteeism besides the persistent medical expenses.

**Aims and Objectives:** 1. To determine the demographic profile of ACD patients 2. To determine the source of allergens and its preferred sites of involvement 3. To evaluate the patch test and its relationship with various allergens.

**Materials and Methods:** This study enrolled 60 patients diagnosed with ACD attending the Department of Dermatology, Venereology and Leprosy Vinayaka Mission Medical College & Hospital, Salem and relevant history, clinical examination and patch test were done using standard protocols. Data were entered in Microsoft Excel [2007] and analyzed using Statistical Package for Social Sciences [SPSS] version 21.0 Chicago, USA.

**Results:** The mean age of the subjects were 40.4±13.7 years. The males and females were affected in the ratio of 3:2. Housewives (28.3%) hugely contracted ACD followed by agriculturists (20.0%), masons (15.0%), students (11.7%), professionals (10.0%) cement factory workers (8.3%), and others (6.7%). Nickel sulphate and potassium dichromate were the most common allergens found. The patch test was positive for 51.7% of the subjects while it was negative and doubtful for 35.0% and 13.3% respectively.

**Conclusion:** India being a developing nation, has seen rising rates of occupational dermatosis in the venture of its rapidly expanding urbanization. Hence vibrant protection measures at all occupational levels in addition to the stricter implementation of regulatory control and warranting public education about the safety protocols has to be exercised in all set ups.

© 2020 Published by Innovative Publication. This is an open access article under the CC BY-NC license (<https://creativecommons.org/licenses/by-nc/4.0/>)

## 1. Introduction

Allergic contact dermatitis (ACD) has been a global problem and showing an upward trend owing to its quantum of morbidity and the compromise of quality of life among affected individuals.<sup>1</sup> Despite the heterogeneity seen in persons contracting ACD, studies lack in providing a complete picture of associated demographic risk especially in developing economy like India where divergent groups of people reside besides contributing significantly to

occupational dermatoses.

## 2. Aims and Objectives

1. To determine the demographic profile of ACD patients.
2. To determine the source of allergens and its preferred sites of involvement.
3. To evaluate the patch test and its relationship with various allergens.

\* Corresponding author.

E-mail address: [drgunalan1986@gmail.com](mailto:drgunalan1986@gmail.com) (P. Gunalan).

### 3. Materials and Methods

This study enrolled 60 patients attending the Department of Dermatology, Venereology and Leprosy Vinayaka Mission Medical College & Hospital, Salem and has been diagnosed with ACD based on relevant history & clinical examination and those who were willing for patch test. We excluded those who were presenting with acute and/or generalized eczema and those undergoing treatment. The allergens were manufactured by Systopic laboratory, Bombay. Patients were patch tested using Indian Standard Series approved by the Contact and Occupational Dermatoses Forum of India [CODFI] consisting of 20 allergens. Finn-chambers were used for patch testing and were done on the upper back of the participants. Readings were recorded after 48 hours according to the International Contact Dermatitis Research Group Criteria. The study got clearance from Institute Ethics Committee and the data that were collected using semi-quantitative questionnaire were fed into Microsoft Excel [2007] and analyzed using Statistical Package for Social Sciences [SPSS] version 21.0 Chicago, USA.

### 4. Results

#### 4.1. Age and Gender

The mean age of the subjects were  $40.4 \pm 13.7$  years. Their age ranged from minimum 19 years to maximum of 67 years. The interquartile range (25th to 75th quartile) which carried almost 50% of the population fell between 29.3 to 51.8 years of age. The males were found to be slightly elder ( $42.3 \pm 14.2$  years) than their counterparts ( $37.6 \pm 12.7$  years). However, this difference was not found to be statistically significant (Independent t-test used, p-value=0.18). The males and females were affected in the ratio 3:2 although the condition was found to be rare in people younger than 20 years and elder than 65 years.

#### 4.2. Occupation

As far as the occupation is concerned, the housewives possessed higher risk (28.3%) of contracting ACD followed by agriculturists (20.0%), masons (15.0%), students (11.7%), professionals (10.0%) cement factory workers (8.3%), and others (6.7%). The coolie workers, painters, welders and weavers were categorized in the other occupational group. The risk for each occupational group in acquiring the source of allergen has been illustrated in Table 1.

#### 4.3. Allergens

About one fourth of the patients were allergic to nickel sulphate and its contact was traced to the constant exposure to chains, rings, safety pins, hooks among females and with watch straps, buttons, belts and coins among males. The next common allergen divulged was potassium dichromate

and its victims were mainly masons and cement factory workers. Among masons, 92.3% (12 out of 13) showed positivity to this substance. Overall, this chemical has led to one-fifth of ACD cases and most commonly affected males. Paraphenylenediamine (PPD) resulting from use of hair dyes or kumkum encroached one-tenth of the population. Furthermore, parthenium weed, has indulged ACD in 5% of patients mainly the agriculturalists. Subjects who were exposed to fragrances and colophony also has shared 5% of the ACD patients.(Figure 1)

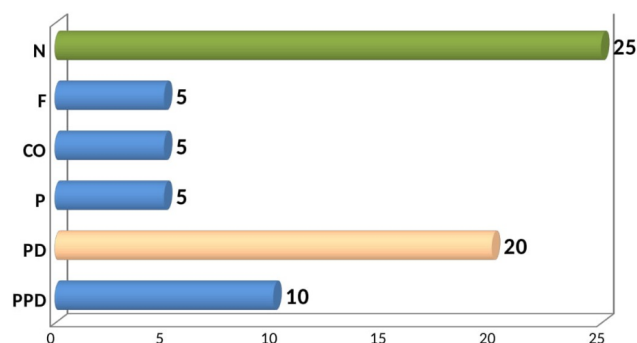


Fig. 1:

Table 1: Occupation and source of allergen

Occupation and source	Number	Frequency (%)
<b>1. Agriculture and related</b>	N=12	
Plant	7	58.3
Dye	2	16.7
Slipper	2	16.7
Detergent	1	8.3
<b>2. Professionals &amp; students</b>	N=13	
Watch	3	23.1
Jewels	3	23.1
Metals	2	15.4
Gloves	1	7.7
Dye	1	7.7
Slipper	1	7.7
Perfume	1	7.7
Mehendi	1	7.7
<b>3. Housewives</b>	N=17	
Detergent	4	23.5
Kumkum	4	23.5
Metal	2	11.8
Jewels	1	5.9
Pins	1	5.9
<b>4. Masons &amp; daily wagers</b>	N=18	
Cement	15	83.3
Dye	2	11.1
Mineral oil	1	5.6

#### 4.4. Allergen and Body parts

It was observed that the allergen 'nickel sulphate' has significant consideration in striking all body parts other than trunk of the exposed as every four out of five individuals gets their head and extremities affected out of it. (Pearson's chisquare = 5.7,  $p=0.01$ ). This substance has not been engaged in affecting lower limbs in any of the 15 cases it has affected and this notice was found to be statistically significant (Pearson's chisquare= 13.3,  $p<0.001$ ).

The relationship of the allergen 'framycetin' in causing ACD around the neck region (100%) was identified to be predominant and sparing the other body parts (0%) and this association was found to be statistically significant (Pearson's chisquare = 34.7,  $p<0.001$ ). Of the other regions, upper limbs are literally from the influence of this allergen. (Pearson's chisquare = 6.3,  $p=0.01$ )

Parthenin has caused relatively more damage to face (60%) than the other parts of the body (40%). This correlation was found to be statistically significant. (Pearson's chisquare = 4.7,  $p=0.03$ ).

Converse to the above, 'potassium dichromate' hardly affects the face (0% vs 100%) as against the other body parts concerned (Pearson's chisquare = 4.7,  $p=0.03$ ). It was observed that this chemical induces type-IV hypersensitivity in exposed parts of upper (Pearson's chisquare = 7.5,  $p=0.006$ ) and lower limbs (Pearson's chisquare = 22.5,  $p<0.001$ ) in all the twelve cases it has been reported with.

The paraphenylenediamine (PPD), the allergen seen in hair dye has produced established disease (ACD) mainly over the scalp (66.7% vs 33.3%) than other areas. Every second out of third person presenting with ACD of scalp contracts the disease resulting from PPD containing hair dye (Pearson's chisquare = 7.9,  $p=0.005$ ). Lower limbs remain the only parts that were significantly spared from this (Pearson's chisquare = 4.4,  $p=0.03$ ).

Hot and humid climates (April to June) have shown spikes in the occurrence of ACD. The commonest sites of occurrence of ACD were hands and feet.(Fig.2) The duration between initial allergen contact and the outset of ACD symptoms or signs varied from weeks to months and sometimes years. Atopy was seen in 16.6% patients perhaps no significant correlation was observed between atopy and contact sensitization.

#### 4.5. Allergens and patch test

The patch testing turned positive for only 51.7% of the subjects while it was negative and doubtful for 35.0% and 13.3% respectively. This test hardly produced any complications except in a single individual wherein the positive subject developed flaring up of dermatitis superimposed over the existing sites.

Nickel most commonly caused weak reaction (80%) than doubtful (13.3%), strong (6.7%) and extreme (0%) reaction.

However this difference was not found to be statistically significant (Fishers exact = 3.5,  $p=0.32$ ).

Parthenin predominantly caused weak reaction (80%) than strong (0%) and extreme (20%) reaction and this difference was found to be statistically significant (Pearson's chisquare = 9.2,  $p = 0.02$ ).

Potassium Dichromate has caused strong reaction (41.7%) more predominantly than doubtful (25.0%), weak (33.3%) and extreme (0%) reaction. This difference was observed to be statistically significant (Fishers exact= 9.7,  $p=0.008$ ).

PPD has produced an equivocal doubtful (50%) and weak (50%) reaction whereas none reacted to be strong or extreme. This observance has yielded no statistical significance (Fishers exact= 3.9,  $p=0.26$ ).

### 5. Discussion

In view of the complex interplay between the allergens and host's immune responses besides apprehension in the mechanisms for allergen activation our study elucidated few glimpses on demographic profile of ACD patients, the source of allergen, the preferred anatomical sites and sensitivity to patch tests. Almost all of our subjects aged above twenty years and below 65 years. Older adults might have lowered induction mechanisms for allergy while the younger ones might be hypo-responsive to allergens owing to relatively limited contacts or exposure.

Hand eczema is the commonest of all ACD and it scraps 10% of global population. Being the anatomical portion that is repeatedly exposed to water or moisture tend to weaken thestratum corneum thereby rendering it susceptible for risky allergens or irritants. The scalp is mainly affected by shampoos, conditioners or dyes has found to cause erythema, desquamation, pruritis or dryness. Likewise, the safest of all is the trunk which is well protected from contact with allergens although clinicians has to review the specific patterns in relation to the distinguished diseases. The ACD involving feet has prevalence up to 24.2% wherein the shoe pattern eczema tend to occur commonly. In most of these cases, black rubber or adhesives that comprises of PPD, mercaptobenzothiazole or thiurams might be the culprits. Potassium Dichromate has been an important constituent of leather shoes.<sup>2</sup> In a study by Lazzarini R et. al., (2018), it was disclosed that rubber (55.2%), metals (38%), leather (31%) and adhesives (13.8%) being the important sub-components of shoes that were responsible for foot or toe lesions.<sup>3</sup>

Our study showed that 66.7% of the subjects having ACD of upper extremity. In concordance the study by Chen YX et. al., (2017) also showed hands, forearms and wrists being the most common (68%) sites of dermatitis.<sup>4</sup>

Our study is dominated by housewives and the kumkum dermatitis has been observed in about one-quarter of them. As a tradition, our country women mainly the married

practice the application of kumkum over their forehead as a sign of their marriage. This led to the extensive testing of contact allergens of kumkum that include turmeric, sudan, aminobenzene, nickel, chlorocresol, PPD, fragrance mix and parthenium. Annabathula A et. al., (2018) have concluded from their observation that kumkum related ACD occurred due to added dyes that enhances the color besides the turmeric per se.<sup>5</sup>

PPD being an important constituent of hair dye owing to its increased penetration across skin layers is also a component of some foot-wears and rubbers. It has tested positive in 4% of patch tests as portrayed by Duran BE et. al., (2018). Public has to be educated about ensuring proper mixing of the anti-oxidant hydrogen peroxide and the colorant PPD in order to adequately polymerize the later thereby preventing its penetration deep inside the skin and causing hypersensitivity.<sup>6</sup>

Industrial workers gets affected by resins found in immersion oils, electrical coating, adhesives, and some medical products. Geier J et. al., (2017) in their study have postulated that the construction workers and bricklayers who were exposed to cement mainly gets affected by potassium dichromate in addition to epoxy resin and they observed decline of sensitization related to these substances owing to usage of chromate reduced cement and proper usage of gloves. Hence it is recommended to abide similar precautionary measures in order to reduce its morbidity in our country.<sup>7</sup>

Metals that contain Nickel and Cobalt are always found to be associated with our people as a consequence of social and religious practices of wearing such ornaments around their body parts. The nickel avoidance could be made with possible shifting of its replacement with good quality stainless steel, gold, platinum or other elements.<sup>8</sup> Hence remembrance of potential side effects and avoidance of potentially allergic substances in addition to wearing of proper or standardized protective gears will prove to be helpful in curbing the morbidity associated with ACDs.

## 6. Source of Funding

None.

## 7. Conflict of Interest

None.

## References

1. Alikhan A, Maibach HI. Allergic contact dermatitis. *Chem Immunol Allergy*. 2014;100:97–100.
2. Owen JL, Vakharia PP, Silverberg JI. The Role and Diagnosis of Allergic Contact Dermatitis in Patients with Atopic Dermatitis. *Am J Clin Dermatol*. 2018;19(3):293–302.
3. Lazzarini R, Mendonça RF, Hafner MFS. Allergic contact dermatitis to shoes: contribution of a specific series to the diagnosis. *An Bras Dermatol*. 2018;93(5):696–700.
4. Chen YX, Gao BA, Cheng HY, Li LF. Survey of Occupational Allergic Contact Dermatitis and Patch Test among Clothing Employees in Beijing. *Biomed Res Int*. 2017;2017:3102358.
5. Annabathula A, Priya S, Srinivas CR. Kumkum-induced allergic contact dermatitis: Are we missing the actual culprit? *Indian J Dermatol, Venereol, Leprol*. 2018;84(2):153–6.
6. Duran BE, Romero-Perez D, Slvador J. Allergic Contact Dermatitis due to Paraphenylenediamine: An Update. *Actas Dermosifiliogr*. 2018;109(7):602–9.
7. Geier J, Lessmann H, Skudlik C, Ballmer-Weber BK, Weisshaar E, Uter W, et al. Occupational contact allergy in bricklayers, tile setters etc. Current spectrum of sensitization and recent time trends. *Allergol Select*. 2017;1(2):127–40.
8. Burkemper NM. Contact Dermatitis, Patch Testing, and Allergen Avoidance. *Mo Med*. 2015;112(4):296–300.

## Author biography

**M Madhumitha** Assistant Professor

**P Gunalan** Senior Resident

**S Gunaseelan** Professor

**T Arun Kumar** Professor

**Cite this article:** Madhumitha M, Gunalan P, Gunaseelan S, Kumar TA. A detailed study of allergic contact dermatitis, clinical patterns, allergens and patch testing. *IP Indian J Clin Exp Dermatol* 2020;6(3):209-212.