

ASSOCIATION OF NICKEL EXPOSURE AND ALLERGIC CONTACT DERMATITIS

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Abstract

Background: Woman experienced more nickel allergy than men, which is around 8.6% globally. Exposure with jewellery and many other related items can causes association with nickel. Exposure in working area like cashier or hairdressers can also increase the potentiality of having risk. Apart from that, genetic factors, environmental factors also can cause allergic contact dermatitis (ACD). EU Nickel Directive is aimed at reducing the impact. **Materials and Methods:** This cross-sectional, prospective, observational study on allergic contact dermatitis (ACD) involved 75 housewives in India over one year. Conducted in a medical College hospital, 42 patients were selected via patch tests using the India Standard Series (ISS). Patch test was utilized for diagnosis of ACD. Willing patients were clinically examined and on the basis of inclusion criteria were selected. Any steroid user was excluded from the study. MS Excel and SPSS 25.0 is used for statistical analysis. **Result:** Maximum patients were between 21-40 years of age, while one younger patient below 20 years was there. The study about lesion revealed, maximum lesions was observed in feet, while hands and face observed the least lesion. 76.19% patients faced sub-acute eczema reactions. 14.28% and 9.5% were acute and chronic eczema found respectively. 48 hours of patch test reaction revealed 57% 1+ while after 96 hours it was 73.8%. study about different allergen mix among patients revealed nickel is the most prevalent allergen. Significance of statistical analysis was maintained at $p < 0.05$. **Conclusion:** The study has concluded that young adults (21-40) most commonly have foot lesions, with prevalent sub-acute eczema. Allergic reactions increase over time, especially to nickel and black rubber mix, necessitating targeted management.

INTRODUCTION

Nickel is a primary catalyst for allergic contact dermatitis (ACD) for the general populace, affecting both children and adults, with a global frequency of around 8.6%. The incidence rate among teenage females was markedly elevated, around 17%. The majority of illnesses are caused by exposure unrelated to work.^[1] Women are affected by nickel allergy at a rate 3 to 10 times higher than males. This condition is typically caused by regular contact with jewelry, clothing, and wristwatches.^{5 to 7} Several empirical investigations indicate that women have a higher propensity to acquire touch sensitivity compared to males.^[2]

Occupational sickness primarily impacts men, while the incidence of women having occupational exposure is on the rise. An allergy to nickel might result in employment disability and need a career shift. Occupations with a high risk of nickel exposure includes cashiers, hairdressers, jewellery designers, dentists, individuals such as auto-mechanics, electroplaters, dye makers, homemakers, as well as other professionals that make use of hand instruments that are coated with nickel.^[3]

Nickel was a transition metal with a nuclear number of 28. It ranks sixth in terms of abundance among the elements found on Earth, and is mostly found Naturally occurring compounds can be found outdoors as oxides, sulphides, and silicates. Nickel is

an elemental substance characterized by the chemical symbol Ni & atomic number 28 predominantly utilized in the production of stainless steel and various alloys.^[4] Moreover, it is used in its unadulterated state for the purpose of plating and the production of compounds containing nickel. Nickel is extensively utilized in many applications because to its exceptional malleability, durability against oxidation & corrosion, elevated melting point, ferromagnetic properties, and affordability effectiveness. Indeed, it is challenging to prevent regular exposure to nickel through skin contact in our daily activities.^[5]

Nickel is the main substance that causes allergic reactions when it gets into contact with the skin across the majority of developed countries globally. The enactment the European Union's Nickel Directive is resulting in a decrease in the occurrence of nickel allergy across several European countries.^[6] The user's text is concise prevalence rates range from around 8% through 19% in adults. The prevalence of this condition ranges from 3% to 8% in kids and teens in the general population. There is a notable predominance of this syndrome in women when compared to males, with a ratio of 4 to 10 times higher. Additionally, girls are more affected by this condition compared to boys.^[7] The prevalence of dermatitis is higher in adults, ranging from 12% to 25%, and in children, ranging from 5% to 30%. Outside of Europe, there has been relatively less research conducted on nickel allergy. However, consistently high rates of nickel allergy have been recorded in Asia as well as North America. Several research have demonstrated a greater occurrence of nickel allergy for persons with atopic dermatitis, whereas other investigations have reported no significant connections.^[8]

Nickel-contact allergy contact dermatitis is a form of delayed-type hypersensitivity response, namely type IV, that manifests on the skin two phases. The first stage is the triggering of the allergy, followed by a following phase where the reaction takes place is elicited. During the induction phase, there are several instances of exposure to liberate nickel that above a certain minimal limit.^[9] During the first phase, the dendritic cells of the skin transfer an antigen in the main types of T cells involved are T helper 1 & T helper 17 cell. This leads to the creation the memory T cells within the skin which explicitly acknowledge the presence of nickel. After the elicitation phase, an allergic response is increased via repeated exposure of the allergen, leading to the development of allergic contact dermatitis (ACD).^[10]

Leading scientists say that Ni-ACD is affected by a synergistic interplay of genetic & environmental variables, with the latter exerting a greater impact significant of greater significance. Filaggrin mutations are linked to an increased susceptibility to getting nickel allergic contact dermatitis (Ni-ACD). HLA antigen expression is another genetic factor that may contribute to an increased risk for Ni-ACD. Staphylococcal biofilms can contribute for the

occurrence for nickel allergic contact dermatitis (Ni-ACD) on persons with atopic dermatitis.^[11]

Menné and Holm demonstrated an identical the incidence of twin concordance is 29% among persons with Ni-ACD, which was verified by a survey conducted on a population-based sample. Amongst the Silverberg et. al16 cohort, it was shown that half of the children suffering from the individual suffering from severe Ni-ACD along with other idiopathic symptoms had a parent who also had Ni-ACD. This number exceeds the frequency of Ni-ACD amongst the general population.^[12]

MATERIALS AND METHODS

Research Design: This is a cross sectional, prospective and observational study about the presence of allergic contact dermatitis (ACD) which is an immunological response against any foreign substance named as allergen. The study was conducted in MES Medical College, Kerala with Ethical Committee approval No. IEC/MES/45/2016, with a duration of 1 year. The cross sectional study was conducted among 75 women who were housewives. All of the women were investigated by the research authority to be aware about any past clinical history. Clinical examination was conducted, considering different clinical parameters and was kept in medical record. Among 75 patients, selected were only 42 patients and were selected by conducting patch test which is used for the diagnosis of the presence of ACD. Test was done utilizing the India Standard Series (ISS). All the willing patients must submit both written and verbal consent about their participation the study. No patients will be forced without their consent to get involved for the study. After 48 or 96 hour of patch test, results were analyzed and was elucidated on the basis of ICDG criteria.

Inclusion Criteria

Some criteria were considered for the inclusion of the patient, those are –

- Patients should be tested positive for the patch test for ACD. Patient should have the incidence of ACD which is required for the study.
- ACD patients should have no lesions on back

Exclusion Criteria

Criteria on the basis of which patients were excluded were---

- Patients with any past history or recent history about taking steroids should not be allowed for the study.
- Patients with pre incidence of ultraviolet therapy were excluded
- Patients without their consent for the study or not followed up were not allowed in the study.

Statistical Analysis

For the significance of statistical analysis, MS Excel was used for entering data. Analysis of the data was done with the use of SPSS (Statistical Package For The Social Sciences) for windows version 25.0.

RESULTS

[Table 1] represents the age distribution of 42 patients. The age distribution of the patient group, consisting of 42 individuals, shows that the majority of patients fall within the 21-40 age group, accounting for 57.14% (24 patients). The next largest group is the 41-60 age range, comprising 33.33% (14 patients). A smaller portion of patients, 7.14% (3 patients), are over the age of 60, and the smallest group, at 2.38% (1 patient), includes those under 20 years of age.

[Table 2] shows that the lesions were most commonly found on the feet, affecting 50% (21 patients) of the group. Hand lesions were present in 26.2% (11 patients), while 14.2% (6 patients) had lesions on their faces. Generalized lesions, affecting multiple areas, were observed in 9.5% (4 patients) of the cohort.

[Table 3] represents different types of eczema reactions among 42 patients. The types of eczema reactions observed in the 42 patients indicate that sub-acute lesions are the most prevalent, affecting 76.19% (32 patients). Acute lesions were present in

14.2% (6 patients), and chronic lesions were noted in 9.5% (4 patients).

[Table 4] is showing different type of patch test reactions after 48 and 96 hours of patch test result. After conducting patch tests at 48 and 96 hours, different types of reactions were observed among the patients. At the 48-hour mark, 21.4% (9 patients) showed a 1- reaction, which decreased to 11.9% (5 patients) after 96 hours. The 1+ reaction was noted in 57% (24 patients) initially, increasing to 73.8% (31 patients) at the 96-hour evaluation. The 1++ reaction was consistent at 21.4% (9 patients) at 48 hours and slightly decreased to 14.28% (6 patients) after 96 hours.

[Table 5] is showing different types of allergen mix among 42 patients. Among the 42 patients tested for allergens, 40.5% (17 patients) were found to be allergic to nickel. Black rubber mix allergies were present in 31% (13 patients). Mercapto mix and fragrance mix allergies were less common, affecting 7.1% (3 patients) and 9.5% (4 patients) of the patients, respectively. Additionally, 11.9% (5 patients) showed no allergic reaction to the tested allergens.

Table 1: Patients with age distribution

Patients with age group	
No of patients n=42	Age group
1(2.38%)	<20
24(57.14%)	21-40
14(33.33%)	41-60
3(7.14%)	>60

Table 2: Represents different site of lesions among patient group

Site of lesions	No of patients n= 42
Lesion in feet	21 (50%)
Hand lesion	11(26.2%)
Face lesion	6 (14.2%)
Generalized lesion	4 (9.5%)

Table 3: Different type of Eczema reaction among patients

Type of Eczema reaction	No of patients n= 42
Acute lesion	6(14.2%)
Chronic lesion	4(9.5%)
Sub-acute lesion	32(76.19%)

Table 4: Type of patch reaction observed after 48 and 96 hours of patch test among patients

Type of reaction	Reaction 1 after 48 hours of patch test	Reaction after 96 hours of patch test
1- reaction	9(21.4%)	5(11.9%)
1+ reaction	24(57%)	31(73.8%)
1++ reaction	9(21.4%)	6(14.28%)

Table 5: The mix of different types of allergen among 42 patients

No of Patients n=42	Allergen
17(40.5%)	Nickel
13(31%)	Black rubber mix
3(7.1%)	Mercapto mix
4(9.5%)	Fragrance mix
5(11.9%)	Nil for allergen mix

DISCUSSION

An investigation was carried out in Odense, Denmark to determine the presence the study examines the occurrence with the study examines the relationship

between nickel allergy sensitization and three factors: ear piercings the use includes dental braces, and hand eczema. The cohort consists of 1,501 teenagers in the 8th grade, aged between 12 and 16 years. 8.6% of patients experienced a nickel response, with 69% of

these cases being classified as clinically severe these instances.^[13] Females exhibited the highest frequency of nickel allergy, and a distinct the connection between ear piercing was proven. The utilization of orthodontic braces, that necessitates previous oral exposure to nickel, prior to undergoing an ear piercing procedure that involves contact with nickel on the skin, has been associated with a substantial decrease in the prevalence of nickel allergy. A strong correlation was seen in adolescents between hand eczema and nickel allergy.^[14]

The objective of the study is to assess the effects of the Danish nickel restriction by comparing the occurrence of nickel allergy & hand eczema in two separate cross-sectional surveys conducted on the same population in Copenhagen. The implementation of regulatory measures to regulate exposure to nickel may have reduced the influence the impact of nickel on the occurrence acute hand eczema in young girls.^[15]

The objective is to assess the ratio to assess the prevalence of This study aims to investigate the prevalence of nickel allergy among female hairdressers and analyse the extent of excessive nickel release from hairdressers' scissors & crochet hooks.^[16]

WHO underwent patch test. Young hairdressers had a decreased incidence of nickel allergy compared to their older counterparts. This might be attributed to both the EU Nickel Directive reflects the Reduced utilization of instruments in salons that release nickel.^[17] When hairdressers individuals who have sensation to nickel in order to determine the cause of hand eczema, that is crucial to inspect the tools and equipment used at work for any possible nickel emissions.

Nickel allergy proved to be the predominant type of contact allergy. It exists classified within a distinct hypersensitivity category from asthma and rhinoconjunctivitis.^[18] The objective of this research was to evaluate the possible relationship there is an association between people who say they have a nickel allergy& the incidence of respiratory symptoms such as prevalence of wheeze, asthma, & rhinoconjunctivitis for younger German adults.^[19] In addition, we took into account the possibility of any influence from gender on this relationship. Our findings indicate that those who self-report having a nickel allergy are more likely to experience the onset of wheeze. The cause of this relationship, whether the cause of this phenomenon, whether it is influenced by environmental circumstances, genetic predisposition, and a mix. The mechanisms behind type I & type IV hypersensitivity reactions need to be clarified.^[20]

We investigated the impact of regular daily exposure to trace levels of nickel onto patients having hand eczema & nickel allergy. The selected concentrations were intended to include the spectrum of little to significant occupational nickel exposure. The experiment was conducted carried out utilizing a double-blind methodology and had a control group that received a placebo. Patients immersed their

finger for a duration of 10 minutes every day in water containing a nickel concentration of 10 parts per million (p.p.m.) in the initial week. During the second week, they submerged their finger in water with a nickel concentration of 100 p.p.m.^[21] The administration of this treatment resulted in a substantial rise ($P = 0.05$) in the creation of vesicles at the local level, as well as an increase in the patients who submerged a finger in water exhibited a statistically significant reduction in blood flow ($P = 0.03$) comparing to the control group. The amounts of nickel utilized also resulted in notable inflammatory alterations in the skin the forearm skin of the patients treated with sodium lauryl sulphate (SLS). Conversely, no inflammatory skin changes occurred the study examines the presence of nickel allergy in healthy individuals without hand eczema, both on normal skin and on skin treated with sodium lauryl sulfate (SLS). The present study presents convincing evidence whether the observed changes were specifically induced by exposure to nickel. There is a need for standardized techniques to evaluate the impact of low to moderate levels of nickel exposure upon the hands, as well as the resulting consequences in individuals who are sensitive to nickel.^[22]

CONCLUSION

The main conclusion from the analysis of the 42 patients reveals that the majority are young adults between the ages of 21 and 40, with lesions most commonly found on the feet. Sub-acute eczema lesions are the most prevalent type among the patients. Patch tests indicate an increased allergic reaction over time, particularly to nickel and black rubber mix, which are the most common allergens identified. These insights underscore the need for targeted approaches in managing eczema and allergies within this demographic. In conclusion, the analysis of the patient group, consisting of 42 individuals, reveals several notable findings. The age distribution shows a predominance of patients within the 21-40 age group, accounting for over half of the cohort, while the next largest age group is 41-60 years. Lesion distribution indicates that the feet are the most commonly affected site, followed by the hands and face, with a smaller proportion of patients exhibiting generalized lesions. Regarding eczema reactions, sub-acute lesions are the most prevalent, significantly outweighing the presence of acute and chronic lesions. Patch test results highlight a notable increase in the 1+ reaction from 48 to 96 hours, indicating a progressive response to allergens over time. Lastly, allergen sensitivity is most commonly associated with nickel and black rubber mix, with fewer patients reacting to mercapto and fragrance mixes, and a small percentage showing no allergic reactions. These findings provide a comprehensive overview of the demographic and clinical characteristics of the patient group, offering valuable

insights for targeted medical interventions and further research.

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