

# Nickel allergy in patch-tested female hairdressers and assessment of nickel release from hairdressers' scissors and crochet hooks

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**Background:** Hand eczema as well as nickel contact allergy is prevalent among hairdressers. Recently, two female hairdressers were diagnosed with nickel contact allergy-related hand eczema following prolonged skin contact with scissors and crochet hooks used during work.

**Objectives:** To determine the proportion of hairdressers' scissors and crochet hooks that released an excessive amount of nickel and to determine the prevalence of nickel allergy among patch-tested female hairdressers.

**Materials:** Random hairdressers' stores in Copenhagen were visited. The dimethylglyoxime (DMG) test was used to assess excessive nickel release. The prevalence of nickel allergy among female hairdressers from the database at Gentofte Hospital was compared with the prevalence of nickel allergy among other consecutively patch-tested dermatitis patients.

**Results:** DMG testing showed that 1 (0.5%; 95% CI = 0 – 2.0) of 200 pairs of scissors and 7 (53.8%; 95% CI = 26.0 – 82.0) of 13 crochet hooks released an excessive amount of nickel. The prevalence of nickel allergy was higher among middle-aged and older female hairdressers than among young female hairdressers.

**Conclusions:** The prevalence of nickel allergy was lower among young hairdressers in comparison to older hairdressers. This may possibly be a result of the European Union (EU) Nickel Directive or a consequence of a decreased use of nickel-releasing work tools in salons. When nickel allergic hairdressers present with hand eczema, their work tools should be investigated for nickel release.

**Key words:** contact dermatitis; dimethylglyoxime test; hairdressers; nickel allergy; prevalence; scissors.  
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Nickel contact allergy remains prevalent in European female populations although a significant decrease has recently been suggested among young Danish women (1–5). Nickel allergic subjects are at a risk of developing hand eczema (6), a disorder associated with increased health care costs as well as poor quality of life (7). Traditionally, nickel allergy derives from repeated or prolonged skin exposure

to consumer items such as jewellery, buttons, hair clasps, and cell phones (8–13). Nickel release from such products has, therefore, been regulated within the European Union (EU) member states since 1994. However, nickel release from work tools has not yet been regulated. Lidén et al. demonstrated excessive nickel release ( $>0.5 \mu\text{g}/\text{cm}^2/\text{week}$ ) from 27% of 565 hand-held work tools (14). Furthermore,

Lidén et al. recently showed that nickel in high concentrations was deposited on the hands in various occupations, e.g. lock smiths, carpenters and cashiers (15).

The incidence of hand eczema is high among hairdressers (16) as they are readily exposed to irritants (e.g. water and shampoo) as well as contact allergens (e.g. p-phenylenediamine and rubber accelerators). Thus, their hand eczema tends to have a mixed aetiology (17). Although, the prevalence of contact allergy to various allergens among hairdressers has recently been investigated (18–20), the prevalence of nickel allergy has, to our knowledge, not been presented or discussed for a long time (21, 22). In 1981, based on high prevalence of nickel allergy among hairdressers, Wahlberg questioned whether hairdressers' work tools should be manufactured from plastic and not metal (22).

Recently, two female hairdressers were diagnosed in our clinic with a nickel allergic hand eczema following skin contact with scissors and crochet hooks used during work. Dimethylglyoxime (DMG) testing showed excessive nickel release from both items. It has previously been shown that the DMG test is positive when an item releases more than  $0.5 \mu\text{g}$  nickel/ $\text{cm}^2$ /week, an ion concentration that may also result in nickel sensitization and elicitation (23–25). Inspired by these cases, an investigation was initiated to determine the proportion of hairdressers' scissors and crochet hooks that were positive upon DMG testing. Furthermore, the prevalence of nickel allergy among female hairdressers with dermatitis was compared with the prevalence of nickel allergy among consecutively patch-tested dermatitis patients at Gentofte Hospital.

## Materials and Methods

### DMG test study

This study was performed in April 2009 in Copenhagen, the capital of Denmark. We set out to DMG test 200 pairs of hair scissors and as many crochet hooks as possible. Random hairdresser salons in central Copenhagen were visited and we tried to visit a wide variety of subcategories such as barbers and salons targeting, e.g. immigrants and customers from different social groups. A total of 51 hairdresser salons were visited but hairdressers in 10 salons refused to participate (some were busy; and in some salons the owners were not present). Hairdressers were informed about the study aim and a photograph of a positive DMG test reaction performed on a pair of scissors was shown (Fig. 1). Brief information about nickel allergic dermatitis was offered. In case we identified any positive DMG test reactions, further advice was given about possible sensitization and elicitation of nickel dermatitis.

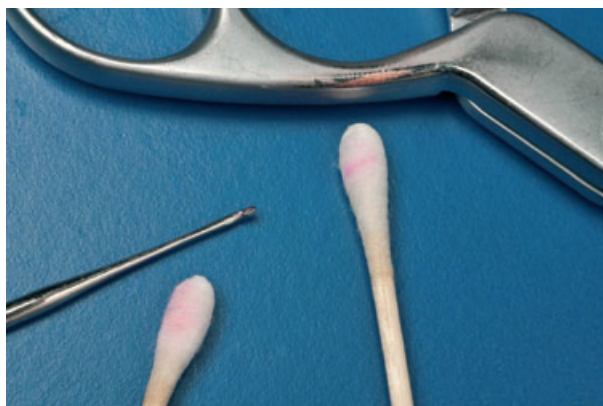


Fig. 1. A positive dimethylglyoxime test reaction indicated by the pink colour of two cotton sticks that were rubbed against the pair of scissors and the crochet hook.

We examined 200 pair of scissors and 13 crochet hooks. The number of scissors tested in salons varied between 1 and 11. The number of crochet hooks tested in salons varied between 0 and 4. Testing for nickel release was done with the DMG spot test at site. The value of the DMG test has previously been demonstrated on 15 alloys of known composition (23). It was prepared by a hospital pharmacy in the Capital Region of Copenhagen. The test solutions were 1% DMG in alcohol, and 10% ammonium hydroxide in water. We examined only parts of work tools that potentially came into direct and prolonged skin contact. The test was administered by placing two drops of each solution in succession on a white cotton-wool-tipped applicator that was rubbed for up to 20 seconds against the test object. A positive reaction was indicated by a pink or a red colour of the applicator, whereas a negative reaction was registered when no colour change was observed. Doubtful reactions (reactions where dirt could possibly cover a positive reaction) were retested, and if the reaction remained doubtful it was considered negative. All testing was performed by Dr Kristina Milting.

### Patch test study

Patch test data recorded between January 2000 and February 2009 at Gentofte Hospital were included in this study. Information about occupation and possible occupational relevance of positive patch test reactions to nickel were obtained through interviews performed by treating dermatologists and recorded directly in the database. All testing were performed with the European baseline series using a Finn Chambers<sup>®</sup> (8 mm Epitest Ltd, Oy, Finland) on a Scanpor tape<sup>®</sup> (Norgesplaster A/S, Alpharma, Venesla, Norway). Nickel sulfate was tested in petrolatum in a concentration of 5%. The patch tests were

applied to the upper back and occluded for 2 days. Readings had been done on D 2, 3 or 4, and 7 according to the recommendation from the International Contact Dermatitis Research Group (26). Thus, homogeneous redness and infiltration in the entire test area was scored as a 1+ reaction. Homogeneous redness, infiltration and vesicles in the test area were scored as a 2+ reaction, and homogeneous redness, infiltration and coalescing vesicles in the test area as a 3+ reaction. A 1+, 2+ or 3+ reading was interpreted as a positive response. An irritant response, a doubtful (+?), or a negative reading was interpreted as a negative response.

### Statistical analysis

Using the normal approximation to the binomial distribution, confidence intervals (CIs) for the 95% estimated prevalence were calculated. A  $\chi^2$  test was used to test for possible significant differences. All results were expressed as odds ratios (ORs) with 95% CIs. Patch test data were analysed with the Statistical Products and Service Solutions package (SPSS Inc., Chicago, IL, USA) for Windows (Release 15.0).

## Results

### DMG test results

DMG testing was positive in 1 (0.5%; 95% CI = 0 – 2.0) of 200 pairs of scissors and 7 (53.8%; 95% CI = 26.0 – 82.0) of 13 crochet hooks. No scissors or crochet hooks had any visual signs of defect coatings.

### Observations

The following observations were derived from communication with hairdressers: Most of the hairdressers said they would never buy inexpensive scissors and that their scissors would not release an excessive amount of nickel. Some claimed their scissors were made of surgical stainless steel to underscore the quality of their scissors. Most hairdressers spent €300–1200 on scissors. However,

they regularly received flyers offering inexpensive scissors (e.g. two pairs of scissors for 100 €). The only pair of scissors that was positive upon DMG testing cost about 400 €. Crochet hooks were used to pull hair through a cap upon hair dyeing. However, this technique was infrequently used in Copenhagen but some hairdressers postulated that this technique was still used in rural parts of Denmark.

### Patch test data

Data analysis showed that 122 (2.3%) of 5317 consecutively patch-tested dermatitis patients were hairdressers and that 114 (93.4%) of these were female. As nickel allergy was much more prevalent among female patients than male patients, only patch test results from female patients were presented (Table 1). The prevalence of occupational dermatitis and hand eczema was significantly higher among female hairdressers than among other female patients with dermatitis (Table 2). Furthermore, hairdressers were generally younger.

The overall prevalence of nickel allergy was comparable among female hairdressers and among other consecutively patch-tested female dermatitis patients although the prevalence was non-significantly higher in the latter group (21.9% versus 24.1%) (Table 1). A stratification by age group also showed that the prevalence of nickel allergy was lower among 16–30-year-old female hairdressers in comparison to other female dermatitis patients (11.3% versus 19.5%). However, this difference did not reach statistical significance (OR = 0.52; 95% CI = 0.24 – 1.11). Among older age groups, the prevalence of nickel allergy was higher among female hairdressers with dermatitis than among other consecutively patch-tested female dermatitis patients. Thus, a statistically significant difference was observed among 46–60 year olds (42.1% versus 21.3%) but not among 31–45 year olds (37.5% versus 30.3%) (Table 2). Finally, the prevalence of nickel allergy was lower among female hairdressers and other female dermatitis patients aged 16–30 years in comparison to those aged 31–45 years (OR = 0.21;

**Table 1.** The prevalence of nickel contact allergy among female patients with dermatitis and female hairdressers with dermatitis stratified by age group. Data were obtained from the patch test database at Gentofte Hospital, University of Copenhagen for the period 2000–2009

|                   | Nickel allergy                      |                         |                                 |                         |                                  |
|-------------------|-------------------------------------|-------------------------|---------------------------------|-------------------------|----------------------------------|
| Age group (years) | Female hairdressers with dermatitis |                         | Female patients with dermatitis |                         | Odds ratio (95% CI) <sup>†</sup> |
|                   | % (95% CI)                          | (n/n <sub>total</sub> ) | % (95% CI)                      | (n/n <sub>total</sub> ) |                                  |
| 16–30             | 11.3 (3.8–18.7)                     | (8/71)                  | 19.5 (16.8–22.2)                | (159/815)               | 0.52 (0.24–1.11)                 |
| 31–45             | 37.5 (17.7–57.3)                    | (9/24)                  | 30.3 (27.6–32.9)                | (365/1206)              | 1.38 (0.60–3.19)                 |
| 46–60             | 42.1 (19.3–64.9)                    | (8/19)                  | 21.3 (19.1–23.5)                | (292/1370)              | 2.69 (1.07–6.73)                 |
| All               | 21.9 (14.3–29.5)                    | (25/114)                | 24.1 (22.6–25.5)                | (816/3391)              | 0.88 (0.57–1.39)                 |

CI, confidence interval.

<sup>†</sup>Odds ratio for the comparison of female patients with dermatitis and female hairdressers with dermatitis.

Table 2. The MOAHLFA (Males, Occupational, Hand dermatitis, Leg ulcers, Facial dermatitis, Age > 40 y) index (38) among female hairdressers with dermatitis and among other female patients with dermatitis that were nickel-patch-tested at Gentofte Hospital, University of Copenhagen between January 2000 and February 2009

|                         | Female hairdressers with dermatitis<br>( <i>n</i> <sub>total</sub> = 114) |              | Female patients with dermatitis<br>( <i>n</i> <sub>total</sub> = 3391) |              |                                  |
|-------------------------|---------------------------------------------------------------------------|--------------|------------------------------------------------------------------------|--------------|----------------------------------|
| Variables               | % (95% CI)                                                                | ( <i>n</i> ) | %(95% CI)                                                              | ( <i>n</i> ) | Odds ratio (95% CI) <sup>†</sup> |
| <b>MOAHLFA index</b>    |                                                                           |              |                                                                        |              |                                  |
| Males                   | —                                                                         | —            | —                                                                      | —            | —                                |
| Occupational dermatitis | 57.9 (48.7–66.9)                                                          | (66)         | 14.3 (13.1–15.4)                                                       | (485)        | 8.23 (5.61–12.10)                |
| Atopy                   | 25.4 (17.4–33.5)                                                          | (29)         | 18.5 (17.2–19.8)                                                       | (626)        | 1.50 (0.98–2.32)                 |
| Hand dermatitis         | 64.9 (56.1–73.7)                                                          | (74)         | 36.3 (34.7–37.9)                                                       | (1232)       | 3.24 (2.19–4.79)                 |
| Leg ulcers              | 4.4 (0.006–8.1)                                                           | (5)          | 5.2 (4.4–5.9)                                                          | (175)        | 0.84 (0.34–2.09)                 |
| Facial dermatitis       | 15.8 (9.1–22.5)                                                           | (18)         | 21.4 (20.0–22.8)                                                       | (725)        | 0.69 (0.41–1.15)                 |
| Age > 40 years          | 24.6 (16.6–32.5)                                                          | (28)         | 55.7 (54.0–57.4)                                                       | (1889)       | 0.26 (0.17–0.40)                 |

CI, confidence interval.

<sup>†</sup>Odds ratio for the comparison of female patients with dermatitis and female hairdressers with dermatitis.

95% CI = 0.07 – 0.64 and OR = 0.86; 95% CI = 0.69 – 1.07, respectively). No statistically significant difference in the prevalence of nickel allergy was calculated between 31–45-year-old and 46–60-year-old female hairdressers (OR = 0.83; 95% CI = 0.24 – 2.82) whereas a statistically significant difference was recorded between other consecutively patch-tested female patients with dermatitis, aged 31–45 years and 46–60 years (OR = 1.60; 95% CI = 1.34 – 1.92). Occupational relevance of nickel allergy was not routinely recorded during the study period.

Two hairdressers were recently diagnosed with nickel allergy in our patch test clinic.

A 24-year-old non-atopic female hairdresser was referred with unilateral vesicular hand dermatitis on the hand using scissors during work hours. Her antecedent medical history included nickel allergy which she apparently developed following insertion of orthopaedic metal components in a fractured right elbow. Furthermore, she had previously experienced nickel allergic dermatitis following skin contact with inexpensive jewellery. Her current dermatitis had been present for 9 months and was located on her right hand and arm. Patch testing was performed with the European baseline series as well as aimed testing with the hairdressers series used at Gentofte Hospital. Furthermore, standard prick testing and prick testing with ammonium persulfate and natural rubber latex were performed. All tests were negative except 5% pet. nickel sulfate (++). A pair of scissors and a crochet hook used during work were tested with the DMG test. She used the crochet hook for up to 4 hours per day pulling hair through a cap while dyeing customers' hair. Both items showed positive test reactions. After instruction, the patient stopped using the work tools and mild corticosteroid treatment was continued.

At follow-up after 4 months, her dermatitis had cleared.

A 33-year-old atopic female hairdresser was referred with vesicular hand dermatitis located on the fingertips of her left hand. Her palms were unaffected. Her antecedent medical history was unremarkable except for immediate type I allergy towards cat hairs. Patch testing was performed with the European baseline series as well as aimed testing with the hairdressers' series used at Gentofte Hospital. Positive patch test reactions were identified for 5% nickel sulfate (++), ammonium thioglycolate (+) and toluene-2,5-diamine sulfate (+). The latter two contact allergens were identified in hair dye- and permanent wave products used in her salon and she was instructed to avoid skin contact with these. DMG testing was performed on one pair of scissors and one crochet hook. Testing showed positive reactions on both items and we observed that the coating on the scissors was defective (Fig. 1). The scissors could be purchased on the internet for approximately €30. The patient was instructed to stop using the work tools and instead use DMG-negative tools. Treatment was initiated with potent corticosteroids but replaced with UVB treatment due to relapse. At a final follow-up 3 months later, the dermatitis had almost cleared.

## Discussion

The two case reports presented in this paper demonstrate that nickel release from hairdressers' work tools may cause or aggravate nickel-related hand eczema if used frequently or for a long time. This finding emphasizes that metallic work tools should always be collected and examined for nickel release when patients have concomitant nickel allergy and hand eczema. This approach was also recommended by Wahlberg almost 30 years ago (22). Despite the possible association between nickel allergy and hand

eczema has repeatedly been debated based on the results from epidemiological studies (5, 6, 27–29), a clinical cause–effect relationship is indisputable. In a double-blind placebo-controlled exposure study over 2 weeks, a statistically significant aggravation of hand eczema was observed when patients with nickel allergy and low-grade hand eczema were exposed to 10–100 ppm nickel (30).

A total of 200 pairs of scissors were examined for nickel release with the DMG test. Testing identified only one pair that was positive upon DMG testing. Apparently, this pair of scissors was expensive and one can, therefore, not predict the DMG test outcome based on price. Nickel release from crochet hooks was prevalent although such tools may only infrequently be used for modern high/low lightning of hair. A limitation of our DMG test study was that we visited salons only in central Copenhagen and not in suburbs or provincial cities. It is possible that such investigations would alter the result. Also, excessive nickel release from scissors could possibly be more prevalent in less developed countries where it is unlikely that hairdressers spend as much money on their scissors as inner-city Danish hairdressers. Other study limitations were that we investigated only the scissors and hair crochets (and not other work tools that may be used in salons); and that only the DMG test was used to assess nickel release and not more accurate chemical analyses. Finally, it could have been interesting to investigate cobalt release from scissors and hair crochets as concomitant nickel and cobalt allergy is frequent (31).

The prevalence of nickel contact allergy was lower among 16–30-year-old female hairdressers with dermatitis than among consecutively patch-tested female patients of same age (11.3% versus 19.5%). However, among older age groups, the prevalence of nickel allergy was higher in hairdressers than in consecutive patch-tested patients (31–45 year olds; 37.5% versus 30.3% and 46–60 year olds; 42.1% versus 21.3%). This difference was statistically significant among 46–60 year olds. Furthermore, the prevalence of nickel allergy was significantly lower among female hairdressers aged 16–30 years in comparison to middle-aged and older hairdressers. The above findings may possibly be explained by two conditions (or perhaps their combination): Firstly, the 1990 regulatory intervention on nickel release from consumer products in Denmark (32) may have resulted in an efficient protection of young hairdressers from consumer nickel exposure as some were born after the regulation was introduced. We submit that female hairdressers may tend to follow fashion more readily than other consecutively patch-tested dermatitis patients. This may involve frequent hair dyeing, ear piercing and use of inexpensive jewellery.

An effect is therefore expected to be substantial. Recent Danish epidemiological studies (from the general population and from seven private dermatology practices and one tertiary referral patch test centre) showed that the prevalence of nickel allergy was higher among middle-aged and older women in comparison to young women (4, 31, 33). Middle-aged female hairdressers (31–45 years) from this study were born between 1964 and 1978 and were, therefore, readily at risk of nickel exposure from, e.g. ear piercings (34, 35) as well as buttons and zippers (36) in the 1970–1980s (37). The high prevalence of nickel allergy among 46–60-year-old female hairdressers (42.1%) may be coincidental (as the number of hairdressers in this age group was very little) but could also be explained by genuinely high nickel exposure. Secondly, it is possible that middle-aged and older female hairdressers were frequently exposed to excessive nickel release from hairdressers' work tools during the 1970s and 1980s (21). However, we have no data to verify any of these postulates. Regardless, nearly half of middle-aged and older female hairdressers with dermatitis were allergic to nickel. This means that a high proportion of current hairdressers may be at a risk of aggravating their hand eczema if continuously exposed to nickel-releasing work tools. Finally, the prevalence of nickel allergy among other consecutively patch-tested female dermatitis patients was also lower among 16–30 year olds in comparison to middle-aged and older age groups although the difference was not statistically significant. This may be explained by heterogeneity within this group or by more substantial occupational nickel exposure.

Taken together, occupational nickel exposure among hairdressers definitely occurs and should be suspected in nickel allergic hairdressers with hand eczema. The study showed that the prevalence of nickel allergy was highly prevalent among middle-aged and older female hairdressers, perhaps owing to occupational exposure to nickel-releasing tools in the past or to substantial consumer nickel exposure before 1990.

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