Occupational dermatitis in welding: does nickel exposure account for higher rates in women?

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Nickel contact dermatitis.

- Nickel was identified as a suspect agent in 12% of cases of occupational contact dermatitis reported to EPIDERM by dermatologists in a series of 9937 cases 1993-1999 in the UK. There was a female: male ratio of 3.3:1.

- Nickel sensitivity can be demonstrated by patch testing. But a positive patch test does not imply occupational causation. In the EPIDERM series occupation was thought to contribute in only 36% of cases patch-test-positive for nickel.

- Women – particularly – may be sensitized to nickel outside work.
EPIDERM worked from a positive patch test to determine occupation as a cause.

In the current study we are working the other way round.

• We can estimate how much nickel may be present in the work environment.

• We know who reports contact dermatitis (and whether they feel it’s made worse by work).

• But we do not have any measure of sensitization to determine whether nickel might be a cause.
Causation would be strengthened by positive answers to the following questions:

*Is new onset* contact dermatitis related to nickel exposure now or to cumulative exposure to nickel to that point?

*Is episodic* contact dermatitis related nickel exposure now or to cumulative exposure to nickel to that point?

*Is existing contact dermatitis made worse* by occupational nickel exposure?
To address the question on sex differences

- For the same level of nickel exposure, do more women than men develop contact dermatitis, have recurrent contact dermatitis or are more likely to report worsening due to work?

To study this we need occupations where nickel exposures occur and are likely to be similar for men and women.

The WHAT-ME cohort of women and men in the welding and electrical trades provides such an opportunity.
• The WHAT-ME study (Women’s Health in Apprenticeship Trades – metalworking and electric) recruited women from across Canada who had undertaken an apprenticeship in welding or electrical trades.

• The WHAT-MEN study recruited men in the same trades in the province of Alberta.
<table>
<thead>
<tr>
<th></th>
<th>Women</th>
<th>Men</th>
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<tbody>
<tr>
<td>Welders</td>
<td>447</td>
<td>554</td>
</tr>
<tr>
<td>Electricians</td>
<td>438</td>
<td>447</td>
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Participants completed a detailed baseline and then a follow-up questionnaire every six months for up to 5 years.

The questionnaire at each follow-up contained trade specific sub-routines that allowed us to collect specific occupational behaviours.

Baseline and follow-up asked for presence of 10 symptoms
Data available
1) On dermatitis

At baseline (on average 7 years since start of trade training) and every 6 months for up to 5 years

*Do you have dermatitis or itchy/inflamed skin now? Yes/No*

If Yes, *how old were you when this started* (baseline only)?

*Was this made worse by work? Yes/No.*
2) On exposure

i) History of work in trade (every job with, for welders, hours of welding) from first in trade.

ii) Trade specific information at each follow-up (e.g. type of welding, type of electrical work, industry)

iii) Trade specific subroutines for the most recent job (within 6 months) at each follow-up with, for each type of welding, base metal, consumables (rods or wires). Ventilation and PPE.
2) On exposure

iv) We also have urine samples collected for metal analysis in

a) Male and female welders and electrical workers in their trade
b) Pregnant women as early as possible in pregnancy
iv) Estimates of metal exposure (aluminum, chromium, manganese, nickel) and total particulates (PM2.5) from

1) Modelling of data extracted from the literature (8 papers contributed to model of nickel exposure)
2) Welding carried out under controlled conditions for this study, to validate modelled estimates and fill gaps.
Results

• At baseline 12.3% of women and 9.0% of men reported dermatitis made worse by work.

• At baseline 11.6% of women and 7.8% of men reported dermatitis that started before they went into their trade.

• 34.8% of women and 29.2% of men reported dermatitis since starting in their trade on at least one questionnaire
New onset* dermatitis:

Cox regression of time to first report, adjusting for age and smoking.

1) Women in welding and women in electrical work
2) Men and women in welding.

* Excluding those whose baseline dermatitis started before in trade
Women: Time to first onset dermatitis in trade

- **Electricians**
- **Welders**

Proportion reporting dermatitis

Years: 0 to 10
Welders: Time to first onset dermatitis in trade

Proportion reporting dermatitis vs Years

- **Men** (blue line)
- **Women** (red line)

The graph indicates a decrease in the proportion reporting dermatitis over time, with a steeper decline for women compared to men.
Episodic dermatitis
Multilevel logistic regression adjusting for age and smoking.

1) Are women in welding more at risk than women in electrical?
   OR = 1.80  95% CI 1.15-2.83    p = 0.01
2) In welding, are women more at risk than men?
   OR = 2.76  95% CI 1.61-4.73    p < 0.01
Women: Time to episodic dermatitis in trade

Proportion reporting dermatitis

Years

Electricians
Welders
Exacerbation of dermatitis

Multilevel logistic regression adjusting for age and smoking.

1) Are women in welding more at risk than women in electrical?
   OR= 1.65  95% CI 0.97-2.83  p= 0.07

2) In welding, are women more at risk than men?
   OR=2.29  95%CI 1.19-4.40  p= 0.01
So there appears to be something about welding that increases dermatitis in women.

But is it nickel?

- Cumulative nickel exposure to first onset/sensitization?
- Current nickel exposure (or cumulative exposure) in episodic or exacerbation?
Our data does NOT support a role for occupational nickel exposure in \textit{new onset} or \textit{episodic} dermatitis in welders.

On small numbers we see a weak effect on \textit{exacerbation}. Among those with dermatitis, those with nickel exposure above the median are more likely to say that the dermatitis was made worse by work. This is stronger for men.
Comparing those with nickel exposure above median with those below (in those with dermatitis)

<table>
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<tr>
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<th>OR</th>
<th>95%CI</th>
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<tbody>
<tr>
<td>All</td>
<td>2.25</td>
<td>0.85-5.93</td>
</tr>
<tr>
<td>Men</td>
<td>3.36</td>
<td>0.83-13.57</td>
</tr>
<tr>
<td>Women</td>
<td>1.27</td>
<td>0.33-4.96</td>
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Urinary nickel also related to exacerbation (made worse by work)
Conclusions

Women in welding do appear to have more dermatitis than male welders or female electrical workers.

On present estimates of nickel exposure (still in progress) nickel sensitivity does not appear to play a major part.