

A quantification of occupational skin exposures and the use of protective gloves among hairdressers in Denmark

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Summary

Background. Occupational hand eczema is common in hairdressers, owing to excessive exposure to wet work and hairdressing chemicals.

Objectives. To quantify occupational skin exposure and the use of protective gloves among hairdressers in Denmark.

Methods. A register-based study was conducted comprising all graduates from hairdressing vocational schools from 1985 to 2007 ($n = 7840$). The participants received a self-administered postal questionnaire in May 2009, including questions on hairdressing tasks performed in the past week at work and the extent of glove use. A response rate of 67.9% ($n = 5324$) was obtained.

Results. Of the respondents, 55.7% still worked as hairdressers, and they formed the basis of this study. Daily wet work was excessive; 86.6% had wet hands for ≥ 2 hr, and 54% for ≥ 4 hr. Glove use was fairly frequent for full head hair colouring and bleaching procedures (93–97.7%), but less frequent for highlighting/lowlighting procedures (49.7–60.5%) and permanent waving (28.3%). Gloves were rarely worn during hair washing (10%), although this was more frequently the case after hair colouring procedures (48.9%).

Conclusions. Occupational skin exposure was excessive among hairdressers; the extent of wet work and chemical treatments was high, and glove use was inconsistent, especially for certain hair colouring procedures and wet work tasks.

Key words: hand eczema; hairdresser population; hairdressers; occupational contact dermatitis; occupational hygiene; occupational skin exposure; protective gloves; questionnaire study; register-based study.

Recently, we published results showing that hand eczema is reported in more than 42% of hairdressers in Denmark (1), and these findings are consistent

with previous studies of both hairdressers (2–4) and hairdresser apprentices (2, 5, 6). In addition, we found that 84.9% of hairdressers with hand eczema believed that it was caused or worsened by their job (7).

Hairdressing is one of the occupations in which occupational hand eczema commonly occurs (4, 8–10). This is because of the intense exposure to wet work resulting from washing and handling damp hair, combined with frequent contact with skin irritants and allergens. Occupations, such as hairdressing, that involve skin contact with water and other irritants are prone to have a high prevalence of irritant occupational hand eczema (11). In addition, hairdressers are exposed to hair dyes, permanent wave solutions, bleaching products,

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fragrances, and preservatives, which are all well-known causes of allergic occupational hand eczema (12, 13). Very few studies have quantified this skin exposure; in 2006, Anveden et al. estimated that hairdressers were exposed to skin irritants for 62% of the working day (14), and in 2008 Lind et al. concluded that the number of hairdressing tasks involving skin-damaging chemical exposure was high (8). In another study, Lind et al. found positive hand rinse samples for permanent hair dyes among the majority of hairdressers after application of hair dye and after cutting newly coloured hair (15). If properly used, protective gloves can provide considerable protection against permeation of, for example, hair dye chemicals (16). However, a few studies have been published on the use of protective gloves among hairdressers (15, 17), and have concluded that glove use is infrequent, improper, and insufficient to prevent exposure from irritants and allergens.

The aim of this study was to quantify the occupational skin exposure among hairdressers by the weekly number of hairdressing tasks carried out and the use of protective gloves for these procedures.

Materials and Methods

Design

We conducted a register-based questionnaire study with a self-administered postal questionnaire among hairdressers in Denmark. The study was carried out in collaboration with the Danish Hairdressers' and Beauticians' Union and the Danish Hairdresser Association, and was approved by the Danish Data Protection Agency.

Registers

In order to perform this study, we used information on current postal addresses from the Central Person Registration Office. The Labour Market Supplementary Pension Scheme provided information on the annual affiliation to the hairdressing trade for every individual in the cohort.

Study population

The study population comprised all graduates from public hairdressing vocational schools in Denmark between 1985 and 2007 and whose current postal addresses were available from the Civil Registration System ($n = 7840$). They received a postal questionnaire in May 2009 and, after two reminders, answers were obtained from 5324 persons (67.9%). In this study, only respondents currently working as hairdressers were included, giving a sample of 2918 individuals aged between 22 and 65 years.

Questionnaire

In May 2009, the respondents completed a questionnaire that consisted of 147 questions concerning topics of both an occupational and a personal nature. Previously validated questions concerning self-diagnosed hand eczema from the Nordic Occupational Skin Questionnaire (NOSQ-2002) were used (18). We defined atopic dermatitis according to the UK Working Party's diagnostic criteria (19, 20). The results regarding hand eczema have been published previously (1, 7).

All hairdressers were asked to state the number of times that a particular hairdressing task was carried out in the past week of work, and to assess the duration of wet work and the extent of glove use. In addition, respondents were asked how often they wore rings and bracelets and/or wristwatches at work, and how often they used moisturizer on their hands.

The questionnaire was pretested as a peer review among supervisors of the project and the two hairdressing unions. The pilot test included 19 hairdressers, who received a postal questionnaire and who were subsequently interviewed by telephone. The questionnaire was modified accordingly.

Non-respondents

Of those contacted, 32.1% ($n = 2516$) did not return the questionnaire: 8.8% men ($n = 221$) and 91.2% women ($n = 2295$). There were significantly more men in the group of non-respondents than in the group of respondents [$p < 0.0001$; odds ratio (OR) 2.16; 95% confidence interval (CI) 1.78–2.61]. There was no significant mean age difference between respondents (37 years) and non-respondents (36.7 years) ($p = 0.126$; 95% CI for the mean difference -0.62 to 0.505).

The geographical distribution between the five regions in Denmark was similar among respondents and non-respondents, with the only exception being that significantly more non-respondents than respondents lived in the Capital Region of Denmark ($p < 0.001$; OR 1.19; 95% CI 1.08–1.32).

According to data from the Labour Market Supplementary Pension Scheme (ATP) 1768 (73.2%) non-respondents no longer worked in the hairdressing trade.

For the non-respondents, 7.1% ($n = 179$) of the addresses were not valid according to the Danish Postal Service.

Statistics

Characteristics of the groups were described by the use of plane frequencies, percentages, and mean and median

values. The groups were compared by use of the two-tailed χ^2 -test, *t*-test, or Fisher's exact test.

The χ^2 -trend test (univariate analysis) was used to test for statistically significant differences across the categories of the variable 'age in groups' (≤ 25 years versus 26–30 years versus 31–35 years versus 36–40 years versus 41–45 years versus ≥ 46 years).

Fisher's exact test (univariate analysis) was used to test for statistically significant differences between men and women and the number of hairdressing tasks performed. The reason for using this test was that several cells had a cell count of less than 5.

All statistical analyses were carried out with PASW™ STATISTICS 18 (SPSS, Chicago, IL, USA) for Windows™. A *p*-value of <0.05 was considered to be significant.

Definitions

Occupational skin exposure was measured with the question: 'How many times have you carried out the following tasks at work during the past week?' (Table 3). For every task, respondents could indicate the number of times that the particular task was performed, or tick off 'Did not perform this task'. Respondents who indicated '0' for the number of times that the particular task was performed were added to the group of 'Did not perform this task'.

Furthermore, we chose to focus on wet and chemical exposures only. As a consequence, hair styling procedures are not included. It is generally accepted that wet work is defined by (i) having wet hands for ≥ 2 hr on a regular work day, or (ii) using occlusive gloves for ≥ 2 hr/day, or (iii) frequent cleaning of hands (> 20 times/day) (10, 21–23). We defined cutting wet hair, washing hair, dishwashing, cleaning etc. without using gloves as having wet hands.

In Denmark, the rules are quite complex regarding hairdressers and their working hours. According to the agreement between the Danish Hairdresser Association and the Danish Hairdressers' and Beauticians' Union (24), a full-time hairdresser should work a maximum of 37 hr/week divided into 5 working days over a period of 16 weeks (the hours/days may vary within this period). In this study, we defined 'a week at work' as 5 days when reporting the mean number of times that a particular hairdressing task was performed.

In order to investigate the correlation between hand eczema and glove use, a variable of 'recent hand eczema' was constructed. This variable is defined by the following answers to the question 'When did you last have hand eczema?': 'I have hand eczema at the moment' ($n = 213$) and 'I don't have hand eczema at the moment,

but I've had it within the past 3 months' ($n = 181$). Thus, a total of 394 hairdressers had had recent hand eczema. The analyses were conducted for (i) the group of hairdressers with recent hand eczema ($n = 394$) as compared with the rest of the hairdressers (regardless of their hand eczema status) ($n = 2524$) and (ii) the group of hairdressers who had ever had hand eczema ($n = 1089$) as compared with the rest of the hairdressers ($n = 1829$) (i.e. hairdressers without hand eczema). This approach was chosen because no information about the time of initiation of glove use was available.

Results

Information on current occupation was obtained from 5239 respondents: 2918 (55.7%) still worked in the hairdressing trade. The trade is dominated by women, and 95.7% of the hairdressers were female (Table 1). The mean age of the hairdressers was 36.4 years, and, on average, the hairdressers had worked for 11.3 years in the hairdressing profession when they answered the questionnaire (Table 1). More than half of the hairdressers were self-employed (1532/2895, 52.9%).

Wet work

The majority of both males and females reported washing their hands an average of 6–10 times/day at work (38.4% and 41.2%, respectively; Table 2). Washing hands ≥ 20 times/day was reported by 7.0% of all hairdressers. A total of 78.4% of the males and 86.9% of the females (in all, 86.6%) reported having wet hands for ≥ 2 hr on any normal day at work (Table 2). As a whole, 54.0% reported having wet hands for ≥ 4 hr/day.

Wearing jewellery and wristwatches

Less than one-quarter of the hairdressers never wore rings to work (Table 2), but 55.2% of the males and 68.9% of

Table 1. Characteristics of the 2918 hairdressers participating in this study; the respondents are described with regard to sex, age, and number of years in the hairdressing trade

	Male <i>n</i> = 125 (4.3%)	Female <i>n</i> = 2793 (95.7%)	Total <i>n</i> = 2918 (100%)
Age			
Mean (range)	38.5 (26–52)	36.3 (22–65)	36.4 (22–65)
Median	39	36	36.5
Number of years in the hairdressing trade			
Mean (range)	10.6 (1–24)	11.3 (1–27)	11.3 (1–27)
Median	10	10	10

Table 2. Description of the occurrence of potential risk factors for hand eczema among 2918 trained hairdressers (125 men and 2793 women) who answered a postal questionnaire

	Male hairdressers Total (%)	Female hairdressers Total (%)	All hairdressers Total (%)
Hand washing			
Question: On any normal day at work: how many times do you wash your hands? Do not include washing hair. Please tick one box only	n = 125 (100)	n = 2786 (100)	n = 2911 (100)
0–5 times a day	45 (36.0)	596 (21.4)	641 (22.0)
6–10 times a day	48 (38.4)	1147 (41.2)	1195 (41.1)
11–20 times a day	27 (21.6)	843 (30.3)	870 (29.9)
More than 20 times a day	5 (4.0)	200 (7.2)	205 (7.0)
Wet hands			
Question: On any normal day at work: for how long are your hands wet? Include cutting of wet hair, washing hair, washing dishes, cleaning in the salon, etc. Please tick one box only	n = 125 (100)	n = 2771 (100)	n = 2896 (100)
Never	0 (0)	3 (0.1)	3 (0.1)
Less than half an hour a day	10 (8.0)	55 (2.0)	65 (2.2)
½–1 hr a day	8 (6.4)	111 (4.0)	119 (4.1)
More than 1 hr but less than 2 hr a day	9 (7.2)	194 (7.0)	203 (7.0)
2–3 hr a day	21 (16.8)	464 (16.7)	485 (16.8)
More than 3 hr but less than 4 hr a day	25 (20.0)	431 (15.6)	456 (15.8)
4 hr or more a day	52 (41.6)	1513 (54.6)	1565 (54.0)
Jewellery			
Question: Do you wear rings when you work? Please tick one box only	n = 125 (100)	n = 2790 (100)	n = 2915 (100)
Yes, every day	69 (55.2)	1921 (68.9)	1990 (68.3)
Yes, several times a week	0 (0)	118 (4.2)	118 (4.0)
Yes, approximately once a week	2 (1.6)	29 (1.0)	31 (1.1)
Yes, but rarer	2 (1.6)	110 (3.9)	112 (3.8)
No, never	52 (41.6)	612 (21.9)	664 (22.8)
Question: Do you wear bracelets and/or a wristwatch when you work? Please tick one box only	n = 120 (100)	n = 2713 (100)	n = 2833 (100)
Yes, every day	85 (70.8)	1838 (67.7)	1923 (67.9)
Yes, several times a week	3 (2.5)	184 (6.8)	187 (6.6)
Yes, approximately once a week	0 (0)	60 (2.2)	60 (2.1)
Yes, but rarer	7 (5.8)	199 (7.3)	206 (7.3)
No, never	25 (20.8)	432 (15.9)	457 (16.1)

The varying n-values in the subsamples are attributable to missing data for the individual items.

the females wore rings to work on a daily basis. The picture is very similar with regard to bracelets and/or wristwatches; a total of 16.1% never wore them, whereas 70.8% of the males and 67.7% of the females wore them on a daily basis.

Use of moisturizer

Only 7.0% (203/2828) of the hairdressers never used moisturizer on their hands. This was, however, more common among the males (21/118, 16.9%) than among the females (182/2710, 6.5%). The majority of females (1888/2710, 67.8%) used moisturizer on their hands at least once a day; this was true for 51.6% (64/118) of the males. There was a statistically significant difference between males and females regarding the

overall frequency of using moisturizer; the males used moisturizer less frequently than the females ($p < 0.0001$; OR 0.34; 95% CI 0.21–0.57).

Hairdressing tasks performed during the past week at work

The mean number of hairdressing tasks performed at work during the past week is shown in Table 3. The tasks are arranged in sequence of descending order. Wet work hairdressing tasks such as cutting wet hair and hair washing were the most frequently performed (36.4 times/week, equivalent to 7.3 times/day, and 27.8 times/week, equivalent to 5.6 times/day, respectively). Males performed significantly more haircuts than females (weekly mean, 40.3 times; $p = 0.017$; 95% CI of the

Table 3. Hairdressing tasks^a

Question: How many times have you carried out the following tasks at work during the past week? Please write the number of times or tick the box for each task. If you cannot remember, please look at your work slip							
	Male hairdressers		Female hairdressers		All hairdressers		
	Number of times in the past week at work	Did not perform this task n = 125 Total (%)	Number of times in the past week at work	Did not perform this task n = 2793 Total (%)	Number of times in the past week at work	Did not perform this task n = 2918 Total (%)	
Cutting wet hair	n = 111 Range: 1–99 Mean: 40.3 Median: 40	3 (2.4)	n = 2276 Range: 1–99 Mean: 36.3 Median: 35	73 (2.6)	n = 2387 Range: 1–99 Mean: 36.4* Median: 35	76 (2.6)	
Hair washing	n = 109 Range: 2–80 Mean: 26.7 Median: 25	5 (4.0)	n = 2252 Range: 1–99 Mean: 27.9 Median: 25	86 (3.1)	n = 2361 Range: 1–99 Mean: 27.8 Median: 25	91 (3.1)	
Scalp massaging	n = 79 Range: 1–50 Mean: 17.9 Median: 14	31 (24.8)	n = 1542 Range: 1–99 Mean: 19.9 Median: 15	732 (26.2)	n = 1621 Range: 1–99 Mean: 19.8 Median: 15	763 (26.1)	
Cutting wet hair after any type of hair colouring	n = 102 Range: 1–70 Mean: 15.3 Median: 10	10 (8.0)	n = 2106 Range: 1–99 Mean: 14.6 Median: 10	219 (7.8)	n = 2208 Range: 1–99 Mean: 14.7 Median: 10	229 (7.8)	
Full head colouring with permanent hair dye	n = 94 Range: 1–50 Mean: 9.6 Median: 8	17 (13.6)	n = 2079 Range: 1–60 Mean: 9.3 Median: 8	259 (9.3)	n = 2173 Range: 1–60 Mean: 9.3 Median: 8	276 (9.5)	
Deep conditioning	n = 68 Range: 1–50 Mean: 8.3 Median: 5	40 (32.0)	n = 1367 Range: 1–99 Mean: 7.7 Median: 5	918 (32.9)	n = 1435 Range: 1–99 Mean: 7.8 Median: 5	958 (32.8)	
Highlighting/lowlighting with foil	n = 88 Range: 1–30 Mean: 8.1 Median: 6	25 (20.0)	n = 2008 Range: 1–60 Mean: 6.8 Median: 5	331 (11.9)	n = 2096 Range: 1–60 Mean: 6.8* Median: 5	356 (12.2)	
Colouring of eyelashes and/or eyebrows	n = 56 Range: 1–50 Mean: 5.6 Median: 4	55 (44.0)	n = 1945 Range: 1–80 Mean: 5.3 Median: 4	391 (14.0)	n = 2001 Range: 1–80 Mean: 5.3 Median: 4	446 (15.3)	

Question: How many times have you carried out the following tasks at work during the past week? Please write the number of times or tick the box for each task. If you cannot remember, please look at your work slip

Table 3. *Continued*

Question: How many times have you carried out the following tasks at work during the past week? Please write the number of times or tick the box for each task. If you cannot remember, please look at your work slip

	Male hairdressers		Female hairdressers		All hairdressers	
	Number of times in the past week at work	Did not perform this task n = 125 Total (%)	Number of times in the past week at work	Did not perform this task n = 2793 Total (%)	Number of times in the past week at work	Did not perform this task n = 2918 Total (%)
Root/regrowth colouring	n = 72 Range: 1–20 Mean: 4.9 Median: 4	37 (29.6)	n = 1673 Range: 1–60 Mean: 4.5 Median: 3	605 (21.7)	n = 1745 Range: 1–60 Mean: 4.6 Median: 3	642 (22.0)
Highlighting/lowlighting with a cap	n = 53 Range: 1–20 Mean: 4.7 Median: 3	55 (44.0)	n = 1545 Range: 1–40 Mean: 4.5 Median: 3	766 (27.4)	n = 1598 Range: 1–40 Mean: 4.5 Median: 3	821 (28.1)
Full head colouring with semi-permanent hair dye	n = 72 Range: 1–40 Mean: 5.2 Median: 4	38 (30.4)	n = 1380 Range: 1–50 Mean: 4.4 Median: 3	890 (31.9)	n = 1452 Range: 1–50 Mean: 4.5 Median: 3	928 (31.8)
Permanent waving	n = 51 Range: 1–20 Mean: 3.2 Median: 2	58 (46.4)	n = 1611 Range: 1–40 Mean: 3.4 Median: 2	713 (25.5)	n = 1662 Range: 1–40 Mean: 3.4 Median: 2	771 (26.4)
Full head bleaching	n = 43 Range: 1–20 Mean: 3.4 Median: 2	65 (52.0)	n = 627 Range: 1–50 Mean: 2.8 Median: 1	1630 (58.4)	n = 670 Range: 1–50 Mean: 2.8 Median: 2	1695 (58.1)
Attaching hair extensions with hot adhesives/thermal hair bonding	n = 4 Range: 1–2 Mean: 1.3 Median: 1	103 (82.4)	n = 115 Range: 1–10 Mean: 2.0 Median: 1	2207 (79.0)	n = 120 Range: 1–10 Mean: 2.0 Median: 1	2310 (79.2)

^aThis table describes the number of times that a typical hairdressing task was carried out during the past week of work by 2918 hairdressers. Note that, in Denmark, a full-time hairdresser works a maximum of 37 hr/week divided into 5 days. For each task, the hairdressers could write the number of times that the particular task was carried out or tick off 'Did not perform this task'. Respondents who had written '0' were added to the latter category. The following information is provided for each task: the number of respondents who answered the question, the range, the mean, the median, and the number and percentage of hairdressers who did not perform the task. The tasks are arranged in sequence of descending order. The means were compared by use of the *t*-test; an asterisk following the value of the total mean indicates that a statistically significant difference ($p < 0.05$) was found between the mean number of times that a particular task was performed among male and female hairdressers.

Table 4. Glove use among 2918 trained hairdressers (125 men and 2793 women) who answered a postal questionnaire

	Male Total (%)	Female Total (%)	All hairdressers Total (%)
Question: Do you use gloves at work? Please tick one box only	n = 124 (100)	n = 2763 (100)	n = 2887 (100)
Yes	119 (96.0)	2715 (98.3)	2834 (98.2)
No	5 (4.0)	48 (1.7)	53 (1.8)
Question: What type of gloves do you most frequently use at work? Please tick one box only	n = 109	n = 2441	n = 2550
Vinyl gloves	44 (40.4)	863 (35.4)	907 (35.6)
Latex gloves	30 (27.5)	859 (35.2)	889 (34.9)
Nitrile gloves	28 (25.7)	541 (22.2)	569 (22.3)
Polyethylene gloves	5 (4.6)	48 (2.0)	53 (2.1)
Rubber household gloves	0 (0.0)	20 (0.8)	20 (0.8)
Other	0 (0.0)	41 (1.7)	41 (1.6)
Do not know	2 (1.8)	69 (2.8)	71 (2.8)
Question: For how many hours a day do you wear gloves at work? Please tick one box only	n = 119	n = 2678	n = 2797
Less than half an hour a day	18 (15.1)	143 (5.3)	161 (5.8)
½–1 hr a day	34 (28.6)	514 (19.2)	548 (19.6)
More than 1 hr but less than 2 hr a day	39 (32.8)	905 (33.8)	944 (33.7)
2–3 hr a day	23 (19.3)	865 (32.3)	888 (31.7)
More than 3 hr but less than 4 hr a day	4 (3.4)	186 (6.9)	190 (6.8)
4 hr or more a day	1 (0.8)	65 (2.4)	66 (2.4)

The varying n-values in the subsamples are attributable to missing data for the individual items.

difference 0.72–7.40). Cutting wet hair following any type of hair colouring was performed 2.9 times/day (equivalent to 14.7 times/week; Table 3). Hair colouring procedures were also performed on a daily basis, full head colouring with permanent hair dye being the most frequently performed type (9.3 times/week, equivalent to 1.9 times/day). Except for highlighting/lowlighting with foil ($p = 0.032$; 95% CI of the difference 0.11–5.57), there were no statistically significant differences in the mean number of times that a hair colouring procedure was performed between males and females.

Wearing gloves

Of all hairdressers, 98.2% (2834/2887) reported using gloves at work (Table 4), and 40.9% of them wore gloves for ≥ 2 hr/day. The majority of the hairdressers (96.4%) were able to use as many gloves as they needed at work. The most frequently used gloves were vinyl gloves (35.6%; Table 4), latex gloves (34.9%), and nitrile gloves (22.3%). The re-use of gloves was frequent; 20.2% (569/2818) of hairdressers did not take a new pair of gloves every time, and the majority of those only took a new pair of gloves when the old ones were torn (381/569, 67.7%). The mean number of times that a pair of gloves was used was 3.46 (range 1–20).

Of the hairdressers who re-used their gloves, 59.6% (336/564) never turned their gloves inside out before re-using them (Table 5). Consequently, a total of 40.4%

Table 5. Of the 569 respondents who reported not taking a new pair of gloves every time, 564 answered the question on turning gloves inside out before re-using them

Question: Do you turn your gloves inside out and re-use them? Please tick one box only	n = 564 Total (%)
Yes, every time	104 (18.4)
Yes, more than half the time	43 (7.6)
Yes, approximately half the time	43 (7.6)
Yes, but less than half the time	38 (6.7)
No, never	336 (59.6)

(228/564) regularly turned their gloves inside out before re-using them (Table 5). This is equivalent to 8% of all hairdressers (228/2834) who used gloves at work.

Wearing gloves for individual hairdressing tasks

Although almost all hairdressers answered that they wore gloves at work, the picture changes when we look at glove use for the individual hairdressing tasks. The majority of both males and females wore gloves for full head colouring (regardless of type) and bleaching (Table 5), but for highlighting/lowlighting with a cap or foil, this tendency changed to 60.5% and 49.7%, respectively. There was a statistically significant difference in glove use between males and females for these treatments (Table 5). Although glove use was frequent during hair colouring procedures, less than half of the hairdressers wore gloves when washing the dye out of the hair (48.9%; Table 5).

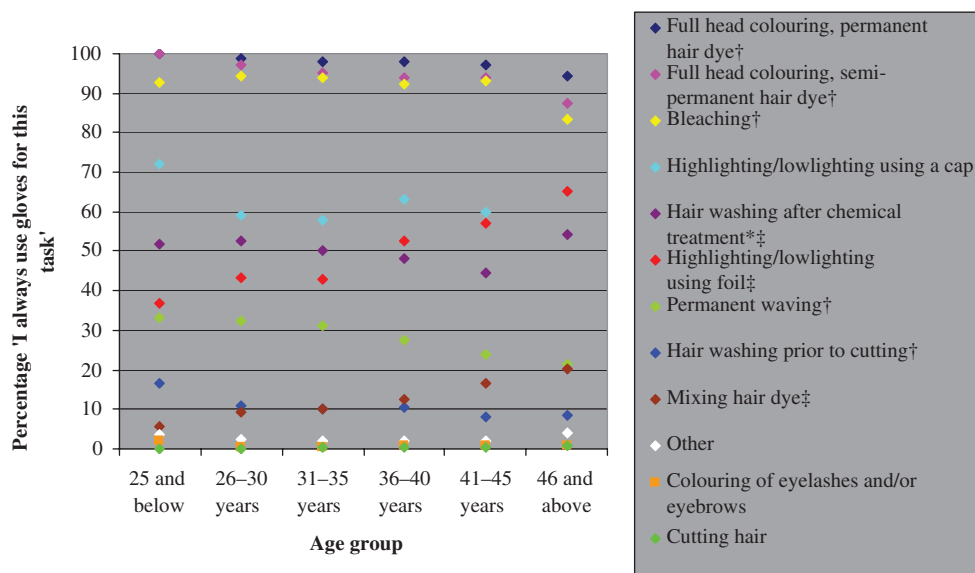


Fig. 1. The percentage of glove use for each hairdressing task among hairdressers divided into six age groups. A χ^2 -trend test was performed to examine whether there was a difference in glove use for each hairdressing task between the age groups. A significant difference between the age groups was seen for eight of 12 treatments; for hair washing after chemical treatments, highlighting/lowlighting with foil, and mixing hair dye, glove use improved with age. For full head colouring with either permanent or semi-permanent hair dye, bleaching, permanent waving, and hair washing prior to cutting, glove use decreased with age. *Chemical treatments defined as any type of hair colouring and permanent waving. † p (χ^2 -trend) < 0.05, indicating a negative association with age. ‡ p (χ^2 trend) < 0.05, indicating a positive association with age.

For a high-risk exposure such as permanent waving, only 28.3% wore gloves, and, in addition, gloves were very rarely worn for colouring eyelashes and/or eyebrows (0.7%). For basic hair washing, 10% wore gloves.

Figure 1 shows the percentage of glove use for each hairdressing task among hairdressers divided into six age groups. A statistically significant difference in glove use between the age groups was seen for eight of 12 treatments (Fig. 1); for hair washing after chemical treatments, highlighting/lowlighting with foil, and mixing hair dye, glove use increased with age. For full head colouring with either permanent or semi-permanent hair dye, bleaching, permanent waving, and hair washing prior to cutting, the use of gloves decreased with age.

Hairdressing tasks performed during the past week without gloves

Hairdressers in Denmark participating in this study were fairly good at using protective gloves for full head colouring and bleaching procedures (between 93% and 97.7%; Table 6). This was not the case for several other hairdressing tasks involving hair dye or permanent wave solution. When analysing the mean number of times that these tasks were performed among hairdressers who did not always wear gloves for specific treatments, we found

that 'cutting wet hair after any type of hair colouring' was performed an average of 14.7 times/week (equivalent to 2.9 times/day) without gloves ($n = 2146$), 'permanent waving' an average of 3.4 times/week (equivalent to 0.7 times/day) without gloves ($n = 1193$), and 'colouring eye lashes and/or eyebrows' 5.3 times/week (equivalent to 1.1 times/day) without gloves ($n = 1931$). Furthermore, highlighting/lowlighting with either foil or a cap were performed, on average, 7 times/week (equivalent to 1.4 times/day, $n = 1074$) and 4.6 times/week (equivalent to 0.9 times/day, $n = 539$), respectively, without gloves.

Correlation with hand eczema

Among the hairdressers participating in this study, 37.6% (1089/2895) had ever had hand eczema, and the majority (61.3%) had it several times (1). A total of 394 hairdressers (13.6%) had had recent hand eczema (within the past 3 months).

Both hairdressers with recent hand eczema (i) and hairdressers who had ever had hand eczema (i) used gloves significantly more often for hair washing tasks than their colleagues; this was also the case for glove use during permanent waving procedures (Table 7). Extensive glove use (≥ 2 hr/day) and frequent cleaning of the hands (> 20 times/day) were more pronounced among (i) hairdressers

Table 6. Usage of gloves for hairdressing tasks among 119 male and 2715 female respondents who reported using gloves at work

Question: For what treatments do you always use gloves?	Male n = 119 Total (%)	Female n = 2715 Total (%)	Total N = 2834 Total (%)
Full head colouring with permanent hair dye	114 (95.8)	2656 (97.8)	2770 (97.7)
Full head colouring with semi-permanent hair dye	107 (89.9)	2577 (94.9)	2684 (94.7)*
Bleaching	111 (93.3)	2524 (93.0)	2635 (93.0)
Highlighting/lowlighting with a cap	47 (39.5)	1668 (61.4)	1715 (60.5) [†]
Highlighting/lowlighting with foil	44 (37.0)	1364 (50.2)	1408 (49.7) [‡]
Hair washing after hair colouring or permanent waving	58 (48.7)	1327 (48.9)	1385 (48.9)
Permanent waving	33 (27.7)	769 (28.3)	802 (28.3)
Mixing of hair dye	19 (16.0)	337 (12.4)	356 (12.6)
Hair washing prior to cutting hair	13 (10.9)	269 (9.9)	282 (10.0)
Other	4 (3.4)	60 (2.2)	64 (2.3)
Colouring of eyelashes and/or eyebrows	1 (0.8)	20 (0.7)	21 (0.7)
Cutting hair	1 (0.8)	11 (0.4)	12 (0.4)

Multiple answers were possible. Glove use for the individual hairdressing tasks was compared among male and female hairdressers by use of Fisher's exact test. A *p*-value of <0.05 was considered to be significant.

*Fisher's exact, *p* = 0.022. [†]Fisher's exact, *p* < 0.0001. [‡]Fisher's exact, *p* = 0.003.

Table 7. Glove use for individual hairdressing tasks and the correlation with hand eczema

Question: For what treatments do you always use gloves?	<i>p</i> ; OR; CI
Hair washing prior to cutting hair	
(i) Recent versus all other	<0.0001; 3.58; 2.72–4.74
(ii) Ever versus never	<0.0001; 2.38; 1.85–3.06
Hair washing after hair colouring or permanent waving	
(i) Recent versus all other	0.034; 1.26; 1.02–1.56
(ii) Ever versus never	0.027; 1.18; 1.02–1.38
Permanent waving	
(i) Recent versus all other	0.007; 1.36; 1.09–1.71
(ii) Ever versus never	0.021; 1.22; 1.03–1.44

CI, confidence interval; OR, odd ratio. Analysis (i) compared hairdressers with recent hand eczema with all other hairdressers (regardless of hand eczema status). Analysis (ii) compared hairdressers who had ever had hand eczema with hairdressers without hand eczema. The analyses were carried out as separate 2 × 2 tables for the individual hairdressing tasks.

with recent hand eczema and (ii) hairdressers who had ever had hand eczema than among their colleagues (data not shown). No difference in the reported re-use of gloves was observed in either of the analyses (data not shown).

Discussion

In this study, we aimed to assess the occupational skin exposure and the use of protective gloves among hairdressers. Overall, we found that more than half of the hairdressers had wet hands for ≥4 hr/day, and that no hairdressing task was performed with gloves every time. Consequently, hairdressers have excessive skin exposure, on a daily basis, to very potent allergens, water, and other

irritants, all of which are well-known causes of hand eczema (15, 25).

Several studies have shown a strong correlation between wet work and hand eczema (3, 4, 10). In this study, the extent of wet work was high; 86.6% had wet hands for ≥2 hr/day, and of those, 54% reported having wet hands for ≥4 hr/day. We defined cutting wet hair as a wet work task, and it was the most frequently reported hairdressing task, being performed, on average, 36.4 times/week. Hair washing was the second most frequently performed hairdressing task (mean, 27.8 times/week). Despite the fact that the majority of hairdressers with hand eczema believe that their hand eczema is caused by hair washing (2), only 10% of the hairdressers in this study always wore gloves for this task. These findings are consistent with those of other studies: wearing gloves for hair washing was reported in 5.5% of hairdressers by Nixon et al., and in 11% of hairdressers by Lind et al. (5, 8). Even though this study was performed among trained hairdressers who had been, on average, 11.3 years in the trade, the hairdressers reported a high extent of wet work. Thus, hairdressers have extensive exposure to wet work throughout their career, regardless of their seniority.

Besides the wet work, hairdressers performed several tasks a day involving hairdressing chemicals. Hair colouring procedures were the most frequently performed type of chemical treatment, and full head bleaching was the least frequently performed type.

No hairdressing task was performed with gloves every time, and, as a consequence, hairdressers had daily skin exposure to hairdressing chemicals. However, the majority of hairdressers in Denmark always wore gloves for certain hairdressing tasks, such as applying full head colouring with permanent hair dye (97.7%),

semi-permanent hair dye (94.7%), and bleaching (93.0%). In studies by Nixon et al. and Lind et al., similar frequencies were found (5, 8). However, gloves were rarely used for the procedures of mixing and rinsing off hair dye (12.6% and 48.9%, respectively; Table 5), permanent waving (28.3%), and hair washing (10%). All of these procedures provide significant exposure to allergenic hairdressing chemicals.

We found that the age of the hairdressers played a significant role in glove use for the individual hairdressing tasks. The young hairdressers were better at using gloves for full head colouring with both permanent and semi-permanent hair dyes, permanent waving, and basic hair washing (Fig. 1), whereas the older hairdressers more frequently wore gloves for hair washing after a chemical treatment (any type of hair colouring and permanent waving), highlighting/lowlighting with foil, and mixing hair dye (Fig. 1). The young hairdressers in Denmark have been taught about glove use at the vocational schools to a greater extent than the older hairdressers, and these results highlight the need for better training material and the incorporation of better working habits.

Additionally, we found that hairdressers with hand eczema had a higher frequency of extensive glove use (≥ 2 hr/day), and used gloves more frequently for hair washing procedures than their colleagues. The reasons for this are speculative, as we do not know when the individual hairdressers began using gloves. The results suggest, however, that hairdressers are better at using gloves after they develop hand eczema.

An alarming lack of knowledge becomes evident from the facts that 1 in 5 hairdressers re-use their gloves, and that 8% of all hairdressers turn their gloves inside out before re-using them. Turning the gloves inside out leads to prolonged skin contact with the contaminated surface of the gloves. This practice must be stopped. Efforts should be made to understand and remedy the motivation for this habit.

Wearing jewellery at work is a potential risk factor for developing eczema as a hairdresser. Excess styling products, detergents etc. are caught under the jewellery, providing extended exposure. Furthermore, the area of skin covered by the jewellery is likely to be moist for a prolonged period of time unless the jewellery is removed when the hands are dried. The majority of hairdressers in this study wore rings and/or bracelets/wristwatches to work on a daily basis.

As this is a questionnaire study a possible shortcoming might be that the number of tasks performed is self-reported. This may lead to recall bias. However, by restricting the question to include the number of tasks performed within the past week only, we believe that

we have reduced this risk significantly. Furthermore, the weekly number of hairdressing tasks reported in this study is largely consistent with that reported by Lind et al. in 2008 (8).

Information on glove use was also self-reported. Wearing gloves has been strongly promoted among hairdressers within the past decade. Thus, it is likely that respondents may have over-reported their glove use, as 'I wear gloves' is the socially desirable answer. However, the glove use reported in this study is similar to that in other studies (5, 8).

In the questionnaire, the hairdressers could specify what type of gloves they used (Table 3). Unfortunately, we did not specify which gloves were disposable and which types could be used several times.

This study was performed among 7840 trained hairdressers. The relatively high response rate of 67.9% ($n = 5324$) makes it possible for us to assume that the results can be extrapolated to the entire population of hairdressers in Denmark. However; it is possible that we lost valuable information about the ex-hairdressers among the non-respondents: according to the ATP data, 73.2% of the non-respondents no longer worked in the trade, and this could suggest selection bias, as one could speculate that they would be more reluctant to answer a questionnaire regarding something that may not be of relevance to them anymore. However, the sample sizes of both current and ex-hairdressers are considerable.

Hairdressers have excessive skin exposure to both irritants and very potent allergens on a daily basis, and they are therefore at very high risk of developing both hand eczema and allergies. In this study, we chose to focus on wet and chemical exposures only. As a consequence, hair styling procedures are not included. Thus, the exposure to potential irritants and allergens among hairdressers are likely to be even higher than reported in this article.

In an earlier publication, we proved occupational hand eczema to be of crucial importance for the high occurrence of career change among hairdressers in Denmark (1). Several studies support these findings (9, 11, 26–28). Prevention of hand eczema in the hairdressing trade is a remedy to cause hairdressers to stay in the hairdressing trade for longer than the current 8.4 years (1) and also to reduce the morbidity in this trade and the very high costs of this occupational disease (29).

Hand eczema among hairdressers is largely preventable. Preventive measures should include a reduction of exposure to irritant and allergenic hairdressing products by replacement of these products with less hazardous variants, as well as relevant skin protection legislation [e.g. a requirement that gloves in all sizes should be

located by (i) every workstation and by (ii) every sink where wet work is performed in the salon, that glove use should be statutory for all chemical treatments and wet work, and that the gloves must be hypo-allergenic and be impermeable to hairdressing chemicals].

Although glove use exceeding 2 hr/day is an independent risk factor for hand eczema (10, 21–23), the unprotected exposure to wet work, irritants and allergens in this trade is a more significant risk factor (10). As a consequence, the use of suitable protective gloves should be promoted for hair washing as well as for all procedures (i.e. mixing, applying, and rinsing off) that could involve skin contact with extreme sensitizers such as hair dyes, bleach, and permanent wave solutions.

In order to further reduce skin exposure to hair dye chemicals (15), hairdressers should cut the customer's hair before initiating the colouring process. Traditionally, hairdressers colour the customer's hair prior to

cutting it, and, as a consequence, hairdressers cut newly dyed hair several times a day (Table 2), exposing their skin to hair dye compounds that are released from the hair (15).

In conclusion, the results from this study show that hairdressing is an occupation with a high degree of skin exposure to wet work and allergenic substances, and that hairdressers are very inconsistent in their glove use. This study further shows the need for an increased focus, raised awareness and a mindset change regarding this subject among all stakeholders in the hairdressing trade.

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