

Exposures and reactions to allergens among hairdressing apprentices and matched controls

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Summary

Background. Early and extensive exposures to chemical substances such as are found in hair dyes, perfumes and nickel are known risk factors for allergic reactions. Hairdressing apprentices belong to a high-risk group, as they are exposed both occupationally and personally.

Objectives. To estimate the degree of exposure and adverse skin reactions to chemical substances in a cohort of hairdressing apprentices, at the start of their education, as compared with a matched sample from the general population.

Materials. During their first 2 weeks of training, 382 hairdressing apprentices were enrolled in this study. All apprentices completed a self-administered questionnaire that included questions regarding, for example, exposures and skin reactions to hair dye, perfumed products, and piercings. For comparison, the questionnaire was sent to a control group from the general population, matched on age, sex, and postal code ($n = 1870$).

Results. Within the previous year, 95.2% of hairdressing apprentices and 66.9% of the control group had dyed their hair ($p < 0.001$); the apprentices dyed their hair, on average, 6.6 times per year, as compared with 3.7 times per year in the control group ($p < 0.001$). The mean age of the first hair dyeing among the apprentices was 12.1 years, as compared with 13.3 years for the matched control group ($p < 0.001$). The hairdressing apprentices reported more eczematous reactions to hair dye ($p = 0.002$) than the controls. Semi-permanent so-called 'black henna tattoos' had been carried out in 48.1% of the apprentices, as compared with 31.0% of the controls ($p < 0.001$).

Conclusions. Both hairdressing apprentices and the matched control group of young people from the general population were highly exposed to potent allergens. The hairdressing apprentices were even more exposed to products containing hair dye substances and piercings, and reported more adverse reactions to hair dye products than their matched controls from the general population.

Key words: Adolescent; allergic reactions; dermatitis; exposure; hair dye; hairdresser; hairdressers; hairdressing apprentices; perfume; piercing; semi-permanent black tattoos; temporary tattoo.

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Early and extensive exposures to chemical substances such as are found in hair dyes, perfumes and nickel are risk factors for allergic reactions (1, 2). It has been shown that hairdressers have a higher frequency of allergic reactions to perfumes, hair-bleaching products and permanent wave chemicals than the general population (3). Both hairdressers and hairdressing apprentices are exposed both professionally and personally, and belong to a high-risk occupational group.

Allergic reactions to hair dyes in the general population and in hairdressers have been investigated in several studies (3–5). Information about how hairdressing apprentices and adolescents from the general population expose themselves to hair dyes is missing. However, it is known that hair dye products are used at early ages, and severe allergic reactions in children have been reported (6). In a Danish study from 2004, it was found that the average age at first hair dye use in the general population was 16 years (5). Exposures to hair dye chemicals are achieved by the use of either hair dye or eyebrow/eyelashes dye (7). In addition, semi-permanent so-called 'black henna tattoos', which have become popular among children, teenagers, and adults, may contain hair dye ingredients (8). Several reports on exposure to semi-permanent black henna tattoos and the development of severe allergic reactions have been recently published (4, 9).

The aim of this study was to estimate the degree of exposure and adverse skin reactions to potential allergens in a cohort of hairdressing apprentices just starting their education, as compared with a matched control group from the general population.

Materials and Methods

We conducted a questionnaire study among hairdressing apprentices and, for comparison, a matched control group from the general population.

Study population

During the first 2 weeks of their education, the hairdressing apprentices were enrolled in a follow-up study on occupational hand eczema. The enrolment took place in two phases: in August 2008 ($n = 382$) and in January 2009 ($n = 120$). The data presented include results from the first of the two enrolments of the hairdressing apprentices ($n = 382$) and a matched control group ($n = 1870$). All apprentices completed a self-administered questionnaire.

All apprentices gave informed consent, and the Committee on Biomedical Research Ethics of Copenhagen and Frederiksberg approved the protocol (H-B-2007-096). The study was conducted from August 2008 to March 2009.

Matched control group

For comparison, the questionnaire was sent to a matched control group from the general population. Matching was performed with the social security number, a unique identifier that all Danes have from birth. Each apprentice enrolled in August 2008 (except for eight, because of

invalid social security numbers) ($n = 374$), was matched to five controls ($n = 1870$). Matching was based on age, sex, and postal code.

Comparison of study population and matched control group

The participation rate of the hairdressing apprentices was 99.7% (374 of 375 hairdressing apprentices present on the day of inclusion). The response rate of the matched controls was 68.3% (1277 of 1870 completed the questionnaire).

The mean age was 17.5 years (range 15–39 years) for the apprentices and 17.4 years (range 15–39 years) for the controls; the median age was 17 years for both groups. Both groups mainly consisted of females; 96.3% of the apprentices and 96.9% of the controls were females.

In the matched control group, the responders were slightly younger (mean age 17.4 years) than the non-responders (mean age 17.8 years) ($p = 0.02$). Also, there were fewer males among the responders (3.1%) than among the non-responders (5.1%) ($p = 0.04$).

The questionnaire

Questions concerning exposures and adverse skin reactions to hair dyes, semi-permanent black henna tattoos, perfumed products and piercings were previously validated and adapted from large epidemiological studies in Denmark: SUSY (5) and the Copenhagen Allergy Study questionnaires (10, 11) (see Appendix).

The development of the questionnaire included a pilot test with 25 hairdressing apprentices and 5 young people not in the hairdressing trade.

Statistical analysis

For analysis of a matched dataset, the preferable method to use is a conditional logistic regression. In this analysis, Cox regression was used as conditional logistic regression for comparison of exposure and adverse skin reactions in the two cohorts. A p -value < 0.05 was considered to be significant. All analyses of adverse skin reactions were adjusted for atopic dermatitis.

All statistical analyses were performed with the Statistical Products and Service Solutions package (SPSS, Chicago, IL, USA) for Windows (Release 17.0).

Results

Data collected from both cohorts are compared in Table 1.

It was found that 98.4% of the hairdressing apprentices and 82.2% of their controls had ever dyed their hair.

Table 1. Self-reported exposures and reactions; comparison between newly started hairdressing apprentices and a matched control group

	Hairdressing apprentices (<i>n</i> = 374)	Controls (<i>n</i> = 1277)	<i>P</i>
Hair dye			
Lifetime prevalence, % (no.)	98.4 (368)	82.2 (1050)	<0.001
One-year prevalence, % (no.)	95.2 (356)	66.9 (854)	<0.001
Hair dyes per year	6.6 (1–30 times)	3.7 (1–30 times)	<0.001
Age at first hair dye (years)	12.1 (2–19)	13.3 (5–23)	<0.001
Reaction to hair dye (eczematous), % (no.)	13.7 (50)	10.0 (105)	0.002 ^a
Reaction to hair dye (oedema), % (no.)	4.9 (18)	2.9 (30)	0.001 ^a
Eyebrow dye			
Lifetime prevalence	62.0 (232)	32.5 (415)	<0.001
One-year prevalence, % (no.)	52.9 (198)	19.3 (246)	<0.001
Eyebrow dye per year	3.8 (1–35 times)	3.1 (1–24 times)	0.007
Reaction to eyebrow dye (eczematous), % (no.)	3.9 (9)	3.6 (15)	0.02 ^a
Semi-permanent black henna tattoos			
Lifetime prevalence, % (no.)	48.1 (180)	31.0 (396)	<0.001
Age at first tattoo (years)	12.9 (4–32)	12.7 (3–22)	0.7
Reactions to tattoo, % (no.)	0.0 (0)	2.5 (10)	0.1 ^a
Piercing			
Ear piercing, % (no.)	96.8 (362)	92.1 (1176)	<0.001
Piercing in other places, % (no.)	65.0 (243)	35.1 (448)	<0.001
Reactions to jewellery, % (no.)	29.9 (112)	35.2 (449)	0.002 ^a
Perfume rash			
One-year prevalence, % (no.)	6.1 (23)	11.3 (144)	0.001 ^a
Lifetime prevalence, % (no.)	13.6 (51)	21.8 (278)	<0.001 ^a
Deodorant rash			
One-year prevalence, % (no.)	8.6 (32)	11.4 (146)	0.004 ^a
Lifetime prevalence, % (no.)	17.4 (65)	24.3 (310)	0.001 ^a

The hairdressing apprentices were all enrolled at the time when they started their education at 10 different technical schools in Denmark. The controls were matched with the hairdressing apprentices by age, sex, and postal code. Conditional logistic regression was used for the matched comparison. $p < 0.05$ was considered to be significant. The results with the highest significance are in bold.

^aAdjusted for atopic dermatitis.

The median age at first hair dying was 12 years among the hairdressing apprentices and 13 years among their controls (Table 1).

In general, the hairdressing apprentices were more exposed to hair dye, eyebrow and eyelash dye and semi-permanent black henna tattoos at the time when they started their education than the matched control group. Significantly more hairdressing apprentices had dyed their hair within the previous year ($p < 0.001$), and the apprentices were younger at the time of their first hair dye use ($p < 0.001$) (Fig. 1) and dyed their hair more times per year ($p < 0.001$). The hairdressing apprentices who, at some point, had dyed their hair reported significantly more adverse skin reactions to hair dye than members of the matched control group, after adjustment for atopic dermatitis. Similarly, significantly more hairdressing apprentices had dyed their eyebrow and eyelashes and had had semi-permanent black henna tattoos applied than members of the matched control group.

Discussion

To our knowledge, this is the first study to describe the exposures and adverse skin reactions to widely used chemical substances among hairdressing apprentices at the beginning of their education, as compared with a matched control group from the general population.

As expected, the hairdressing apprentices are highly exposed to products containing hair dye substances and to piercings. Almost all new hairdressing apprentices had dyed their hair at any time (98.4% of the apprentices as compared with 82.2% of the controls, $p < 0.001$), 95.2% within the previous year. For comparison, 95.7% of trained hairdressers in Copenhagen had dyed their hair at any time, 52.3% within the previous year (4). The high 1-year prevalence among the apprentices may reflect an interest in hairdressing prior to entering hairdressing school. The apprentices had their first hair dye at the age of 12 years on average, and some at the age of 2 years, which is significantly earlier than the controls (Fig. 1). In this study, 13.7% of the hairdressing apprentices who had

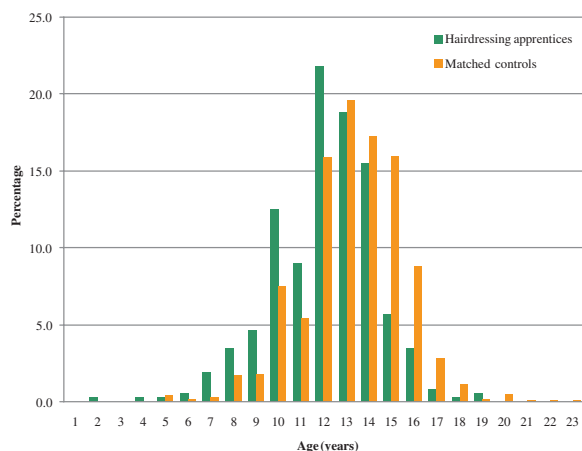


Fig. 1. Age at first hair dyeing in a cohort of Danish hairdressing apprentices ($n = 374$) at the time when they started their education, as compared with a cohort of Danish adolescents from the general population, matched on age, sex, and city code ($n = 1277$). The median age at time of first hair dyeing in the cohort of hairdressing apprentices was 12 years, and that in the matched cohort was 13 years ($p < 0.001$).

died their hair at any time reported eczematous reactions following personal use of hair dyes, which is significantly more than among the matched control group (10.0%, $p = 0.002$) after adjustment for atopic dermatitis. In a previous study, the prevalence of eczematous reactions in relation to hair dye in the general adult population was estimated to be 4.9%, and several patch test studies have estimated the prevalence of allergy to the hair dye ingredients to be 0.1–4.0% in the general population (5, 11, 12). These results indicate an increase in exposure to and incidence of hair dye allergy in younger people. As hair dyeing is more fashionable among young people, at least in the northern part of Europe (13), the young age of the participants could reduce recall bias, and thereby give more precise results in comparison with studies in the general adult population.

In addition to hair dye, more hairdressing apprentices used eyebrow/eyelash dye, and had had semi-permanent black henna tattoos, which also might lead to sensitization to hair dye, although some of these eczematous symptoms might be caused by irritant reactions.

The hairdressing apprentices are more exposed to semi-permanent black henna tattoos than the matched control group, skilled hairdressers in Copenhagen, and the Danish adult population. Among the hairdressing apprentices in this study, 48.1% have had a tattoo; in comparison, 38% of trained hairdressers in Copenhagen aged 18–24 years and 33.3% of Danish adult women aged 18–24 years have had a temporary tattoo (4). A previous study indicated increasing exposure to semi-permanent

black henna tattoos in the general population (4), in spite of the attention from both dermatologists and the media concerning the risk of allergic reactions to these temporary tattoos.

According to the data presented, both ear piercing and body piercing are still popular. The positive correlation between piercings and nickel allergy has been shown in several studies (14, 15). Despite the EU Nickel Directive (1994/27/EC)(16), nickel allergy is still frequent, including among hairdressers in Denmark (17). About one-third of both the apprentices and the matched controls have experienced dermatitis from metallic items, which correlates well with results on nickel allergy and nickel dermatitis in a population of young women in Denmark who had their ears pierced after the introduction of the nickel regulation in 1990 (14).

In contrast, the matched control group reported significantly more skin reactions to jewellery, perfumes, and perfumed deodorants. These results indicate that persons who have had a rash caused by perfumed products and jewellery choose not to become hairdressers, as has also been shown with eczematous diseases. In a previous publication, we showed that the cohort of hairdressing apprentices reported less previous or present hand eczema and less atopic dermatitis at the time when they started their education, than the matched control group (18). This underlines the importance of adjusting for atopic dermatitis in the analysis of adverse skin reactions. The results are based on self-administered questionnaires, which, although validated, have some limitations. It is possible that the newly started hairdressing apprentices are likely to under-report, for example, allergic problems, whereas participation as controls might be higher among those with allergic diseases. This could possibly lead to an increase in the differences between the two groups.

In this study, a matched control group is an advantage, as it takes both the young age and the predominance of females among the hairdressing apprentices into account.

In conclusion, both cohorts are highly exposed to potent allergens and frequently report adverse skin reactions. Additionally, at the start of their education, the hairdressing apprentices are more exposed to the allergens investigated in this study, and report more adverse skin reactions to products containing hair dyes than their matched controls from the general population. Regulation of exposure needs to be considered in order to prevent primary sensitization and elicitation in those already sensitized, with a special focus on younger people. Additionally, these young people, and hairdressing apprentices in particular, require information concerning the potential risk of extensive exposure to chemical substances.

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Appendix

Questions concerning the use of hair dye were: 'Have you ever dyed your hair?', 'How old were you, the first time you dyed your hair?', 'Have you dyed your hair during the last 12 months, and how many times?', 'Have you ever experienced redness, scaling and itching in your face, ears, neck or scalp after dying your hair?', and 'Have you ever experienced oedema of your face, scalp or around your eyes, or ulceration in your scalp after dying your hair?' Questions concerning the use of eyebrow or eyelash dye were: 'Have you ever dyed your eyebrows or eyelashes?', 'Have you dyed your eyebrows or eyelashes during the last 12 months, and how many times?', and 'Have you ever experienced redness, scaling and itching around your eyes after dying your eyebrows or eyelashes?'

Questions concerning exposures and reactions to semi-permanent black tattoos were: 'Have you ever had

a black henna tattoo (a temporary tattoo that is painted on the skin and disappears after 2–3 weeks)?', 'How old were you the first time you had a black henna tattoo?', and 'Did you get eczema at the site where the tattoo was painted?'

Questions concerning the prevalence of piercings and reactions to jewellers were: 'Have you ever had your ears pierced?', 'Have you ever had piercings in other places on your body?', and 'Have you ever had a rash from jean buttons, metallic buckles or imitation jewellery (e.g. ear rings, piercing jewellery)?'

Finally, two questions concerning rash after the use of perfumed products were asked: 'Have you ever had a rash after the use of perfume (examples: eau de toilette, eau de cologne, aftershave)?', and 'Have you ever had a rash in your armpit after the use of perfumed deodorant?'