ORIGINAL ARTICLE

Artificial Nails and Long-lasting Nail Polish in Danish Hairdressers: Self-use, Occupational Exposure and Related Eczema

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Artificial nail modelling systems (ANMS), encompassing artificial nails and long-lasting nail polish, are sources of acrylate exposure in beauticians and users of ANMS. Hairdressers' exposure to ANMS from self-use and occupational exposure is currently unknown. In 2020 a questionnaire was sent to all hairdressers graduating during 2008 to 2018 in Denmark ($n = 4,830$). Self-use of ANMS was reported by 87.6% of respondents (1,251/1,428), and application of ANMS to others was reported by 22.1% (316/1,428). Of these, application to others was performed in a salon by 37.1% (109/294), privately by 51.0% (150/294) and in both settings by 11.9% (35/294). Compliance with glove use was seen in 23.0% (67/291) among those applying ANMS to others. Among hairdressers exposed to ANMS, 4.3% (52/1,218) reported ANMS-related hand eczema. Being a trained beautician (adjusted odds ratio 3.26, 95% confidence interval 1.06–9.99) and having had a positive patch-test to acrylates (adjusted odds ratio 7.70, 95% confidence interval 1.44–41.13) were associated with ANMS-related hand dermatitis. In conclusion, hairdressers have a high prevalence of exposure to ANMS and ANMS-related hand dermatitis. Compliance with glove use when applying ANMS to others is poor. Patch-testing with acrylates is valuable in the diagnostic work-up of hand eczema in hairdressers.

Key words: allergic contact dermatitis; cosmetics; hand eczema; hairdressers; nails.

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SIGNIFICANCE

Exposure to acrylates from nail cosmetics is a relevant occupational allergen in hairdressers. Prevention schemes aimed at reducing the incidence of hand eczema in hairdressers should therefore target the reduction of skin exposure to acrylates, in addition to skin exposure to wet-work and allergens in hair cosmetics. The relatively large proportion of hairdressers reporting hand eczema caused by exposure to acrylic nail cosmetics makes acrylate allergy a relevant differential diagnosis when clinically investigating hand eczema in hairdressers.

Acrylates are plastic materials composed of acrylic or methacrylic acid (hereafter referred to as (meth) acrylates). They are used in industrial products, such as fiberglass, coatings, and glues, and in healthcare, notably in blood glucose sensors and dental composite fillings. (Meth)acrylates are strongly allergenic as monomers, but are safe once polymerized (1).

Allergic contact dermatitis (ACD) to (meth)acrylates has traditionally been seen in industry workers and in dentistry (1, 2). However, artificial nail modelling systems (ANMS), encompassing artificial nails and long-lasting nail polish (also known as ultraviolet (UV)-nail polish and Shellac®; Creative Nail Design, USA), have been the predominant cause of (meth)acrylate allergy more recently (3).

A study by the European Environmental Contact Dermatitis Research Group (EECDRG) reviewing patients patch-tested from 2013 to 2015, found ANMS to be responsible for two-thirds of cases of (meth)acrylate allergy, primarily affecting beauticians and consumers (4). More than 90% of cases tested positive to 2-hydroxyethyl methacrylate (HEMA), attributed both to HEMA's efficacy as a screening allergen for methacrylate allergy, and the majority of cases being caused by HEMA-based ANMS, i.e. long-lasting nail polish and gel nails (4, 5); the latter being supported by other studies of patch-tested patients (6, 7).

(Meth)acrylates have been reported as an emerging occupational allergen in hairdressers in Finland, accounting for 5% of occupational cases of ACD in Finish hairdressers from 2005 to 2018. As only 12.5% of cases were caused by cyanoacrylates, which are commonly used in applying artificial eyelashes, the authors speculated that the remaining cases were caused by methacrylate-based ANMS (8). Data on the number of hairdressers applying ANMS to others, both professionally and in private, is, to our knowledge, currently unavailable. In addition, with hairdressers being employed in the beauty industry, a high proclivity to be a self-user of ANMS must be assumed. Thus, hairdressers may have a high level of exposure to acrylates in nail cosmetics, both in the occupational setting and as consumers.

The aim of this study was to estimate exposure to ANMS among hairdressers, both in terms of self-use and due to application to others. In addition, the risk factors associated with ANMS-related hand eczema were assessed.

MATERIALS AND METHODS

The Danish Hairdressers and Beauticians Union provided information on all hairdressers graduating from Danish hairdressing vocational schools during the period 2008 to 2018. A postal questionnaire was sent in May 2020. The design of the questionnaire has been described previously (9). In brief, questions about hand eczema were derived from the Nordic Occupational Skin Questionnaire (10). A section of the questionnaire contained questions relating to self-use and application of ANMS, and hand and facial eczema related specifically to exposure to ANMS.

Definition of outcome variables

The definitions of outcome variables related to ANMS and ANMS-related eczema are shown in Table SI. Briefly, ANMS was defined as artificial nails (acrylic nails, gel nails and press-on nails) and long-lasting nail polish. To have been exposed to ANMS was defined by the questions "Have you ever used artificial nails or applied them on others?" and "Have you ever used long-lasting nail polish or applied it on others?" by an affirmative answer to the first 3 response options to each question (Yes, used myself, but not applied on others/Yes, both used myself and applied on others/Yes, applied on others, but not used myself/No).

Occupational status was defined by the second response alternative to the question: "What is your current occupation?" (I work as a hairdresser/I no longer work as a hairdresser). To have had hand eczema related to the hairdressing profession was assessed, first by the question "Have you ever had hand eczema?" (yes/no) and, secondly, by the question "When the hand eczema started, were you then a…" (hairdressing apprentice/fully trained hairdresser/other). Occupational hand eczema was defined as hand eczema with onset as a hairdressing apprentice or as a fully trained hairdresser. A history of atopic dermatitis (AD) was defined by The UK Working Party Criteria (11). A history of AD was diagnosed by having the major criterion plus 3 or more of the minor criteria to increase specificity (12). A history of an itchy skin condition was used as the major criterion, while a history of onset under age 2 years, a history of generally dry skin, a history of flexural involvement, and a personal history of asthma or hay fever, were used as minor criteria. To have ever been patch-tested was defined as an affirmative answer to the question "Have you ever been tested for allergy with a patch-test applied to the back?" (yes/no). It was possible to report if the patch-test was positive to acrylates.

Statistical analysis

A χ^2 test was used to test for a significant difference between proportions. A logistic regression model with the outcome variable ANMS-related hand eczema ever (yes/no) adjusted for age (21–30/31–40/>40 years), a history of AD (yes/no), occupational status (current hairdresser/ex-hairdresser), occupational hand eczema related to hairdressing (yes/no) was used to assess associations with having hand eczema related to ANMS. No males had had ANMS-related hand eczema; hence sex was excluded as an explanatory variable. A p-value <0.05 was considered statistically significant.

This study was approved by the Danish Data Protection Agency (P-2019-346).

RESULTS

A total of 4,830 hairdressers graduating during the period 2008 to 2018 was identified. A response rate of 30.7% (1,485/4,830) was obtained after 4 reminders (1 postal and 3 electronic). Respondents were 96.6% female (1,430/1,485), had a median age of 31 years (range 21–64 years) and 7.6% (111/1,453) had a history of AD. Of respondents, 45.2% (671/1,484) no longer worked as hairdressers and 2.4% (35/1,438) were trained beauticians in addition to being trained hairdressers (**Table I**). Having left the hairdressing profession was not associated with being a trained beautician (odds ratio (OR) 1.0, 95% confidence interval (95% CI) 0.5–1.9, $p=0.96$). Respondents tended more often than non-respondents, to be female (OR 1.7, 95% CI 1.2–2.2) and less often to be in the age range 21–30 years (OR 0.8, 95% CI 0.7–1.0) (Table SII).

Self-use of artificial nail modelling systems: prevalence, frequency of use and setting of application

Results relating to self-use of ANMS are summarized in **Table II** and **Fig. 1**.

Self-use of artificial nails. In total, 81.4% (1,160/1,425) of hairdressers had ever used artificial nails. Of these, 33.1% (471/1,425) had used artificial nails within the past year and 16.7% (238/1,425) were current users.

Among hairdressers with artificial nails within the past year, gel nails had been used by 78.9% (325/413), acrylic nails by 48.2% (165/342), and press-on nails by 13.4% (36/268).

Most hairdressers predominantly had artificial nails applied in a salon, accounting for 72.2% (319/442). In comparison, only 15.8% predominantly had applied artificial nails themselves in private (OR 13.8, 95% CI 9.9–19.2) and 12.0% (53/442) reported to have had artificial nails applied equally, often in both settings

Self-use of long-lasting nail polish. In total, 63.1% (887/1,405) of hairdressers had ever used long-lasting nail polish. Of these, 33.7% (474/1,405) had used long-lasting nail polish within the past year and 16.1% (227/1,405) were currently using long-lasting nail polish.

Similar to the application of artificial nails, most had had long-lasting nail polish applied in a salon, accounting for 52.5% (244/465), compared with 41.7% (194/465) having primarily applied it themselves (OR 1.5, 95% CI 1.2–2.0). However, application of long-lasting nail polish tended more often to be performed in private compared with application of artificial nails (OR 3.8, 95% CI 2.8–5.2).

Table I. Baseline characteristics of study population

Characteristics	% (n/n_{total})
Female	96.3 (1,430/1,485)
Age	
21–30 years	49.5 (735/1,485)
31–40 years	46.5 (691/1,485)
>40 years	4.0 (59/1,485)
History of atopic dermatitis	7.6 (111/1,453)
No longer working as a hairdresser	45.2 (671/1,484)
Trained beautician	2.4 (35/1,438)

Table II. Characteristics of self-users of artificial nail modelling systems

	Total	Long-lasting nail polish	Artificial nails				Long-lasting nail polish vs. artificial nails (total) OR (95% CI)
			Total	Gel nails	Acrylic nails	Press-on nails	
Ever had	87.6 (1,251/1,428)	63.1 (887/1,405)	81.4 (1160/1,425)	NA	NA	NA	**0.4 (0.3–0.5), $p<0.001$**
Female	99.7 (1,247/1,251)	99.8 (885/887)	99.7 (1,157/1,160)				1.1 (0.2–6.9), $p=0.88$
Age range							
21–30 years	52.4 (655/1,251)	52.6 (467/887)	53.3 (618/1,160)				1.0 (0.8–1.2), $p=0.78$
31–40 years	44.1 (552/1,251)	44.3 (393/887)	43.0 (499/1,160)				1.1 (0.9–1.3), $p=0.56$
>40 years	3.5 (44/1,251)	3.0 (27/887)	3.7 (43/1,160)				0.8 (0.5–1.3), $p=0.41$
Age range at first application							
10–15 years	19.6 (243/1,238)	5.1 (44/871)	20.5 (234/1,144)				**0.2 (0.1–0.3), $p<0.001$**
16–20 years	50.6 (627/1,238)	32.3 (281/871)	51.8 (593/1,144)				**0.4 (0.4–0.5), $p<0.001$**
21–30 years	26.9 (333/1,238)	52.9 (461/871)	25.9 (296/1,144)				**3.2 (2.7–3.9), $p<0.001$**
>30 years	2.8 (35/1,238)	9.8 (85/871)	1.8 (21/1,144)				**5.8 (3.6–9.4), $p<0.001$**
Application							
Currently	17.0 (212/1,247)	25.7 (227/884)	20.6 (238/1,153)				**1.3 (1.1–1.6), $p=0.007$**
Within 1 year	56.9 (686/1,205)	55.3 (474/857)	43.3 (471/1,087)	78.7 (325/413)	48.2 (165/342)	13.4 (36/268)	**1.6 (1.4–1.9), $p<0.001$**
Applications/year							
1–6	60.9 (418/686)	59.7 (283/474)	66.0 (311/471)	53.5 (174/325)	57.6 (95/165)	77.8 (28/36)	**0.8 (0.6–1.0), $p=0.04$**
7–12	23.8 (163/686)	26.6 (126/474)	31.2 (147/471)	30.2 (98/325)	35.2 (58/165)	16.7 (6/36)	**0.6 (0.5–0.8), $p=0.001$**
>12	15.3 (105/686)	13.7 (65/474)	2.8 (13/471)	16.3 (53/325)	7.3 (12/165)	5.6 (2/36)	**5.6 (3.0–10.3), $p<0.001$**
Setting/past year							
Mostly applied them myself	NA	41.7 (194/465)	15.8 (70/442)	NA	NA	NA	**3.8 (2.8–5.2), $p<0.001$**
Mostly in a salon	NA	52.5 (244/465)	72.2 (319/442)	NA	NA	NA	**0.4 (0.3–0.6), $p<0.001$**
Both	NA	5.8 (27/465)	12.0 (53/442)	NA	NA	NA	**0.5 (0.3–0.7), $p=0.001$**

NA: not available; OR: odds ratio; 95% CI: 95% confidence interval.

Application of artificial nail modelling systems on others: prevalence, frequency of application, setting application and glove use

Results relating to application of ANMS to others are summarized in **Table III** and Fig. 1.

In total, 22.1% (316/1,428) had ever applied ANMS on others. Of these, 15.4% (220/1,425) had ever applied artificial nails and 13.3% (190/1,405) had ever applied long-lasting nail polish.

Application of ANMS to others was performed mostly in private (by 51.0%; 150/294), mostly due to being employed in a salon (by 37.1%; 109/294), and equally in both settings (by 11.9%; 35/294) (Table III). Hairdressers predominantly applying ANMS in private more often applied long-lasting nail polish than artificial nails (OR 1.6, 95% CI 1.1–2.5). Among employees in salons, no difference was seen in the proportion applying long-lasting nail polish or artificial nails (OR 0.8, 95% CI 0.5–1.1). More current hairdressers than ex-hairdressers had predominantly applied ANMS in salons, accounting for 45.4% (74/163) and 26.7% (35/131), respectively (OR 2.3. 95% CI 1.4–3.7).

Compliance with glove use was observed in only 23.0% (67/291). No difference in compliance with glove use was seen when applying artificial nails or long-lasting nail polish, at 23.3% (34/146) and 26.0% (51/196), respectively ($p=0.56$). Employees in salons tended more often to wear gloves, compared with hairdressers applying ANMS in private, accounting for 33.3% (23/69) and 20.6% (21/102), respectively (OR 1.9, 95% CI 1.0–3.9). Hairdressers who used 2 layers of gloves accounted for 10.6% (7/66) of glove users and 46.2% (30/65) used nitrile gloves.

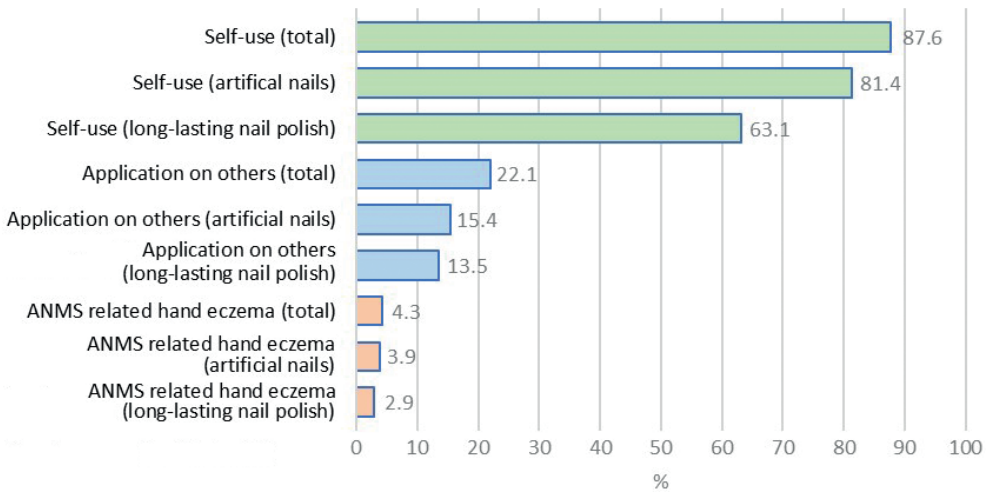

Fig. 1. Proportion of hairdressers who are self-users of artificial nail modelling systems (ANMS), and proportion of hairdressers exposed to ANMS who have ANMS-related hand eczema.

Table III. Characteristics of hairdressers who have applied artificial nail modelling systems to others

	Total	Long-lasting nail polish	Artificial nails				Long-lasting nail polish vs artificial nails (total)
			Total	Gel nails	Acrylic nails	Press-on nails	OR (95% CI)
Applied to others (ever)	22.1 (316/1,428)	13.5 (190/1,405)	15.4 (220/1,425)	67.3 (148/220)	33.6 (74/220)	9.1 (20/220)	0.9 (0.7–1.1), $p=0.15$
Female	99.7 (315/316)	100.0 (190/190)	99.5 (219/220)	100.0 (148/148)	98.6 (73/74)	100.0 (20/20)	NA, p=0.35
Age range							
21–30 years	52.5 (166/316)	55.8 (106/190)	50.0 (110/220)	54.7 (81/148)	39.2 (29/74)	70.0 (14/20)	1.3 (0.9–1.9), $p=0.24$
31–40 years	42.7 (135/316)	40.5(77/190)	43.2 (95/220)	38.5 (57/148)	55.4 (41/74)	30.0 (6/20)	0.9 (0.6–1.3), $p=0.59$
>40 years	4.7 (15/316)	3.7 (7/190)	6.8 (15/220)	6.8 (10/148)	5.4 (4/74)	0.0 (0/20)	0.5 (0.2–1.3), $p=0.16$
Application to others (past month)	19.0 (55/290)	24.0 (42/175)	13.0 (25/193)	72.0 (18/25)	43.8 (7/16)	9.1 (1/11)	**2.1 (1.2–3.7), $p=0.006$**
Persons/month							
1–10	85.5 (47/55)	88.1 (37/42)	84.0 (21/25)	83.3 (15/18)	85.7 (6/7)	100.0 (1/1)	1.4 (0.3–5.8), $p=0.63$
11–20	7.3 (4/55)	7.1 (3/42)	8.0 (2/25)	11.1 (2/18)	0.0 (0/7)	0.0 (0/1)	0.9 (0.1–5.7), $p=0.90$
>20	7.3 (4/55)	4.8 (2/42)	8.0 (2/25)	5.6 (1/18)	14.3 (1/7)	0.0 (0/1)	0.6 (0.1–4.4), $p=0.59$
Setting							
Privately	51.0 (150/294)	45.0 (81/180)	52.0 (104/200)	38.5 (57/148)	31.5 (23/73)	25.0 (5/20)	0.8 (0.5–1.1), $p=0.17$
As employed in a salon	37.1 (109/294)	46.7 (84/180)	35.0 (70/200)	48.6 (72/148)	54.8 (40/73)	60.0 (12/20)	**1.6 (1.1–2.5), $p=0.02$**
Both	11.9 (35/294)	8.3 (15/180)	13.0 (26/200)	12.8 (19/148)	13.7 (10/73)	15.0 (3/20)	0.6 (0.3–1.2), $p=0.14$
Glove use during application							
Yes, always	12.4 (36/291)	9.4 (17/180)	17.9 (35/196)	33.3 (6/18)	42.9 (3/7)	0.0 (0/1)	**0.5 (0.3–0.9), $p=0.02$**
Yes, but not always	10.7 (31/291)	9.4 (17/180)	8.2 (16/196)	11.1 (2/18)	0.0 (0/7)	0.0 (0/1)	1.2 (0.6–2.4), $p=0.66$
Never	77.0 (224/291)	81.1 (146/180)	74.0 (145/196)	16.7 (3/18)	57.1 (4/7)	100.0 (1/1)	1.5 (0.9–2.5), $p=0.10$
Using 2 glove layers (always)	10.6 (7/66)	14.7 (5/34)	18.0 (9/50)	18.2 (2/11)	33.3 (1/3)	NA	0.8 (0.2–2.6), $p=0.69$
Glove type used							
Nitrile	46.2 (30/65)	61.8 (21/34)	66.0 (33/50)	63.6 (7/11)	66.7 (2/3)	NA	0.8 (0.3–2.1), $p=0.69$
Latex	6.2 (4/65)	2.9 (1/34)	10.0 (5/50)	18.2 (2/11)	33.3 (1/3)	NA	0.3 (0.0–2.4), $p=0.22$
Vinyl	9.2 (6/65)	17.6 (6/34)	10.0 (5/50)	18.2 (2/11)	0.0 (0/3)	NA	1.9 (0.5–6.9), $p=0.31$
Other	15.4 (10/65)	20.6 (7/34)	14.0 (7/50)	0.0 (0/11)	0.0 (0/3)	NA	1.6 (0.5–5.0), $p=0.43$
>1 type	23.1 (15/65)	NA	NA	NA	NA	NA	NA

NA: not available; OR: odds ratio; 95% CI: 95% confidence interval.

Artificial nail modelling system-related eczema

Results regarding ANMS-related hand eczema are summarized in **Table IV** and Fig. 1. In total, 4.4%, (54/1,218) of hairdressers exposed to ANMS had experienced ANMS-related eczema. All cases were women. The eczema was located on the hands in 4.3% (52/1,218) and on the face in 0.6% (7/1,218). Only 0.2% (2/1,218) had isolated facial eczema.

No difference was observed in the proportion having eczema due to artificial nails or long-lasting nail polish ($p=0.20$). Hairdressers with hand eczema tended to have: (*i*) a history of a positive patch-test (OR 2.0, 95% CI 1.0–3.8), (*ii*) a positive patch-test to acrylates (OR 4.9, 95% CI 0.9–27.2), (*iii*) to be a trained beautician (OR 3.3. 95% CI 1.1–9.6), and (*iv*) to have applied gel nails to others (OR 2.0, 95% CI 1.0–4.0).

A logistic regression model ($n=1,203$) with hand eczema related to ANMS as the outcome (yes/no) adjusted for age (21–30/31–40/>40 years), a history of AD (yes/no), occupational hand eczema related to the hairdressing profession (yes/no), and occupational status (current hairdresser/ex-hairdresser), showed that being a trained beautician (adjusted odds ratio (aOR) 3.26, 95% CI 1.06–9.99) and a history of a positive patch-test to acrylates (aOR 7.70, 95% CI 1.44–41.13) were associated with having and hand eczema related to ANMS. Having applied gel nails to others was no longer associated with ANMS-related hand eczema in the adjusted model (aOR 1.82, 95% CI 0.89–3.70).

Table IV. Characteristics of hairdressers with dermatitis due to artificial nail modelling systems

Hand eczema	Yes	No	Yes vs no
Artificial nails	3.9 (44/1,118)		
Long-lasting nail polish	2.9 (25/868)		
Total	4.3 (52/1,218)		
Female	100.0 (52/52)	99.7 (1,162/1,166)	NA
Age range			
21–30 years	61.5 (32/52)	52.1 (608/1,166)	1.5 (0.8–2.6), $p=0.18$
31–40 years	34.6 (18/52)	44.5 (519/1,166)	0.7 (0.4–1.2), $p=0.16$
>40 years	3.8 (2/52)	3.3 (39/1,166)	1.2 (0.3–4.9), $p=0.84$
History of AD	11.5 (6/52)	7.8 (90/1,160)	1.6 (0.6–3.7), $p=0.32$
Patch-testing			
Never	73.1 (38/52)	78.2 (909/1,162)	0.8 (0.4–1.4), $p=0.38$
Negative	1.9 (1/52)	7.3 (85/1,162)	0.2 (0.0–1.8), $p=0.14$
Positive	25.0 (13/52)	14.5 (168/1,162)	**2.0 (1.0–3.8), $p=0.04$**
Positive to acrylates	15.4 (2/13)	3.6 (6/168)	**4.9 (0.9–27.2), $p=0.04$**
Self–user (ever)			
Long-lasting nail polish	80.8 (42/52)	71.7 (832/1,160)	1.7 (0.8–3.3), $p=0.15$
Artificial nails	98.1 (51/52)	92.5 (1075/1,166)	4.3 (0.6–31.6), $p=0.12$
Applied to others (ever)			
Long-lasting nail polish	23.1 (12/52)	15.2 (176/1,160)	1.7 (0.9–3.3), $p=0.12$
Gel nails	21.2 (11/52)	11.7 (137/1,166)	**2.0 (1.0–4.0), $p=0.04$**
Acrylic nails	9.6 (5/52)	5.8 (68/1,166)	1.7 (0.7–4.5), $p=0.26$
Press-on nails	0.0 (0/52)	1.7 (20/1,166)	NA, $p=0.26$
Trained beautician	7.7 (4/52)	2.5 (29/1,163)	**3.3 (1.1–9.6), $p=0.02$**
Concomitant OHE related to hairdressing	46.2 (24/52)	37.0 (428/1,156)	1.5 (0.8–2.5), $p=0.18$
Ex-hairdressers	40.4 (21/52)	47.0 (548/1,166)	0.8 (0.4–1.3), $p=0.35$

AD: atopic dermatitis; NA: not available; OHE: Occupational hand eczema. Bold font indicates that $p<0.05$.

DISCUSSION

This study estimated the exposure to ANMS and ANMS-related eczema in hairdressers graduating during the period 2008 to 2018. The proportion

of self-users was 87.6%, and 22.1% had applied ANMS on others. HEMA-based ANMS, i.e. long-lasting nail polish and gel nails, were the most widely used products.

Self-users of long-lasting nail polish accounted for 63.1% of the study population. Interview data from Danish patients patch-tested with HEMA (from 2017 to 2019) showed that 20% of patients had ever used long-lasting nail polish (13). Thus, the proportion of self-users in hairdressers is 3 times higher than in these highly selected patients. Self-application made a considerable contribution to this proportion, with 41.7% of self-users within the past year having predominantly applied long-lasting nail polish themselves in private. In addition, 45.0% of those having applied long-lasting nail polish to others also reported having done so predominantly in private. Home kits for the application of long-lasting nail polish are readily available to consumers. Case studies of patients sensitized to HEMA and other (meth) acrylates from these home kits, have raised concern about their safety (14, 15). The aforementioned Danish study of HEMA-patch-tested patients found an almost 10-fold increased risk of being HEMA positive if they had used long-lasting nail polish, amounting to 6.7% of users of long-lasting nail polish (13). This study found that 2.9% of users of long-lasting nail polish reported ANMS-related hand eczema due to use of long-lasting nail polish, which seems relatively high on the population level, compared with a population of patch-tested patients, suggesting that the large proportion of home-kit users may have contributed to this figure.

A recent Finish study reporting acrylates as emerging occupational contact allergens in hairdressers, suggested that hairdressers are increasingly offering application of ANMS as part of their business (8). The current study found that 37.1% of trained hairdressers who had applied ANMS to others had predominantly done this as an employee in a salon. This proportion among current hairdressers was 45.4%, corresponding to 9.1% of all current hairdressers. It is not known if this was done while the respondents were working as a hairdresser. However, since only 5.1% of Danish hairdressers who leave the hairdressing trade return to the profession, the application of ANMS is performed either before employment as a hairdresser, as a part-time job in addition to hairdressing, or during employment in a hairdressing salon (16). Nevertheless, it is of note that such a large proportion of trained hairdressers engage in a structured business of applying ANMS, especially since training in nail cosmetics is not part of the curriculum in Danish hairdressing vocational schools, and only 2.4% of the study population reported being trained beauticians in addition to being hairdressers.

With the small minority of hairdressers being trained beauticians, most who apply ANMS on others are either self-taught or trained on site in the salons. Thus, a lack of training on safe work practices when handling ANMS is potentially compromising the avoidance of ANMS-related eczema. This was evident in the current study, as 77.0% of those applying ANMS to others reported never using gloves. It is generally advised to use 2 layers of nitrile gloves when handling methacrylate monomers (17, 18). Only 46.2% of glove users in the current study were observed to use nitrile gloves, and only 10.5% of the glove users used 2 layers of gloves. This illustrates the need for better compliance with glove use when handling ANMS.

The current study found 4.4% of those exposed to ANMS had ANMS-related eczema (corresponding to 3.6% of the total study population). Being a trained beautician and having had a positive patch-test to acrylates were significantly associated with ANMS-related hand eczema, specifically. This correlates with a recent systematic review, which showed a 9-fold increased risk of HEMA-allergy in hairdressers and beauticians, compared with controls who were not employed in these professions (19). Thus, an occupational risk of contact allergy to HEMA seems evident in a population of hairdressers, especially in those who also train as beauticians, which may correlate with a higher exposure to ANMS compared with normal users. The proportion of hairdressers who are sensitized to (meth)acrylates through contamination of the workplace with ANMS is unknown. This is, however, a potential source of (meth)acrylate exposure, as observed in nail salons (20).

A study on data from the Information Network of Departments of Dermatology (a network of dermatological departments in Germany, Austria and Switzerland that aggregate data on patients investigated for contact allergy in each country) (data from 2004 to 2013) found that 0.4% of all patch-tested patients initially suspected their eczema to be caused by nail cosmetics. Among these, approximately 1 in 4 tested positive to at least 1 (meth)acrylate, corresponding to 0.1% of the patients (21). These proportions are much lower compared with the proportion with self-suspected ANMS-related hand eczema in the current study population. This could be due to the temporal difference between the studies, or because most cases are never seen in a healthcare setting. Interestingly, among hairdressers reporting to ever have had hand eczema, 5.3% also reported having had ANMS-related hand eczema. This is approximately 1 in 20 hairdressers with hand eczema, indicative of ANMS-related hand eczema being a relevant differential diagnosis when investigating hand eczema in hairdressers. Since a positive patch-test to acrylates was significantly associated with ANMS-related hand eczema, patch-testing with acrylates seems highly relevant in these cases.

Study strengths and limitation

As the respondents tended less often to be in the age range 21–30 years, and users of ANMS were predominantly in

the age range 21–30 years, this study may underestimate the prevalence of self-use of ANMS. In addition, several artificial nail types have been identified, including acrylic nails, gel nails, press-on nails, which are included in the current study (22). The current study did not include powder/dipping nails, a cyanoacrylate-based ANMS, thus the use of this specific nail type is potentially underestimated here. Nevertheless, we found a high prevalence of self-use and of application of ANMS to others, documenting widespread exposure to nail acrylates in hairdressers, both as consumers and due to occupational exposure.

Conclusion

Hairdressers have a high prevalence of exposure to ANMS and ANMS-related hand eczema. Compliance with glove use when applying ANMS to others is poor. Patch-testing with acrylates is valuable in the diagnostic work-up of hand eczema among hairdressers.

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