Ann Dermatol. 2025 Jun;37(3):162-168
https://doi.org/10.5021/ad.25.019
pISSN 1013-9087·eISSN 2005-3894

AD ANNALS of DERMATOLOGY

Original Article

Clinical Patterns and Risk Factors of Occupational Contact Dermatitis in Hairdressers: A Questionnaire-based Cross-sectional Study

Jin Ju Lee, Da Yeon Kim, Heera Lee, Ji Yeon Byun, You Won Choi, Joo Young Roh, Hae Young Choi

Department of Dermatology, Ewha Womans University College of Medicine, Seoul, Korea

Received: Jan 26, 2025
Revised: Mar 21, 2025
Accepted: Apr 3, 2025
Published online: May 7, 2025

Corresponding Author:
Hae Young Choi
Department of Dermatology, Ewha Womans University College of Medicine, 260 Gonghang-daero, Gangseo-gu, Seoul 07804, Korea.
Email: hychoi@ewha.ac.kr

ABSTRACT

Background: Occupational contact dermatitis (OCD) is prevalent among hairdressers due to frequent exposure to chemicals like hair dyes and bleaching agents. Despite the risks, awareness among hairdressers remains low, leading to underreporting and inadequate preventive measures.
Objective: This study evaluated hairdressers' awareness of harmful hair dye ingredients, their experiences with OCD, and the association with product usage patterns.
Methods: A cross-sectional study involving 100 hairdressers in Korea examined the relationship between work experience, product usage, and OCD. Chi-square tests and multivariate regression identified significant correlations.
Results: Among the participants, 51% reported experiencing adverse skin reactions, with the hands being the most commonly affected area. Longer work experience as a hairdresser was significantly associated with the occurrence of adverse effects (p=0.046). Notably, shampoo was identified as a suspected causative material significantly more often by the severe group compared to the non-severe group (28.0% vs. 3.8%, p=0.04).
Conclusion: Chemical exposure and frequent wet work contribute to high rates of OCD among hairdressers. Poor glove usage, especially during shampooing due to inconvenience, is a major risk factor. Raising awareness, promoting proper glove use, and improving workplace safety training are essential for reducing these skin conditions.

Keywords: Awareness; Contact dermatitis; Hair dye

INTRODUCTION

Occupational contact dermatitis (OCD) is a frequent inflammatory skin condition in the workplace. It primarily affects the hands (80% of cases) and sometimes the face (10%)[1]. OCD can be categorized into allergic contact dermatitis (ACD) and irritant contact dermatitis (ICD). ACD is characterized by a type IV hypersensitivity reaction to allergens, while ICD is caused by the direct cytotoxic effects of irritants on the skin barrier. Notably, over 3,700 substances, including ammonium persulfate, potassium dichromate, epoxy resin, rubber accelerators, and para-phenylenediamine (PPD), are known to cause OCD[2].

Hairdressers are at high risk due to frequent exposure to wet-work conditions and allergens in products such as hair dyes, bleaching agents, and other hair cosmetic ingredients[3-6], with OCD on hands being a primary reason for leaving the profession[7]. Recent studies show a high prevalence of OCD on hands among hairdressers, with a lifetime prevalence of 38.2%, a 1-year prevalence of 20.3%, and a point prevalence of 7.7%[8,9]. Carøe et al.[10] found that 48.5% of Danish hairdressers had occupational ICD,

AD ANNALS of DERMATOLOGY

while 49.3% experienced OACD. Moreover, PPD sensitization rates were particularly high, with 21.3% of hairdressers in Korea testing positive for PPD[11]. In addition, studies in East Europe and Italy have similarly reported PPD sensitization rates of 19.7% and 20.4%, respectively[12,13].

Despite these high prevalence rates, many hairdressers lack awareness of the chemical risks they face. Misconceptions about the causes of OCD on hands, such as 'neutralizer poisoning,' which reflects a misunderstanding of the effects of strong chemicals used in hair neutralizers often result in underreporting and insufficient preventive measures[14]. This highlights the need for greater education about occupational skin diseases, especially regarding the risks associated with chemical exposure. Our study aims to investigate hairdressers' awareness of hair dye products and their adverse effects, identifying groups at higher risk and exploring the underlying causes of these conditions.

MATERIALS AND METHODS

Subjects

A cross-sectional study was conducted to evaluate the relationship between work experience, including hair product usage, and OCD among adult hairdressers in Seoul from June to August 2024. A total of 100 hairdressers were recruited through face-to-face visits to hair salons. The in-person survey method was chosen to ensure accurate data collection and detailed responses, as opposed to online surveys which might have limitations in capturing precise symptom descriptions and work patterns. All participants approached agreed to the study, achieving a 100% response rate. Ethical approval was obtained from the Institutional Review Board of Ewha Womans University Mokdong Hospital (EUMC 2024-05-007-001), and written informed consent was obtained from all participants after explaining the study objectives and procedures. Inclusion criteria required active employment as a hairdresser in Seoul, while those who declined to participate were excluded from the study.

Methods

The study utilized a structured 30-item questionnaire divided into 3 sections (**Supplementary Data 1**). The first section collected general demographic information, including gender, age, medical history, and work experience. The second section examined hair dye usage patterns, focusing on preferred brands, product types, PPD content, and allergy testing practices. The allergy testing practices included in the questionnaire referred to self-reported methods, such as patch testing conducted by medical professionals or informal tests performed independently by hairdressers. The final section investigated adverse reactions, covering symptoms, affected sites, suspected causative agents (referred to as "suspected materials"), hospitalization requirements, and treatments. The questionnaire was developed through expert consultation, focusing on key aspects of occupational dermatitis in hairdressers. To ensure comprehensive data collection, participants could select multiple responses for certain questions. All responses were self-reported and collected anonymously.

Statistical analysis

Participants were categorized into 3 groups based on their symptoms: the prickling group (those with prickling and other symptoms but without pruritus), the pruritus group (those with pruritus and other symptoms but without prickling), and the combined group (those experiencing both pruritus and prickling, with or without other symptoms). This classification is based on literature which notes that pruritus is predominantly associated with ACD, whereas a prickling sensation is more commonly seen in ICD, reflecting distinct pathophysiological mechanisms[15]. Cases were classified as severe if they presented with oozing, vesicles, or fissures.

Chi-square tests and multivariate regression analysis were performed using IBM SPSS Statistics version 29.0.2.0 (IBM Corp., Armonk, NY, USA), with statistical significance set at $p \leq 0.05$. Multi-response frequency analysis was conducted for comprehensive evaluation.

RESULTS

Demographic characteristics and risk factors for adverse effects in hairdressers

The study population predominantly consisted of female hairdressers (84%), with the majority in their 20s (42%) and 30s (28%) (**Table 1**). Nearly half (48%) of the participants had more than 7 years of experience as a hairdresser. Regarding daily hair dyeing practices, 73% performed 1–5 procedures per day, while 19% conducted more than 5 procedures. Most hairdressers used multiple hair dye products, with 87% using 3 or more types. The scalp, frequently exposed through self-application of hair cosmetics, accounted for 21% of reported adverse effects.

Statistical analysis revealed that 51% of participants reported experiencing adverse effects from hair dye exposure. Among various demographic factors, only the number of years working as a hairdresser showed a significant association with adverse effects (p=0.046). Other factors, such as sex, age distribution, and medical history, showed no notable correlation. Neither the frequency of daily hair dyeing services nor the number of dye brands used showed a significant correlation with adverse effects.

Further logistic regression analysis confirmed that the number of years working as a hairdresser was the only significant predictor

https://doi.org/10.5021/ad.25.019

AD ANNALS of DERMATOLOGY

Table 1. General characteristics and hair dye usage status (total number=100)

Characteristics	Adverse-effect group (n=51)	Non-adverse effect group (n=49)	*p*-value
Sex			1.000
Male	8 (15.7)	8 (16.3)	
Female	43 (84.3)	41 (83.7)	
Age (yr)			0.861
20–29	20 (39.2)	22 (44.9)	
30–39	16 (31.4)	12 (24.5)	
40–49	11 (21.6)	9 (18.4)	
≥50	4 (7.9)	6 (12.3)	
Past history of disease including skin diseases			1.000
Yes	6 (11.8)	5 (10.2)	
No	45 (88.2)	44 (89.8)	
No. of years working as a hairdresser			**0.046**
<1	6 (11.8)	10 (20.4)	
1–3	7 (13.7)	9 (18.4)	
3–5	3 (5.9)	8 (16.3)	
5–7	8 (15.7)	1 (2.0)	
>7	27 (52.9)	21 (42.9)	
Frequency of dyeing hair (times/d)			0.728
<1	3 (5.9)	5 (10.2)	
1–5	38 (74.5)	35 (71.4)	
>5	10 (19.6)	9 (18.4)	
No. of hair dyes currently using			0.322
1	0 (0)	0 (0)	
2	5 (9.8)	8 (16.3)	
3	19 (37.3)	22 (44.9)	
≥4	27 (52.9)	19 (38.8)	

Values are presented as number (%). Bold value indicates statistical significance.

Table 2. Logistic regression analysis of predictors for adverse effect experience

Explanatory variables	OR	95% CI	*p*-value
Sex	0.95	0.31–2.90	0.934
Age	0.63	0.38–1.06	0.081
Past history	0.69	0.18–2.64	0.580
No. of working years	**1.55**	**1.07–2.24**	**0.021**
Frequency of hair dyeing	0.98	0.51–1.90	0.943
No. of dye brand uses	1.51	0.82–2.78	0.180

Bold values indicate statistical significance.
OR: odds ratio, CI: confidence interval.

for experiencing adverse effects (odds ratio [OR], 1.55; 95% confidence interval [CI], 1.07–2.24; p=0.021) (**Table 2**). Neither demographic factors (sex, age), work-related variables (frequency of hair dyeing, number of dye brands used), nor past medical history showed statistical significance in predicting adverse effects.

Awareness and safety practices regarding hair dye hazards

Analysis of awareness levels revealed significant differences between hairdressers who experienced adverse effects and those who did not (p=0.030) (**Table 3**). In the adverse-effect group, 52.9% were "neither aware nor unaware" of harmful ingredients, while 13.7% were "unaware." In contrast, the non-adverse effect group showed different distribution patterns, with 22.4% and 28.6%, respectively. Knowledge of the inclusion of PPD in hair dyes was remarkably low across both groups, with approximately 90% of all participants unaware of its presence. Despite recognizing the importance of allergy testing, none of the participants consistently implemented this practice. Notably, 76.5% of those who experienced adverse effects admitted to neglecting tests, despite acknowledging their necessity.

Table 3. Awareness of hair dye adverse effects (total number=100)

Characteristics	Adverse-effect group (n=51)	Non-adverse effect group (n=49)	*p*-value
Awareness about harmful ingredients contained in hair dye			**0.030**
Very aware	2 (3.9)	4 (8.2)	
Aware	13 (25.5)	16 (32.7)	
Neither aware nor unaware	27 (52.9)	11 (22.4)	
Unaware	7 (13.7)	14 (28.6)	
Very unaware	2 (3.9)	4 (8.2)	
Knowledge of PPD inclusion in current hair dye usage			0.944
Aware	5 (9.8)	6 (12.2)	
Unaware	46 (90.2)	43 (87.8)	
Necessity of allergy test before hair dyeing			0.140
Test is needed and I perform the test	0 (0.0)	0 (0.0)	
Test is needed and I sometimes perform the test	12 (23.5)	15 (30.6)	
Test is needed but I do not perform the test	39 (76.5)	30 (61.2)	
Test is not needed and I do not perform the test	0 (0.0)	1 (2.0)	
Others	0 (0.0)	3 (6.1)	

Values are presented as number (%). Bold value indicates statistical significance.
PPD: para-phenylenediamine.

Clinical manifestations and temporal patterns of adverse effects

Among the 51 hairdressers reporting adverse effects, the primary sites of involvement were the fingers (20%), hand dorsum (19%), and scalp (21%) (**Table 4**). The most common symptoms were pruritus (38%), prickling (34%), and redness (28%), while more severe manifestations such as oozing (17%), vesicles/blisters (9%), and fissures (8%) were less frequently observed. The principal suspected causative agents were bleach (34%), hair dyes (26%), and permanent solutions (15%).

Regarding the temporal pattern of adverse effects, most reactions developed within one day of exposure (51%) or within 3 days (31.4%). While the majority of cases (80.4%) resolved within one month, a notable proportion (19.6%) experienced prolonged symptoms lasting beyond one month. The clinical course was generally favorable, with 76.5% reporting symptom relief, although 5.9% experienced symptom aggravation.

Comparison of suspected materials associated with symptom subgroups

Participants were categorized into 3 subgroups based on symptoms: prickling group, pruritus group, and the combined group

https://doi.org/10.5021/ad.25.019

(**Table 5**). Participants who reported prickling along with other symptoms were classified into the prickling group (7 participants), while those experiencing pruritus along with other reactions were classified into the pruritus group (11 participants). The combined group consisted of participants exhibiting both pruritus and prickling with overlapping reactions (27 participants).

When comparing the prickling group with the non-prickling group, a significant association with bleach as a suspected material was observed. Specifically, 85.7% of the prickling group identified bleach as a suspected material, compared to 30.1% in the non-prickling group (p=0.01). In the comparison between the pruritus group and the non-pruritus group, shampoo was more frequently identified as a suspected material in the pruritus group (36.4% vs. 4.5%, p<0.01).

The combined group showed the most pronounced differences when compared to participants without these symptoms. Highly significant associations were observed with hair dye (74.1% vs. 8.2%, p<0.001), bleach (81.5% vs. 16.4%, p<0.001), and permanent solutions (33.3% vs. 8.2%, p=0.01) as suspected materials. In contrast, shampoo and fragrances were not significantly associated with the combined condition. Bleach, hair dye, and permanent solutions were strongly associated with the combined pruritus and prickling symptoms, while shampoo showed a more specific association with pruritus-dominant cases.

Table 4. Reported adverse effects of hair dye (total number=51)

Characteristics	No. (%)
Main sites of adverse effect*	
Finger	20 (20.0)
Hand dorsum	19 (19.0)
Palm	8 (8.0)
Fingernail	3 (3.0)
Others	20 (20.0)
No response	2 (2.0)
Additional sites of adverse effect*	
Arm	6 (6.0)
Scalp	21 (21.0)
Face	4 (4.0)
Neck	2 (2.0)
Nowhere (only hand)	22 (22.0)
No response	2 (2.0)
Signs and symptoms*	
Pruritus	38 (38.0)
Prickling	34 (34.0)
Redness	28 (28.0)
Dryness	17 (17.0)
Oozing	17 (17.0)
Vesicles, blisters	9 (9.0)
Fissures	8 (8.0)
Suspected causal substances of the adverse effect*	
Bleach	34 (34.0)
Hair dye	26 (26.0)
Permanent solution	15 (15.0)
Shampoo	8 (8.0)
Product including fragrances	3 (3.0)
Interval between dye usage and adverse effect development	
Within 1 day	26 (51.0)
Within 3 days	16 (31.4)
More than 1 wk	7 (13.7)
No response	2 (3.9)
Duration of adverse effects (mo)	
<1	41 (80.4)
>1	10 (19.6)
Clinical course of adverse effects	
Relieved	39 (76.5)
Continue	1 (2.0)
Aggravated	3 (5.9)
Do not know	7 (13.7)
No response	1 (2.0)

*There are multiple responses for the indicated questions.

Individual analysis of prickling group patients: symptoms, suspected materials, and awareness

The 3 cases of prickling group patients share several commonalities and important observations (**Supplementary Table 1**). All 3 patients were aware of harmful ingredients in hair dye, but none were aware of the inclusion of PPD in the products they used. A key observation is that none of the patients sought medical treatment for their symptoms, which may indicate a lack of awareness regarding the severity of their condition.

The first patient, a male in his 40s with over 7 years of experience, experienced prickling and redness on his hand dorsum and scalp, linked to exposure to bleach and permanent solutions. The second patient, a female in her 20s with less than a year of experience, developed prickling in her palm and arm from exposure to fragrances. The third patient, a female in her 20s with one to 3 years of experience, reported a combination of prickling, redness,

Table 5. Comparison of symptom severity predictors across subgroups (total number=100)

Suspected material*	Prickling group			Pruritus group			Combined group		
	Prickling (n=7)	Non-prickling (n=93)	p-value	Pruritus (n=11)	Non-pruritus (n=89)	p-value	Pruritus and prickling (n=27)	Non-pruritus and non-prickling (n=73)	p-value
Shampoo	0 (0.0)	8 (8.6)	0.93	**4 (36.4)**	**4 (4.5)**	**<0.01**	4 (14.8)	4 (5.5)	0.27
Hair dye	1 (14.3)	25 (26.9)	0.78	4 (36.4)	22 (24.7)	0.64	**20 (74.1)**	**6 (8.2)**	**0.00**
Bleach	**6 (85.7)**	**28 (30.1)**	**0.01**	1 (9.1)	33 (37.1)	0.13	**22 (81.5)**	**12 (16.4)**	**0.00**
Permanent solution	2 (28.6)	13 (14.0)	0.62	4 (36.4)	11 (12.4)	0.10	**9 (33.3)**	**6 (8.2)**	**0.01**
Fragrance	1 (14.3)	2 (2.2)	0.51	1 (9.1)	2 (2.2)	0.75	1 (3.7)	2 (2.7)	1.00

Values are presented as number (%). Bold values indicate statistical significance.
*There are multiple responses for the indicated questions.

https://doi.org/10.5021/ad.25.019

AD ANNALS of DERMATOLOGY

and oozing on her palm, fingers, and nails, linked to hair dye, bleach, and permanent solutions.

Despite differing levels of experience, these cases underscore the risks hairdressers face from exposure to a variety of chemicals, which lead to similar dermatological symptoms. The fact that none of the patients sought medical care suggests a potential underestimation of the severity of their condition, emphasizing the need for greater awareness and preventive measures in the workplace.

Comparison of demographic and occupational factors in subgroups

Severe cases were defined by the presence of symptoms such as oozing, vesicles, or fissures, and these accounted for 25 out of 51 participants with adverse effects. A comparison between the severe and non-severe groups showed no significant differences in demographic characteristics, number of years working as a hairdresser, or the number of hair dye products identified as suspected materials (**Table 6**). Further analysis of symptom severity across the different symptom groups revealed that among the 25 participants who reported severe symptoms (oozing, vesicles, or fissures), 16 (64%) belonged to the combined group, 6 (24%) to the pruritus group, and 3 (12%) to the prickling group. This finding suggests that the presence of both pruritus and prickling sensations may be associated with more severe clinical manifestations, possibly reflecting more complex inflammatory mechanisms or exposure to multiple causative agents.

However, there was a notable difference in shampoo as a suspected material, with the severe group identifying it significantly more frequently than the non-severe group (28.0% vs. 3.8%, p=0.04). For other materials, such as hair dye, bleach, permanent solutions, and fragrance, no significant differences in identification as suspected materials were observed between the 2 groups. This indicates that although demographic and occupational factors did not significantly influence symptom severity, shampoo emerged as a more frequently suspected material in the severe group, suggesting its potential role as an aggravating factor.

Table 6. Comparison of symptom severity predictors in subgroups (total number=51)

Characteristics	Severe group (n=25)	Non-severe group (n=26)	p-value
Sex			1.000
Male	4 (16.0)	4 (15.4)	
Female	21 (84.0)	22 (84.6)	
Age (yr)			0.808
20–29	11 (44.0)	9 (34.6)	
30–39	8 (32.0)	8 (30.8)	
40–49	5 (20.0)	6 (23.1)	
≥50	1 (4.0)	3 (11.5)	
Past history of disease including skin diseases			0.627
Yes	4 (16.0)	2 (7.7)	
No	21 (84.0)	24 (92.3)	
No. of years working as a hairdresser			0.266
<1	2 (8.0)	4 (15.4)	
1–3	4 (16.0)	3 (11.5)	
3–5	3 (12.0)	0 (0.0)	
5–7	5 (20.0)	3 (11.5)	
>7	11 (44.0)	16 (61.5)	
Frequency of dyeing hair (times/d)			0.140
<1	2 (8.0)	1 (3.8)	
1–5	20 (80.0)	18 (69.2)	
>5	3 (12.0)	7 (26.9)	
No. of hair dyes currently using			0.392
1	0 (0.0)	0 (0.0)	
2	1 (4.0)	4 (15.4)	
3	10 (40.0)	9 (34.6)	
≥4	14 (56.0)	13 (50.0)	
Suspected material*			
Shampoo	**7 (28.0)**	**1 (3.8)**	**0.040**
Hair dye	14 (56.0)	12 (46.2)	0.670
Bleach	18 (72.0)	16 (61.5)	0.190
Permanent solution	6 (24.0)	9 (34.6)	0.560
Fragrance	1 (4.0)	2 (7.7)	0.870

Values are presented as number (%). Bold values indicate statistical significance.
*There are multiple responses for the indicated questions.

Behaviors after experiencing adverse effects

Regarding behaviors after experiencing adverse effects, only 7.8% of participants sought medical treatment (**Supplementary Table 2**). The majority relied on no treatment (67.6%) or self-treatment measures, such as topical ointments or oral medications (12.8%). Among those with severe symptoms, 80% reported that their symptoms resolved spontaneously, while 8% experienced worsening symptoms. The non-severe group also showed a high rate of spontaneous symptom resolution (76%), with fewer cases of worsening symptoms. In terms of current adverse effect experience, 48% of individuals in the severe group and 44% in the non-severe group reported experiencing symptoms occasionally. No participants in either group reported always experiencing adverse effects.

Despite the severity of symptoms, most participants did not seek medical care, and behaviors, such as reducing exposure or seeking treatment, were minimal. This points to a potential underestimation of the severity of their condition and highlights the need for greater awareness and preventive measures in the workplace.

DISCUSSION

Hairdressers are frequently exposed to chemical agents like PPD, ammonia, and bleaching agents, which contribute to both ICD and ACD. Uter et al.[3] reported approximately 60% of hairdressers experience contact dermatitis, with PPD being one of the most common allergens. This aligns with our findings where 51% of participants reported adverse effects such as pruritus, prickling, redness, dryness, oozing, vesicles or blisters, and fissures, and 90% were unaware of PPD presence in hair dyes. However, OCD

https://doi.org/10.5021/ad.25.019

on hands is often under-reported as an occupational disease, with only 20.7% of affected individuals notifying authorities[16], reflecting our observation that only 7.8% of affected participants sought medical treatment. Many hairdressers perceive OCD on hands as an inevitable consequence of their work, leading to insufficient reporting and a lack of appropriate intervention[17]. Therefore, efforts to enhance awareness and reporting practices are crucial in addressing this occupational health challenge.

Our findings demonstrate that 51% of hairdressers experience adverse effects from occupational exposure to chemical agents, with years of experience emerging as the primary risk factor (OR, 1.55; 95% CI, 1.07–2.24; p=0.021). The most common symptoms included pruritus (38%), prickling (34%), and redness (28%), primarily affecting fingers (20%), hand dorsum (19%), and scalp (21%). While previous studies[6-10] have shown that OCD often develops during apprenticeship, our findings suggest that prolonged work experience may be associated with an increased risk of adverse effects. This discrepancy may reflect cumulative exposure over time, the healthy worker effect which means individuals with severe early symptoms leaving the profession, or increased exposure to aggressive chemicals through advanced procedures among experienced hairdressers. Preventive measures should therefore target hairdressers across all career stages.

Frequent wet work, such as shampooing and rinsing, was strongly associated with adverse effects, particularly in the severe symptom group where shampoo was significantly more frequently identified as a suspected material (28.0% vs. 3.8%, p=0.04). Although shampoo is a rinse-off product and generally has a short contact time with the skin, its frequent use in wet work may lead to cumulative disruption of the skin barrier, thereby contributing to OCD on hands. Wet work compromises the skin barrier, increasing susceptibility to irritation and allergic reactions[18,19]. While 100% of participants reported wearing gloves during hair dyeing procedures, detailed quantitative data on glove usage during shampooing were not collected. Despite all participants reporting glove use during hair dyeing, many still experienced adverse effects. Detailed quantitative data on glove usage during other procedures such as shampooing were not collected, limiting comprehensive evaluation of glove effectiveness. Therefore, enhancing compliance with glove usage and increasing awareness of proper glove practices during all tasks, including shampooing, are critical to preventing occupational skin diseases.

Our findings highlight a critical knowledge gap regarding occupational skin risks among hairdressers. Although 69% acknowledged the importance of patch testing, none consistently implemented it. The low rate of medical treatment-seeking behavior (7.8%) further indicates underestimation of symptom severity, with most participants relying on self-care (12.8%) or no treatment (67.6%). Even among those with severe symptoms, the majority reported spontaneous resolution, underscoring the need for improved education about the severity and management of occupational dermatitis.

This study has several limitations. First, as the research was conducted exclusively in Seoul, generalizability to other regions is limited. Second, the cross-sectional design restricts causal inference. Third, reliance on self-reported data without clinical assessments such as patch testing introduces potential recall bias and limits the ability to definitively differentiate between ICD and ACD. Fourth, the relatively small sample size (n=100) might limit statistical power for detecting subtle associations. Lastly, we did not collect data on participants' history of metal allergies or other potentially cross-reactive conditions, which might affect susceptibility to sensitization from certain hair dye components. Future studies should assess these factors to clarify predisposition to occupational dermatitis.

To address these issues, we recommend a comprehensive intervention strategy that includes regular occupational health screenings, mobile-based educational programs leveraging Korea's high smartphone penetration, and periodic workplace safety inspections focusing on chemical exposure. Targeted educational interventions for hairdressers with prolonged experience are especially crucial due to cumulative exposure risks. Additionally, standardized protocols for patch testing and medical consultations should be established. Future research should evaluate the long-term impact of chemical exposure and effectiveness of these preventive strategies through longitudinal studies incorporating larger sample sizes and objective clinical assessments.

ORCID iDs

Jin Ju Lee
https://orcid.org/0000-0002-6188-6306
Da Yeon Kim
https://orcid.org/0009-0001-5040-8042
Heera Lee
https://orcid.org/0000-0002-5448-2274
Ji Yeon Byun
https://orcid.org/0000-0003-4519-9474
You Won Choi
https://orcid.org/0000-0001-6315-3889
Joo Young Roh
https://orcid.org/0000-0002-9878-6691
Hae Young Choi
https://orcid.org/0000-0003-3460-2539

FUNDING SOURCE

None.

CONFLICTS OF INTEREST

The authors have nothing to disclose.

DATA SHARING STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

SUPPLEMENTARY MATERIALS

Supplementary Data 1

Research questionnaire

Supplementary Table 1

Summary of symptoms, suspected materials, and awareness in 3 prickling group patients

Supplementary Table 2

Behaviors after experiencing adverse effects (total number=51)

REFERENCES

1. Belsito DV. Occupational contact dermatitis: etiology, prevalence, and resultant impairment/disability. J Am Acad Dermatol 2005;53:303-313. PUBMED | CROSSREF
2. Holness DL. Characteristic features of occupational dermatitis: epidemiologic studies of occupational skin disease reported by contact dermatitis clinics. Occup Med 1994;9:45-52. PUBMED
3. Uter W, Bensefa-Colas L, Frosch P, Giménez-Arnau A, John SM, Lepoittevin JP, et al. Patch testing with hair cosmetic series in Europe: a critical review and recommendation. Contact Dermatitis 2015;73:69-81. PUBMED | CROSSREF
4. Schwensen JF, Friis UF, Menné T, Johansen JD. One thousand cases of severe occupational contact dermatitis. Contact Dermatitis 2013;68:259-268. PUBMED | CROSSREF
5. Schwensen JF, Johansen JD, Veien NK, Funding AT, Avnstorp C, Osterballe M, et al. Occupational contact dermatitis in hairdressers: an analysis of patch test data from the Danish contact dermatitis group, 2002-2011. Contact Dermatitis 2014;70:233-237. PUBMED | CROSSREF
6. Uter W, Strahwald J, Hallmann S, Johansen JD, Havmose MS, Kezic S, et al. Systematic review on skin adverse effects of important hazardous hair cosmetic ingredients with a focus on hairdressers. Contact Dermatitis 2023;88:93-108. PUBMED | CROSSREF
7. Lysdal SH, Søsted H, Andersen KE, Johansen JD. Hand eczema in hairdressers: a Danish register-based study of the prevalence of hand eczema and its career consequences. Contact Dermatitis 2011;65:151-158. PUBMED | CROSSREF
8. Havmose MS, Kezic S, Uter W, Symanzik C, Hallmann S, Strahwald J, et al. Prevalence and incidence of hand eczema in hairdressers-a systematic review and meta-analysis of the published literature from 2000-2021. Contact Dermatitis 2022;86:254-265. PUBMED | CROSSREF
9. Uter W, Johansen JD, Macan J, Symanzik C, John SM. Diagnostics and prevention of occupational allergy in hairdressers. Curr Allergy Asthma Rep 2023;23:267-275. PUBMED | CROSSREF
10. Carøe TK, Ebbehøj NE, Agner T. Occupational dermatitis in hairdressers - influence of individual and environmental factors. Contact Dermatitis 2017;76:146-150. PUBMED | CROSSREF
11. Park JH, Ro YS. Occupational skin disease in hairdressers: results of patch test. Korean J Dermatol 2006;44:669-674.
12. Uter W, Hallmann S, Gefeller O, Brans R, Symanzik C, Oppel E, et al. Contact allergy to ingredients of hair cosmetics in female hairdressers and female consumers-an update based on IVDK data 2013-2020. Contact Dermatitis 2023;89:161-170. PUBMED | CROSSREF
13. Piapan L, Mauro M, Martinuzzo C, Larese Filon F. Characteristics and incidence of contact dermatitis among hairdressers in north-eastern Italy. Contact Dermatitis 2020;83:458-465. PUBMED | CROSSREF
14. Kim JE, Jung HD, Kang H. A survey of the awareness, knowledge and behavior of hair dye use in a Korean population with gray hair. Ann Dermatol 2012;24:274-279. PUBMED | CROSSREF
15. Johansen JD, Frosch PJ, Lepoittevin JP. Contact dermatitis. 5th ed. Berlin: Springer, 2011.
16. Lysdal SH, Søsted H, Johansen JD. Do hairdressers in Denmark have their hand eczema reported as an occupational disease? Results from a register-based questionnaire study. Contact Dermatitis 2012;66:72-78. PUBMED | CROSSREF
17. Krecisz B, Kiec-Swierczynska M, Chomiczewska D. Dermatological screening and results of patch testing among Polish apprentice hairdressers. Contact Dermatitis 2011;64:90-95. PUBMED | CROSSREF
18. Nixon R, Roberts H, Frowen K, Sim M. Knowledge of skin hazards and the use of gloves by Australian hairdressing students and practising hairdressers. Contact Dermatitis 2006;54:112-116. PUBMED | CROSSREF
19. Han JH, Lee HJ, Bang CH, Lee JH, Park YM, Lee JY. P-phenylenediamine hair dye allergy and its clinical characteristics. Ann Dermatol 2018;30:316-321. PUBMED | CROSSREF