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ORIGINAL ARTICLE

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Characteristics and incidence of contact dermatitis among hairdressers in north-eastern Italy

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Abstract

Background: Hairdressers are at high risk of contact dermatitis (CD) due to skin exposure to numerous irritants and haptens in hair products in combination with frequent wet work.

Objectives: To investigate the characteristics and incidence of CD among hairdressers in north-eastern Italy.

Methods: A total of 324 hairdressers who had been examined and patch tested in north-eastern Italy from 1996 to 2016 were retrospectively identified, and compared with 9669 matched controls. Sensitization to allergens of the hairdressing series was analysed among hairdressers attending an occupational medicine clinic in Trieste, Italy. Incidence data were calculated from 1999 to 2016.

Results: Sensitization to *p*-phenylenediamine, thiuram mix, and *N*-isopropyl-*N*′-phenyl-*p*-phenylenediamine was significantly associated with hairdressing and with hand/forearms dermatitis. Frequent sensitizers from hairdressing series were ammonium persulfate, toluene-2,5-diamine, and *p*-aminobenzene. The overall incidence of CD declined from 2003 (31.7 cases/10 000 workers) to 2016 (20.8 cases/10 000 workers).

Conclusions: Sensitization to several haptens was significantly associated with hairdressing. The incidence of CD among hairdressers in north-eastern Italy has declined in recent years, but is still high. Preventive efforts are needed to reduce the burden of CD in this professional group.

KEYWORDS
contact dermatitis, epidemiology, hairdressers, incidence, patch test

1 | INTRODUCTION

Occupational contact dermatitis (OCD) represents up to 48.3% of work-related diseases with different percentages in relation to insurance system characteristics.[1,2] One of the most affected occupations is the hairdressing profession,[3] due to workplace exposure to multiple of sensitizing substances and irritating agents[4,5] in combination with wet work known to induce or aggravate other skin disorders.[6,7]

Wet work, including frequent hand and hair washing, damp hair handling, and glove wearing, is the most frequent irritant exposure.[8] In addition, hairdressers frequently themselves clean the hairdressing saloon[9] and workstations, resulting in intense contact with water, detergents, and solvents that may lead to skin irritation and sensitization if skin care and protection measures are not properly applied.

Hair washing is a typical task that is often performed at an early stage of the hairdressing career.[10] Thus, hairdressing apprentices seem to be most affected by OCD,[11,12] probably because they are less aware of precautionary measures[13] together with the fact that they frequently perform wet work.[14,15] Lysdal et al[16] reported that almost 70% of hairdressers develop skin disorders within the first years of employment, and that hand eczema significantly influences the decision to leave the trade.

Hairdressers are at high risk of developing contact sensitization to components of hair dyes, bleaching products, permanent wave solutions,

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metals, and rubber chemicals.[5,17] Particularly, *p*-phenylenediamine (PPD) in hair dyes is the hapten most frequently responsible for allergic contact dermatitis (ACD) in hairdressers.[4,18] O'Connell et al[19] studied patch test results in hairdressers and found that 19% had a positive patch test to PPD. Furthermore, they reported that sensitization to PPD together with nickel, glyceryl thioglycolate, and ammonium persulfate are the most common causes of ACD in hairdressers. Within the European Surveillance System on Contact Allergies (ESSCA),[20] the North-East Italy Contact Dermatitis Group (NEICDG) is responsible for providing information that permits to evaluate sensitization trends and the role of different haptens in work-related skin disorders.[21] The objectives of this study were to report our findings on contact dermatitis (CD) and OCD of hairdressers from north-eastern Italy patch tested between 1996 and 2016. Italian data on contact sensitization in hairdressers are very scarce and not very recent.[22-24]

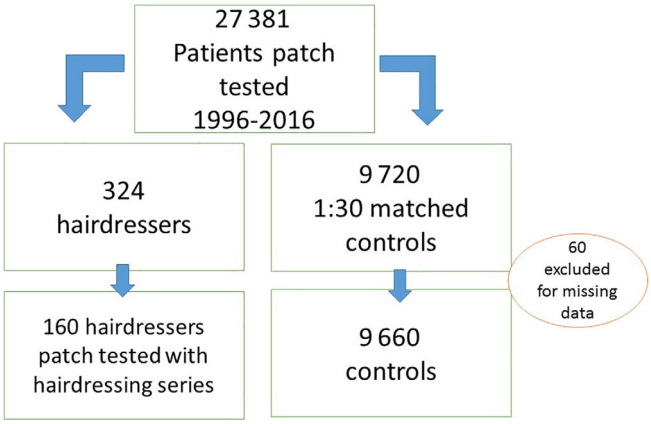

FIGURE 1 Layout of the study

2 | METHODS

2.1 | Case-control study

In the first part of the study, a total of 324 consecutively registered cases of CD among hairdressers, documented electronically by the NEICDG network in the Triveneto Patch Test Database, between January 1996 and December 2016, were retrospectively identified.[25-27] In the considered years, data on 27 381 consecutive patients with symptoms and/or signs of suspected ACD who underwent a clinical assessment and patch testing were collected. Physicians of the NEICDG network performed the medical examination of these patients and filled in a standardized questionnaire to collect information about individual characteristics, occupational history, personal and family history of atopy, nosology, and duration and site of the dermatitis, following the same procedures.[25-27] CD was defined after detailed exploration of the disease considering the patients' history, exposures, and patch test results, clearly differentiating from atopic dermatitis. The hairdressers were matched to a control group in a 1:30 case-control ratio. That is, each hairdresser was matched with 30 other patients with eczema, who were not registered as hairdressers in the database. Matching criteria were sex, age classes, and test year. Among the 9720 controls, 60 were disregarded owing to missing data and finally 9660 controls were used for the analysis (Figure 1). The characteristics of the patients were described according to the MOAHLFA (Male, Occupational, Atopic dermatitis, Hand/forearm dermatitis, Leg dermatitis, Face dermatitis, Age > 40 years) index. OCD was listed by dermatologist or occupational physician as yes, no, or unknown.

2.2 | Analysis of sensitization to hairdressing series

In the second part of the study, we analysed the patch test reactions to relevant haptens from the hairdressing series in 140/157 consecutively registered cases of CD among hairdressers attending the Allergy Clinic at the Clinical Unit of Occupational Medicine in Trieste from January 1998 to December 2016.

2.3 | Incidence study

To calculate incident cases we used CD cases patch tested in Padua, Pordenone, and Trieste (n = 285) because these three centres participated from 1999 to 2016 regularly and because they can be considered as reference centres for 75% of population of the three provinces. The numbers of workers occupied as hairdressers in each province were extracted from Camera di Commercio website.[28]

2.4 | Patch tests

All patients were patch tested using Finn chambers (Epitest, Tuusula, Finland) on Scanpor tape (Norgesplaster, Vennesla, Norway) and haptens produced by Chemotechnique Diagnostics (Vellinge, Sweden) and FIRMA (Firenze, Italy). In the first part of the study, all hairdressers and controls were patch tested with the European baseline series[20] and the Triveneto extended series.[26] Haptens of potential relevance in relation to occupational exposures in hairdressers were selected for comparison between hairdressers and controls. In the second part of the study, we analysed the patch test data of relevant haptens from the hairdressing series.[4]

All patches were applied on the upper back and removed after 48 hours. The sites were examined on removal (day 2 [D2]) and after 72/96 hours (D3/D4), according to the International Contact Dermatitis Research Group (ICDRG) guidelines.[29] Reactions of grades +, ++, and +++ were considered positive. Doubtful reactions (?+) were considered negative. Written informed consent was obtained from all the participants, and the study protocols were approved by the local ethics committee.

2.5 | Statistical analysis

Data analysis was performed using the software STATA version 14.0 (StataCorp, College Station, Texas). Continuous variables were summarized using the mean as a measure of central tendency and the standard deviation as that of dispersion. The difference between means was tested by *t* test, whereas the difference between

categorical data cross-tabulated into contingency tables was tested by the χ^2 test. Odds ratios (ORs) and an accompanying 95% confidence interval (CI) were calculated comparing hairdressers with the control group. ORs were adjusted for age and sex when appropriate. The associations between patch test results and hairdressing were assessed by multivariate logistic regression analysis. Incidence rates were obtained by dividing new cases of hairdressers who were patch tested in each year by the 75% of hairdressers occupied in the three provinces considered. The incidence rate was reported as new cases/10 000 occupied hairdressers. A *P*-value <.05 was considered significant.

3 | RESULTS

In the first part of the study, a total of 324 hairdressers and 9660 controls with CD, patch tested between 1996 and 2016, were included in the analysis. The main characteristics of the study participants are summarized in Table 1. A history of atopic dermatitis was more prevalent among controls: it was found in only 24 of the cases and 938 of the controls (7.4% vs 9.7%). Conversely, occupational dermatitis was observed significantly more often among hairdressers than controls (44.1% vs 10%; OR 7.1, 95% CI 5.7-9.0). The body areas most frequently associated with skin lesions were hands and forearms, noted more in hairdressers than in controls (55.6% vs 34.6%; OR 2.6, 95% CI 2.1-3.4). Less involved sites were legs (3.4% in hairdressers vs 4.5% in controls) and face (10.5% vs 12.2%).

Sensitization frequencies for most relevant haptens from the baseline series for hairdressers are summarized in Table 2. Hairdressing was significantly associated with sensitization to PPD (20.4% vs 3.3%; OR 7.4, 95% CI 5.5-9.9), thiuram mix (OR 2.0, 95% CI 1.1-3.9), and *N*-isopropyl-*N*′-phenyl-*p*-phenylenediamine (IPPD; OR 2.9, 95% CI 1.2-6.8). Among all patch tests, the commonest positive patch test reaction was to nickel sulfate in both hairdressers and controls (37.8% and 38.8%, respectively), but no significant difference was observed.

In the second part of the study, 157 hairdressers with CD, attending the Clinical Unit of Occupational Medicine in Trieste from 1998 to 2016, were included in the analysis. A total of 140 (89%) patients were patch tested with the extended European baseline series, along with the hairdressing series, which varied slightly over the considered years. Sensitization prevalence rates for selected haptens are summarized in Table 3.

Sensitization frequencies for haptens included in the European baseline series are in line with those observed among hairdressers of the Triveneto database; 42% were sensitized to nickel sulfate and

TABLE 1 Main characteristics of the study participants

Characteristics	Hairdressers (n = 324)	Controls (n = 9660)	Crude odds ratios (95% CIs)
Age, mean (SD)	30.9 (12.7)	31.1 (10.8)	
Age > 40, n (%)	74 (22.8)	2016 (20.9)	1.1 (0.9-1.5)
Female, n (%)	297 (91.7)	8848 (91.6)	1.0 (0.7-1.5)
Atopic dermatitis, n (%)	24 (7.4)	938 (9.7)	0.66 (0.44-1.02)
Occupational contact dermatitis, n (%)	143 (44.1)	964 (10)	**7.1 (5.7-9.0)**
Hands and forearms, n (%)	180 (55.6)	3345 (34.6)	**2.6 (2.1-3.4)**
Legs, n (%)	11 (3.4)	434 (4.5)	0.72 (0.39-1.34)
Face, n (%)	34 (10.5)	1755 (12.2)	**0.50 (0.35-0.72)**

Note: Bold font indicates statistical significance.
Abbreviations: CI, confidence interval; SD, standard deviation.

TABLE 2 Frequencies of sensitization to selected haptens included in the European baseline series in hairdressers and controls. Odds ratios (OR) and 95% confidence intervals (CI) are calculated after adjusting for sex

Haptens	Hairdressers (N = 324), n (%)	Controls (N = 9660), n (%)	OR (95% CI)
Nickel sulfate 5%	122 (37.8)	3753 (38.8)	0.97 (0.65-1.5)
***p*-Phenylenediamine base 1%.**	**66 (20.4)**	**322 (3.3)**	**7.4 (5.5-9.9)**
Fragrance mix 8%	21 (6.5)	627 (6.5)	0.99 (0.64-1.6)
Myroxylon pereirae (balsam of Peru) 25%	11 (3.4)	431 (4.5)	0.75 (0.41-1.4)
Thiuram mix 1%	**10 (3.1)**	**150 (1.5)**	**2.0 (1.1-3.9)**
Carba mix 3%	7 (2.2)	293 (2.9)	0.73 (0.34-1.6)
Potassium dichromate 0.5%	**8 (2.5)**	**607 (6.3)**	**0.37 (0.2-0.8)**
***N*-Isopropyl-*N*′-phenyl-*p*-phenylenediamine 0.1%**	**6 (1.75)**	**62 (0.64)**	**2.9 (1.2-6.8)**

Note: Bold font indicates statistical significance.

TABLE 3 Positive patch test reactions in hairdressers to relevant allergens selected from the European baseline series and those included in the hairdressing series

Allergens	Positive test reactions, n/N (%)
Nickel sulfate 5%	66/157 (42.0)
p-Phenylenediamine base 1%	29/157 (18.5)
Fragrance mix 8%	7/157 (4.4)
Myroxylon pereirae (balsam of Peru) 25%	7/157 (4.4)
Thiuram mix 1%	5/157 (3.2)
Carba mix 3%	5/157 (3.2)
Potassium dichromate 0.5%	4/157 (2.5)
N-Isopropyl-*N'*-phenyl-*p*-phenylenediamine 0.1%	2/157 (1.3)
Ammonium persulfate 1%	19/140 (13.6)
Toluene-2,5-diamine sulfate 1%	11/140 (7.9)
p-Aminobenzene 0.25%	9/120 (7.5)
p-Aminophenol 1%	5/121 (4.1)
Hydroquinone monobenzyl ether 1%	5/140 (3.6)
m-Aminophenol 1%	3/131 (2.3)
Glyceryl thioglycolate 1%	3/140 (2.1)
Sodium bisulfite 1%	2/105 (1.9)
Ammonium thioglycolate 2%	2/140 (1.4)
Benzophenone 5%	1/105 (0.95)
Resorcinol monobenzoate 1%	1/124 (0.8)
Resorcinol 2%	1/140 (0.7)

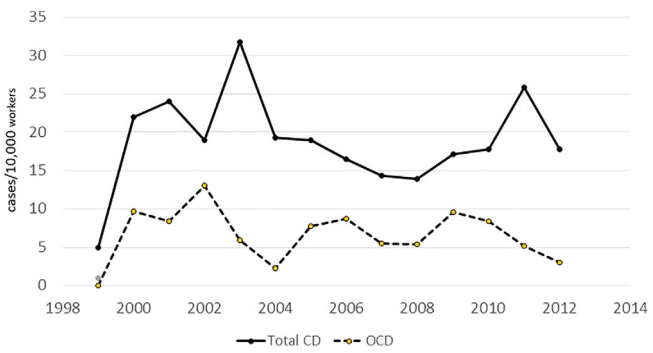

FIGURE 2 Incidence of contact dermatitis (CD) and occupational contact dermatitis (OCD) in hairdressers (numbers/10 000 occupied hairdressers) from 1999 to 2016

18.5% to PPD. Among the hairdressing series, positive patch test reaction was most frequently observed to ammonium persulfate (13.6%), toluene-2,5-diamine sulfate (7.9%), and *p*-aminobenzene (7.5%).

Incident cases per year on 10 000 occupied hairdressers in the provinces of Padua, Pordenone, and Trieste are reported in Figure 2, considering CD and OCD. The overall incidence of CD declined from 2003 (31.7 cases/10 000 workers) to 2016 (20.8 cases/10 000 workers), with a small peak in 2011 (25.8 cases/10 000 workers).

TABLE 4 Incidence study: Data are reported as mean number of cases per year and 95% confidence intervals (95% CI) in Padua, Pordenone and Trieste (on 285 total cases) from 1999 to 2016

	Mean	95% CI
Exposed workers, n	11 412	10 371-12 454
Estimated exposed workers referred to the three centres (75%), n	8559	7778-9340
Total contact dermatitis per year, n	15.5	12.9-18.7
Occupational contact dermatitis per year, n	6.5	4.9-8.12
Incidence of contact dermatitis per year on 10 000 workers	18.4	15.6-21.2
Incidence of occupational contact dermatitis per year on 10 000 workers	7.4	5.7-9.1

Abbreviation: CI, confidence interval.

OCD incidence was between 0 in 1999 and 13 cases/10 000 workers in 2002 and 10.4 cases/10 000 workers in 2016.

Mean values and 95% CI of exposed workers, cases of CD and OCD, and incident cases on 10 000 workers are reported in Table 4.

4 | DISCUSSION

Our study investigating CD in hairdressers revealed that most of them were female (91.7%), reflecting female predominance in hairdressing sector.[30-35] The majority was aged under 40 years, which is in agreement with previous findings.[5,12,36-38]

Less hairdressers than controls had atopic dermatitis. This supports the existence of a "healthy worker effect"[39] in hairdressers, with a higher prevalence of leaving the profession at an early stage due to morbidity associated with atopy status.[19,40-42] Schwensen et al[5] also observed atopic dermatitis less commonly among hairdressers (21.3%) than among controls (29.4%) ($P < .01$). Lysdal et al[42] found that significantly more ex-hairdressers (23.7%) than hairdressers (21.0%) had a history of atopic dermatitis ($P = .017$), with a positive correlation between having atopic dermatitis and leaving the trade because of hand eczema. Carøe et al[12] reported that the prevalence of atopic dermatitis was significantly higher among hairdressing apprentices than among fully trained hairdressers, suggesting that a "healthy worker survivor effect" is found among the latter group. It is also possible that atopic individuals do not choose the hairdressing profession, avoiding an apprenticeship in a profession with multiple skin hazards, or that ex-hairdressers who had left the job due to CD were among those chosen as controls. However, the share of atopic dermatitis among the hairdressers in this study was lower than in other studies.[5,12,14,43,44] This is in agreement with our previous findings,[10] and can be related to the generally lower occurrence of atopic dermatitis in Italy as compared, for instance, with Nordic countries.[44]

The prevalence of OCD was 44.1% and 9.9% in hairdressers and controls, respectively, showing that hairdressing has a significant risk

factor for work-related skin disorders. OCD is frequent in hairdressers[5,15,34] and usually occurs early within few years of work.[45-47]

With respect to dermatitis localization, the most involved sites were hands and forearms in both study groups, but in hairdressers hands and forearms were significantly more affected than in controls. Study participants less often had dermatitis in the face (10.5% in hairdressers vs 12.2% in controls) and on the legs (3.4% vs 4.5%). These findings are in agreement with the literature.[48,49] CD is mostly located on the hands, followed by the face (for airborne contamination, secondary contact through hands, or by direct exposure, ie, make-up), as those parts of the body are most exposed to external agents.[50] Hands and forearms are the most common sites of OCD in manual workers who are exposed to water, detergents, solvents, irritants, and sensitizers, as are hairdressers.[7,44,51] The prevalence of hand dermatitis in hairdressers in the present study (55.6%) is within the same range found in previous investigations.[15,42,43] Moreover, the results of a previous prospective study on hairdressers from north-eastern Italy confirmed frequent occurrence of hand skin symptoms, especially fissuring, dryness, and itching, with a significantly increased prevalence at 10-year follow-up, and with a positive correlation between having skin dryness and developing hand eczema.[10]

Sensitization to nickel sulfate and PPD ranked on the top in hairdressers tested with an extended European baseline series, which is in agreement with previous reports.[5,19,52] The prevalence of sensitization to nickel sulfate was high among both hairdressers (37.8%) and controls (38.8%), and no significant differences were found. The reason may be that in most cases skin exposure to nickel occurs outside the workplace, through the personal use of metal objects containing nickel. Jewellery and clothing accessories, especially piercing, earrings, wristwatches, and clothing buckles, are the most common culprits.[8,53,54] Even though decreased rates of nickel allergy have been found in countries where the Nickel Directive (Council Directive 94/27/EC) has been accepted and followed for a long time,[55] sensitization to nickel is still most prevalent among patients with dermatitis in Europe.[56] One reason for the greater prevalence of nickel sensitization in Italy may be related to a wide presence of costume jewellery and to the delay of the "Nickel Directive" application in Italy compared with other European Union countries.[57-59]

Sensitization to PPD, which is the most well-known component of hair dyes, is the commonest cause of ACD among hairdressers.[60,61] The sensitization prevalence to PPD among hairdressers was 20.4%, which is in line with previous studies (ranging between 3.7% and 25%).[4,5,12,14,19,62,63]

Sensitization to thiuram mix was significantly associated with the occupation of hairdressing, with a prevalence of 3.1% in hairdressers and 1.5% in controls. The chemicals in thiuram mix are used as additives in manufacturing rubber products, such as gloves, and are known sensitizing agents.[64] The prevalence of sensitization to thiuram mix was within the previously reported range among hairdressers.[5,12,19] The major cause of sensitization to thiuram mix is the use of rubber gloves as personal protective equipment (PPE) in hairdressing tasks. The use of protective gloves among hairdressers is crucial to avoid direct contact with several occupation-related irritants and haptens. However, the inadequate use of PPE and the wearing of sensitizer-containing gloves, such as rubber ones, are known problems among hairdressers.[37,65] Hence, there is the need to improve preventive measures in the hairdressing sector, which also means promotion of gloves with low sensitization potential as well as using cotton liner gloves.

Sensitization to IPPD, a "*para* compound" present as antioxidant in black rubber, is significantly associated with hairdressing, as 1.75% of hairdressers had been sensitized to the hapten as compared with 0.64% of controls. Our sensitization prevalence is higher compared with that reported by Schwensen et al[5] who found, from a study of patch test results, 0.6% sensitization among northern Europe hairdressers and 0.3% sensitization among matched controls. Furthermore, they did not find that contact allergy to IPPD was associated with the occupation of hairdressing. Other studies,[18,66] focusing on sensitization to PPD and cross-reactions with related haptens, found that while PPD-positive patients have limited reactions to IPPD, patients allergic to IPPD react to PPD in about 30% of cases, showing that primary sensitization to IPPD may contribute to PPD contact allergy. In this study, of the six patients sensitized to IPPD, four were sensitized to PPD.

In the second part of the study, we investigated sensitization in hairdressers from Trieste, who were patch tested with a hairdressing series (n = 140). Sensitization to ammonium persulfate was seen in 13.6% of hairdressers testing positive. Ammonium persulfate is a component of hair bleaching products and it is among the most common haptens that hairdressers use.[67,68] Previous studies observed a sensitization prevalence to ammonium persulfate in hairdressers between 8.0% and 21.7%.[5,12,14,19,61,67] The other commonest positive patch test reactions were to the hair dyes ingredients toluene-2,5-diamine, *p*-aminobenzene, and *p*-aminophenol. Allergy to all these dye intermediates has previously been reported to be frequent in hairdressers.[5,67] Sensitization to toluene-2,5-diamine was found in 7.9% of hairdressers, which is within the same range previously reported (between 4.5% and 19.6%).[5,12,19,61,67] Sensitization to *p*-aminobenzene and *p*-aminophenol was observed in 7.5% and 4.1%, respectively, of the hairdressers in the analysis, which are higher shares than those found in other studies.[5,12,62] In our analysis, sensitization to hydroquinone, which is a constituent of air bleaching products, was higher (3.6%) than that previously observed.[5,12,19,62,67] Glyceryl thioglycolate, an acid permanent wave ingredient, is a known sensitizer for hairdressers. Sensitization to this ingredient has shown a decreasing time trend in recent years.[5,19,69] Our data show that three of the 140 hairdressers tested had contact allergy to glyceryl thioglycolate, whereas two were sensitized to ammonium thioglycolate, according to literature data[5,12,19,61] Finally, this analysis found a sensitization prevalence to the hair dye ingredient *m*-aminophenol, resorcinol monobenzoate, and resorcinol of 2.3%, 0.8%, and 0.7%, respectively, which were higher prevalences than those previously reported.[5,12,19,61]

Using available data on hairdressers in Padua, Pordenone, and Trieste provinces, we calculated the incidence from 1999 to 2016. We found a decreased overall incidence from 2003 (31.7 cases/10 000 workers) to 2016 (20.8 cases/10 000 workers), with a small peak

in 2011 (25.8 cases/10 000 workers). This downward trend could suggest a progressive improvement in work habits due to preventive measures and probably to less-sensitizing products used. Few incidence data in the hairdressing sector have been published,[32,69,70] some among apprentices,[34,71] and none for Italy. It is well-known that hairdressing apprentices are at increased risk for occupational skin disorders,[12,46] with the highest incidence rates within the first years of training.[70,71] Moreover, a substantial proportion leaves the trade because of these disorders, causing a "healthy worker survivor effect".[34,42] Dickel et al[70] calculated an incidence rate of 97.4 cases of occupational skin diseases/10 000 workers per year among hairdressers in Northern Bavaria. Schwensen et al,[33] based on 1000 cases of severe CD, calculated an incidence rate of 96.8 cases/10 000 workers among hairdressers. Interestingly, our data are much lower than these aforesaid European studies. However, it should be pointed out that the reported prevalence and incidence of CD and OCD in Italy are lower compared with more northern countries,[44] and occupation-related disorders are generally underreported and underdiagnosed.[72]

Our study has some limitations. Although based on large samples, the study population included participants who had undergone patch testing for suspected allergic dermatitis, and, for that reason, the results may be affected by selection bias. Another possible limitation relates to the retrospective and multicentric design that may have affected the data recording in different centres, though all participants accepted a standardized protocol and enrolled the study participants in the same way. However, this latter limitation concerns only the first part of the study, whereas our second analysis is from a single centre using an accurate internal protocol of patch test interpretation, thus reducing interobserver variability. Despite such possible limitations, our findings suggest that hairdressers are still at high risk of OCD, as they are constantly exposed to a wide range of haptens in combination with wet work. The incidence of CD is much lower than in other European reports, with a downward trend (though not steady) in recent years. This seems to reflect some progressive improvements in work habits due to implementation of preventive measures. However, more can still be done to prevent ACD in this occupational group.[72] Hence, it is still important to promote proper preventive measures in hairdressing saloons in order to minimize the exposure to all these chemicals. Preventive efforts must include constantly updated educational programs, use of less irritant and sensitizing hair products, and appropriate PPE. Implementation of skin protection, through the cotton liner glove wearing and the use of gloves with low sensitizing potential, should be priorized.

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AUTHOR CONTRIBUTIONS

Linda Piapan: Investigation; writing-original draft; writing-review and editing. **Chiara Martinuzzo:** Data curation; investigation; resources. **Marcella Mauro:** Writing-review and editing. **Francesca Larese Filon:** Conceptualization; data curation; formal analysis; supervision; writing-review and editing.

CONFLICT OF INTEREST

The authors have no conflict of interest to declare

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