

Factors related to skin health in hairdressing apprentices from two Croatian regions

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Abstract

Background: Hairdressing apprentices are at high risk for developing occupational contact dermatitis.

Objectives: The objective of this study was to analyse whether there are differences in skin health, skin protection and health-related quality of life between apprentices from two Croatian regions (Zagreb and Dalmatia).

Materials and methods: Final-year hairdressing apprentices from Zagreb ($n = 101$) and Dalmatia ($n = 77$) were enrolled in the study. Clinical examination of hands was performed by use of the Osnabrück Hand Eczema Severity Index. Transepidermal water loss (TEWL) was measured on forearm and hand. A history of self-reported skin symptoms, work-related exposure to skin hazards and health-related quality of life were assessed with validated questionnaires.

Results: Apprentices from Zagreb reported having been engaged in practical work more days per month than Dalmatian apprentices (median 12 days vs 8 days, respectively, $P < 0.001$), and washing their hands >20 times per day more frequently (28% vs 10%, respectively, $P = 0.004$), and consequently more frequently having dry hands (37% vs 16%, respectively, $P = 0.002$), and significantly higher TEWL values on the hand and forearm, which was confirmed by the results obtained with multiple linear regression models.

Conclusions: A higher extent of exposure to skin hazards was related to poorer skin barrier function, which confirms the need for improvement of appropriate safety practices in hairdressing schools.

KEYWORDS

health-related quality of life, occupational contact dermatitis, safety at work, TEWL, vocational education

1 | INTRODUCTION

It is well known that hairdressers and hairdressing apprentices are at high risk of developing occupational contact dermatitis related to various workplace exposures to skin hazards.^{1–3} Major risk factors include exposure to skin irritants and sensitizers, particularly wet work, hair dyes, preservatives, and fragrances.⁴ Unfortunately, hand eczema is

considerably under-reported as an occupational disease; the perception of hand eczema among hairdressers and the lack of reporting from doctors are the main reasons for this.^{5,6} Lysdal et al showed that almost 70% of all hairdressers with hand eczema experienced its onset during their apprenticeship, and that hand eczema was the predominant reason for leaving the trade among hairdressers who suffered from hand eczema at one point or other.⁷

The results of a previous study on Croatian hairdressing apprentices at the end of their training⁸ confirmed high exposure to skin hazards during vocational education, as has also been found in other studies,⁹ particularly in terms of hair washing and dyeing, and rinsing dye from the hair. Poor skin protection habits of Croatian hairdressing apprentices, and probably poor supervision of their vocational teachers and tutors regarding prevention of the irritant effects of wet work on skin, was suspected. In the study, 91% of apprentices reported wearing gloves while dyeing hair, 45% while rinsing hair dyes, and only 4% while washing hair.⁸ Such poor protection from skin irritants resulted in skin symptoms on the hands and wrists in 40% of apprentices. However, even this finding was favourable as compared with Germany, where 55% of apprentices had similar skin symptoms in spite of the fact that protective gloves were worn by 18.5% of them when washing hair, which is a significantly higher proportion than among Croatian apprentices.^{10,11} It was speculated that population-specific individual risk factors may have contributed to this difference.

Therefore, we extended our previous study with a sample of hairdressing apprentices from the southern, coastal region of Croatia, which has, to some extent, a different climate from the capital city of Zagreb, situated in the northern, continental part of Croatia, and

whose population has a different diet.^{12,13} The objective of this study was to analyse whether there were differences in skin health, safety and health-related quality of life (HRQoL) between apprentices from two Croatian regions (Zagreb and Dalmatia), and which factors may be related to these differences.

2 | METHODS

2.1 | Study population

This study is an extension of our previous study.⁸ The sample of apprentices recruited and examined at the end of the final (third) year of education in vocational schools in Zagreb in 2015 ($n = 104$) was supplemented with the final-year apprentices from four vocational schools in Dalmatia, Croatia's coastal region (Figure 1), in the cities of Split, Makarska, Sinj, and Imotski, in 2016. Apprentices from both regions were examined: those from Zagreb from 21 April to 6 May 2015, and those from Dalmatia from 2 to 4 May 2016. The study protocol and recruitment process were the same as described previously.⁸ Briefly, the participants were invited to participate in the study via a presentation and flyers at school. Parents of minors were informed during a parents' meeting and by flyers. Participants, or both parents and participants if the participants were aged <18 years, gave



FIGURE 1 Republic of Croatia: geographical positions of the analysed regions

their written informed consent. Ethical approval for this study was granted by the Ethics Committee of the Institute of Medical Research and Occupational Health, Zagreb, Croatia.

The response rates were 81% in Zagreb and 63% in Dalmatia (the total numbers of third-year apprentices were 128 in Zagreb, and 123 in four included schools in Dalmatia). One hundred and one female apprentices from Zagreb and 77 from Dalmatia were ultimately enrolled in the study. Three male apprentices from Zagreb and one male apprentice from Dalmatia were excluded to achieve homogeneity of sex. The median age was 17 years (interquartile range [IQR] 17–18 years; range 16–19 years).

2.2 | Assessment

Detailed assessment protocols have been described elsewhere.⁸ Briefly, a history of ever having work-related skin symptoms on the hands, wrists and forearms was assessed with the Nordic Occupational Skin Questionnaire (NOSQ-2002),¹⁴ with added questions on hand skin xerosis.¹⁵ A question addressing whether there had ever been an itching skin rash located in the skin folds (elbow, knee, neck, or around the ears or eyes) was added to assess the history of atopic dermatitis. Work-related exposure to skin hazards was assessed with the EvaHair questionnaire.¹⁶ Hand skin was examined by physicians using the validated Osnabrück Hand Eczema Severity Index (OHSI) to determine the presence of six different morphological characteristics—erythema, scaling, papules, vesicles, infiltration and fissures, and the extent of the affected skin area.^{17,18} Transepidermal water loss (TEWL) was measured on the forearm and on the dorsum of the hand (Tewameter TM 300; Courage & Khazaka Electronic, Cologne, Germany) with the standard procedure suggested by the manufacturer. To assess HRQoL, we used a shortened version of the Duke Health Profile (DHP),^{19,20} as described in our previous study.⁸ The participants rated each of the 12 questions from the DHP on a three-point rating scale. The scores were calculated separately for five domains—self-esteem, social health, mental health, anxiety, and depression—and standardized to a scale from 0 to 100. Higher scores in the domains of self-esteem, social health and mental health indicated a better HRQoL, whereas higher scores in the domains of anxiety and depression indicated a lower health-related quality of life (HRQoL). A question on smoking status (yes/no) was also included in the general part of the questionnaire.

2.3 | Statistical analysis

For further analysis, participants were divided into two groups with affected skin according to the history of self-reported skin symptoms: those who reported hand/wrist eczema or urticarial symptoms, and those who reported hand skin xerosis (without symptoms of hand/wrist eczema or urticaria). Those who did not report symptoms of hand/wrist eczema, urticaria or hand xerosis were used as the control group. The characteristics of the subjects were illustrated by descriptive statistics. Differences between the three groups of participants according to self-reported skin symptoms were analysed with Pearson's χ^2 test (or Fisher's exact test in the subgroup frequency was

<5) for categorical variables, and the Mann-Whitney test for non-normally distributed continuous variables. The associations of hand and forearm TEWL values as dependent variables with relevant predictors (geographical region, habit of washing hands >20 times per day, and subjective and objective skin symptoms) were analysed in multiple linear regression models adjusted for hand washing within 2 hours before measurement. Hand TEWL values were logarithmically transformed to achieve a normal distribution. The results were considered to be statistically significant at a *P* value of <0.05. Analyses were performed with the statistical software STATA/SE 11.2 for Windows.²¹

3 | RESULTS

3.1 | Exposure and protection

Apprentices from Zagreb reported having been engaged in practical work for significantly more days per month than apprentices from Dalmatia (median 12 vs 8, respectively; Mann-Whitney test, *P* < 0.001). There was no significant difference in hours of practical work per day between apprentices from Zagreb and those from Dalmatia. Washing hands >20 times per day was reported significantly more frequently by apprentices in Zagreb than by apprentices from Dalmatia (28% vs 10%; χ^2 test, *P* = 0.004) (Table 1).

Significantly more apprentices from Zagreb than apprentices from Dalmatia performed the following working tasks for >30 min per day (Figure 2): dyeing hair (78% vs 57%, χ^2 test, *P* = 0.002), washing dyed hair (76% vs 58%; χ^2 test, *P* = 0.009), and cutting of wet hair (42% vs 26%, χ^2 test, *P* = 0.035) (Figure 2). In a subset of apprentices who reported performing a specific task for >30 minutes per day, there were no significant differences between the two regions in proportions of apprentices who wore protective gloves for any of the work tasks (Figure 3).

3.2 | Skin symptoms and TEWL

There were no significant differences in the proportions of apprentices with a history of hand/wrist eczema and/or urticarial symptoms between apprentices from Zagreb and apprentices from Dalmatia; however, there were significantly more apprentices with self-reported dry hands in Zagreb than in Dalmatia (Table 1; 37% vs 16%, respectively, χ^2 test, *P* = 0.002). Ever present itching rash in the skin folds was reported by similar proportions of apprentices from both regions (Table 1; Zagreb, 19%; Dalmatia, 18%). Regarding objective symptoms, one or more skin changes on clinical examination were found overall in 40% of apprentices, without significant differences regarding the location (Table 1; Zagreb, 40%; Dalmatia, 42%). There was no significant difference in the frequency of self-reported smokers between Zagreb and Dalmatia (61 participants [61%] vs 43 participants [57%], respectively; *P* = 0.50).

Erythema and infiltration were the most frequent findings on clinical examination (Figure 4), with significantly more erythema being observed in apprentices from Dalmatia than in those from Zagreb (38% vs 23%, respectively; χ^2 test, *P* = 0.030).

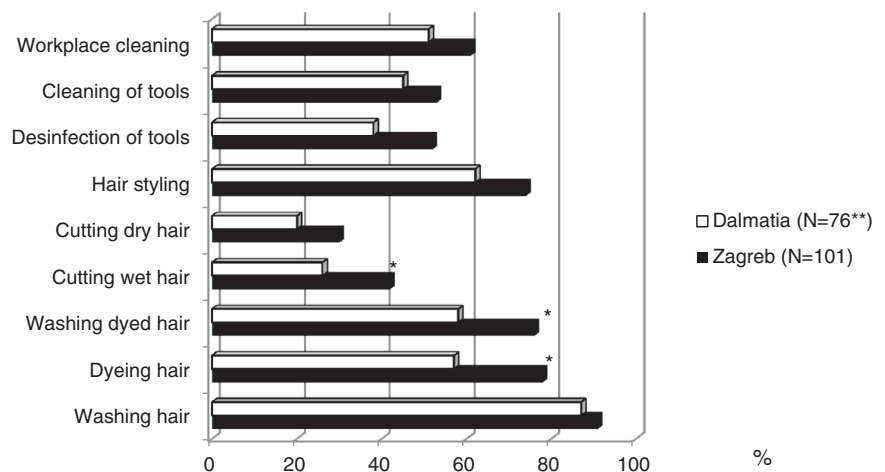
TABLE 1 Differences between characteristics of hairdressing apprentices from two regions in Croatia

	Zagreb N = 101	Coastal region N = 77	P value*
Age (y), median (IQR, TR)	17 (17-18, 16-19)	17 (17-17, 16-18)	0.016
One or more skin changes on clinical examination, n (%)	40 (40)	32 (41.6)	0.79
Self-reported hand/wrist eczema or urticaria symptoms, n (%)	35 (35)	21 (27)	0.29
Self-reported dry hands without eczema or urticaria, n (%)	37 (37)	12 (15.6)	0.002
No report of eczema, urticaria, or dry hands (control group), n (%)	29 (29)	44 (57)	<0.001
Self-reported itching rash in skin folds ever, n (%)	16 (19)	12 (18)	0.95
Practical work, median (IQR, TR)			
Days/month	12 (12-14, 6-22)	8 (8-10, 0-20)	<0.001
Hours/day	7 (7-8, 2-12)	8 (7-8, 0-12)	0.58
Hours/month	96 (84-98, 0-220)	64 (56-70, 0-160)	<0.001
Washing hands >20 times/d, n (%)	28 (28)	8 (10.4)	0.004
TEWL hand ^a , median (IQR, TR)	19.6 (16.7-24.8, 9.4-70.5)	12.2 (10.2-14.9, 6.2-43.5)	<0.001
TEWL forearm ^a , median (IQR, TR)	12.2 (9.9-15.1, 4.2-26.5)	8.8 (7.6-10.4, 4.2-27.5)	<0.001

Abbreviations: IQR, interquartile range; TEWL, transepidermal water loss; TR, total range.

*Statistically significant difference between groups (χ^2 test for categorical variables and Wilcoxon-Mann-Whitney test for non-categorical variables).

^aTEWL measurements were not performed in one apprentice from Dalmatia and one from Zagreb.

FIGURE 2 Proportion of apprentices who performed different types of self-reported work tasks for >30 min/d during practical training

Desquamation and fissures were observed in significantly more apprentices from Zagreb than apprentices from Dalmatia (desquamation, 18% vs. 6%, respectively, χ^2 test, $P = 0.026$; fissures, 9% vs 0%, respectively, Fisher's exact test, $P = 0.006$). Vesicles were more frequently noted in apprentices from Dalmatia than in those from Zagreb (9% vs 1%, respectively, Fisher's exact test, $P = 0.022$). In apprentices with symptoms observed at clinical examination, the OHSI score ranged from 2 to 6 (median 4, IQR 2-5) in the group from Dalmatia, and from 1 to 6 (median 3, IQR 2-4) in the group

from Zagreb, with no significant difference between regions (Table 1). Regarding apprentices with self-reported symptoms in a total sample ($n = 178$), the median OHSI score was 5 (IQR 3.5-5), which was higher than in the control group (median 3, IQR 2-6), with borderline significance (Mann-Whitney test, $P = 0.052$). The OHSI score in the apprentices reporting a history of dry hands was not significantly different from that in the control group, and the OHSI score was not significantly correlated with either hand or forearm TEWL values (data not shown).

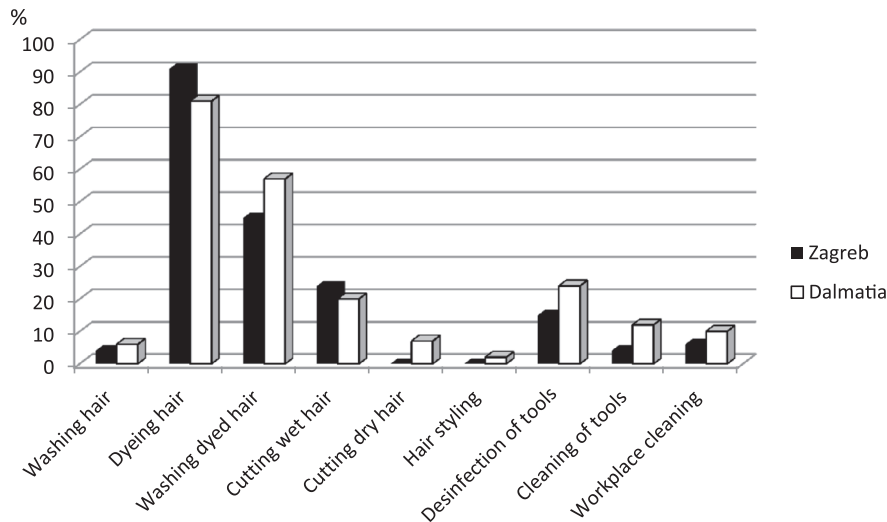


FIGURE 3 Protective glove use among apprentices who performed different types of self-reported work task for >30 min/d during practical education

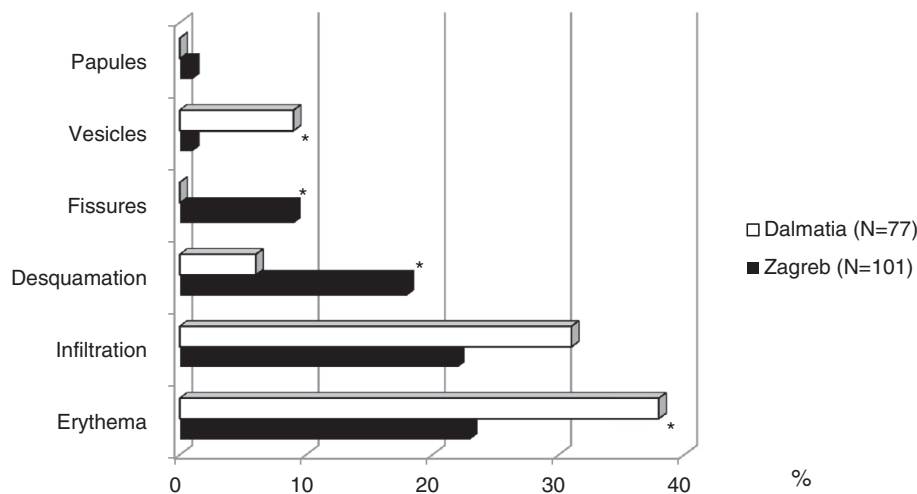


FIGURE 4 Clinical signs observed on hands and wrists of apprentices during examination by a physician

Apprentices from Zagreb had significantly higher TEWL values on the hand and forearm than apprentices from Dalmatia (Table 1). The results of multiple linear regression models (Table 2) with hand and forearm TEWL as the outcome variables confirmed the positive

associations of geographical region (Zagreb) and the habit of washing hands >20 times per day with hand and forearm TEWL. In the overall sample (both regions), there were no significant differences in hand or forearm TEWL values between participants who reported ever having

TABLE 2 Results of multiple linear regression models with hand and forearm transepidermal water loss (TEWL) as outcomes

Predictors	Hand TEWL (N = 176) ^{a,b}			Forearm TEWL (N = 176)		
	Model P < 0.001 Adjusted R ² = 0.320			Model P < 0.001 Adjusted R ² = 0.153		
	Coefficient	95%CI	P-value	Coefficient	95%CI	P-value
Geographical region (Zagreb vs Dalmatia)	0.43	0.30-0.55	<0.001	2.80	1.54-4.06	<0.001
Washing hands >20 times/d	0.27	0.13-0.42	<0.001	1.90	0.43-3.36	0.011
Self-reported hand/wrist eczema and/or urticarial symptoms	0.12	-0.02 to 0.26	0.10	-0.03	-1.45 to 1.38	0.96
Self-reported dry hands	0.01	-0.15 to 0.16	0.93	-0.28	-1.82 to 1.25	0.72
One or more skin changes on clinical examination	0.04	-0.08 to 0.16	0.54	0.96	-0.27 to 2.20	0.13
Washing hands within 2 h before measurement	0.04	-0.08 to 0.16	0.55	-0.07	-1.29 to 1.15	0.91

Abbreviation: CI, confidence interval.

^aTEWL measurements were not performed in one apprentice from Dalmatia and one from Zagreb.

^bHand TEWL values were logarithmically transformed to achieve a normal distribution of residuals.

had an itching rash in the skin folds and those never having had such symptoms (hand TEWL, median 16.5, IQR 11.4-25.2, range 6.2-70.5 vs median 16.1, IQR 11.8-20.7, range 6.8-55.6, respectively, $P = 0.46$; forearm TEWL, median 11.4, IQR 8.7-14.7, range 6.8-20.7 vs median 10.1, IQR 8.0-13.1, range 5.4-27.5, respectively, $P = 0.30$). Neither hand and forearm TEWL values or self-reported and clinically observed skin changes were significantly associated with the smoking status of examined apprentices (data not shown).

3.3 | Health-related quality of life

No differences in four HRQoL domains of the DHP between apprentices from Zagreb and those from Dalmatia were found: self-esteem (median 70, range 20-100 vs median 80, range 10-100); mental health (median 60, range 20-100 vs median 60, range 0-100); anxiety (median 41.67, range 0-83.33 vs median 50, range 0-91.67); and depression (median 30, range 0-80 vs median 40, range 0-90). However, the scores on the social health domain were significantly lower in apprentices from Dalmatia than in apprentices from Zagreb (median 60, range 20-90 vs median 60, range 10-100; Mann-Whitney test, $P = 0.038$).

Apprentices from Dalmatia with a self-reported history of hand/wrist eczema and/or urticarial symptoms had significantly lower self-esteem (median 60, range 30-90 vs median 80, range 50-100, respectively; Mann-Whitney test, $P = 0.001$), lower scores in the social health domain (median 60, range 20-70 vs median 60, range 30-90, respectively [with borderline significance, Mann-Whitney test, $P = 0.054$]) and significantly lower scores in the mental health domain (median 60, range 10-100 vs median 70, range 20-100, respectively, Mann-Whitney test, $P = 0.014$) than the control group. This group of apprentices also had significantly higher scores in the anxiety domain (median 50, range 16.67-75 vs median 33.3, range 0-83.33, respectively, Mann-Whitney test, $P = 0.044$) and the depression domain (median 40, range 10-90 vs median 30, range 0-80, respectively, Mann-Whitney test, $P = 0.023$) than the control group.

4 | DISCUSSION

The purpose of this study was to compare skin health and protective habits between two groups of Croatian hairdressing apprentices attending the final year of their education: apprentices from Zagreb, the capital of Croatia, and apprentices from Dalmatia, a coastal region (Figure 1). The results show different approaches to practical education in vocational schools from Zagreb and Dalmatia, with significantly more days per month of practical training for apprentices from Zagreb. Therefore, exposure to skin irritants and sensitizers during vocational education was greater for apprentices from Zagreb. The work tasks most frequently performed during practical training were also differently distributed between regions. Apprentices from Zagreb worked more with hair dyes than apprentices from Dalmatia, being consequently at higher risk for development of contact sensitization to components of hair dyes, mostly *p*-phenylenediamine (PPD), which

is known as a potent occupational contact allergen in the hairdressing sector.²² This study did not address this issue, but it would be of interest to see in future studies how this difference in exposure is related to the occurrence of early sensitization to PPD in apprentices.²³ Washing hands >20 times per day, which is considered to be a risk factor for skin irritation,²⁴ was reported by more apprentices from Zagreb (28%, in comparison with 10% of apprentices from Dalmatia). However, we cannot determine whether this is related to an adopted risky habit of frequently washing hands, or to more frequent performance of work tasks that include wet work (ie, washing hair) in apprentices from Zagreb.

Summarizing these results, it is obvious that apprentices from Zagreb are qualitatively and quantitatively more exposed to skin hazards during practical training than apprentices from Dalmatia. We found neither a difference in the number of apprentices with self-reported hand/wrist eczema or urticaria between Zagreb and Dalmatia, nor a difference in the number of apprentices with clinically observed skin symptoms. However, apprentices from Zagreb with observed skin symptoms had more desquamation and fissures, that is, more severe symptoms related to skin irritation, than apprentices from Dalmatia. Additionally, self-reported dry skin on the hands was present in more apprentices from Zagreb than in those from Dalmatia, together with higher TEWL values on hands and forearms. TEWL is the most commonly used skin bioengineering technique. There is some evidence that increased TEWL can be an indicator of individual susceptibility to the development of contact dermatitis,²⁵ and of early development of hand dermatitis related to occupational exposure to irritants.²⁶⁻²⁸ In this study, both frequent hand washing and an established greater exposure of apprentices to skin hazards in the Zagreb region were confirmed as predictors that were positively associated with hand and forearm TEWL values in multiple linear regression models. In other words, apprentices from Zagreb and those who frequently washed their hands had higher hand and forearm TEWL values. Thus, apprentices with high TEWL values could be candidates for more extensive education and early intervention regarding the potential risks of wet work during training. The results of this study suggest that, because of the greater exposure to skin hazards, the skin barrier is affected in a higher proportion of apprentices from Zagreb than apprentices from Dalmatia, so they can be considered to be at higher risk for already developing contact dermatitis at the early stage of their career.

It should be mentioned that we found more erythema and vesicles in apprentices from Dalmatia than in apprentices from Zagreb, suggesting that more allergic skin changes are present in Dalmatian apprentices. Self-reported data did not suggest differences in the prevalence of atopic dermatitis between the two regions, and we cannot further address the prevalence of skin sensitization, because this study did not include prick or patch testing. It could be speculated that, because of the greater exposure to skin hazards in Zagreb, a "healthy worker effect" was present there, not allowing apprentices with active atopic dermatitis or contact sensitization to continue with education. The two Croatian regions analysed have different climates, with the most prominent difference being in winter temperatures,

which are higher in the coastal region, with practically no temperatures below 0°C, ice, or snow, which could affect skin barrier function.²⁹ The small number of study participants should be regarded as a limitation for obtaining statistical significance in analysed variables. Safety habits, that is, wearing gloves when performing risky work tasks, such as washing hair or washing dye from the hair, were poorly implemented in both regions, although they were slightly better implemented by apprentices from Dalmatia. Only 4% and 6% of apprentices were wearing gloves while washing hair, and 45% and 57% were wearing gloves while washing dyed hair in Zagreb and Dalmatia, respectively. Evidently, there is a need for a pragmatic approach to ameliorate working conditions for apprentices in hairdressing schools across the entire country. It has been emphasized that hairdressing schools remain the primary source of knowledge for apprentices and tutors.³⁰ Knowledge of skin hazards and the importance of the role of wet work in the pathogenesis of hand eczema is not satisfactory among hairdressing apprentices. In a population-based study on Australian apprentices, up to 70% of participants correctly identified hairdressing chemicals as potential skin hazards, but <15% correctly identified the impact of wet work.³⁰ Another problem is that gloves are often worn inadequately. A recent study from Denmark showed that hairdressers and apprentices lack knowledge of how to handle gloves correctly. Forty-three hairdressers and apprentices were asked to perform a hair wash while wearing gloves. Subsequently, all of the participants (100%) had their hands contaminated during the first round of hair washing.³¹ Moreover, both hairdressers and hairdressing trainees often reuse single-use disposable gloves,³⁰ and there is a lack of knowledge about which types of gloves are adequate for the hairdressing sector with regard to hairdressers' protection from wet work and chemicals, and protection of customers from unpleasant tension or picking of the hair. Nitrile gloves proved to be adequate in both regards.³²

Another existing obstacle is that, whereas tackling insufficient prevention of work-related skin diseases is a top-priority problem in Europe, common standards for the prevention of these conditions are lacking.⁶ After a Cochrane Database Systematic review regarding interventions for preventing occupational irritant hand dermatitis, it was concluded that, at present, there is insufficient evidence to enable confident assessment of the effectiveness of interventions used in primary prevention.³³ Similarly, in a recent quantitative systematic review, there was no evidence available to determine the effectiveness of interventions to prevent occupational irritant hand dermatitis among wet workers who met the review's inclusion criteria.³⁴

The HRQoL assessment in this study confirmed our previously published results⁸ regarding the relationship between subjectively and objectively assessed skin symptoms and HRQoL. The DHP scores of the apprentices from both regions who reported a history of hand/wrist eczema and/or urticarial symptoms indicated significantly lower HRQoL in all five measured domains than in apprentices who did not report a history of such skin symptoms. Reporting of skin symptoms on the day of the study was associated with lower scores for mental health, social health, and self-esteem, as well as with higher

scores for anxiety and depression. Our results are comparable both with the results of other studies using the DHP on adolescent samples in Vietnam³⁵ and in France,²⁰ and with the results obtained for adult samples in the United States.¹⁹ The results of those studies also showed significantly lower HRQoL in participants self-reporting different acute or chronic health conditions. Even though the relationship with objectively identified skin changes was not established in previous studies and the current study, the importance of the perception of one's own health status shows clear links with the reported experience of different aspects of the quality of a person's life. When comparing overall scores in different dimensions of the HRQoL in Zagreb and Dalmatia, we mainly found no differences, except for social health scores, which seemed to be somewhat lower in the Dalmatian sample ($P < 0.05$), suggesting different social positions of apprentices in the analysed regions. Parkerson et al (1990) showed that the dimension of social health was associated with socioeconomic status and age.¹⁹

In conclusion, this study confirms a close relationship of skin health variables with exposure to skin hazards in apprentices with and without clinically evident skin disease. A higher extent of exposure of the hands to skin hazards was related to poorer skin barrier function as assessed by TEWL, a larger proportion of self-reported dry skin, and the development of pronounced irritant skin symptoms, including fissures. The lack of implementation of safety measures among Croatian hairdressing apprentices calls for urgent interventions for improvement of appropriate safety practices that are to be implemented from the beginning of a hairdresser's career, including apprenticeship.

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CONFLICTS OF INTEREST

The authors have no conflicts of interest to report.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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Online supplemental Figure 1. Republic of Croatia: geographic position of the analyzed regions.



Legend: Apprentices were recruited from Zagreb and several locations in Dalmatia (picture source: Wikimedia Commons)