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Comparison of beautician and hairdressing apprentices with regard to skin health and skin barrier function

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Hairdressing and beautician apprentices are at high risk of occupational skin diseases. Our objective was to compare the prevalence of skin symptoms and the condition of skin barrier between them at the end of vocational training. We recruited 101 hairdressing and 76 beautician apprentices (overall median age 17 years), who reported their history of skin symptoms through the Croatian translation of the Nordic Occupational Skin Questionnaire (NOSQ-2002) and had their hand skin clinically examined and evaluated with the Osnabrück Hand Eczema Severity Index (OHSI). Transepidermal water loss (TEWL) was measured following the standard procedure. Hairdressing apprentices reported significantly higher prevalence of hand/wrist eczema or urticaria than beautician apprentices (35 % vs 25 %, respectively; P=0.041) and higher severity of current hand eczema [median (range) 1.5 (0–8) vs 0.5 (0–4), respectively; P<0.001] and had higher hand TEWL values in those who washed their hands >20 times a day [median (interquartile range): 24.4 (19.7–33.7) vs 18.8 (15.4–23.2) g/m^2/h, respectively; P<0.001). Hairdressing apprentices had more severe clinical symptoms on the hands, and 83 % of those who reported eczema also reported that exacerbation occurred during practical training in comparison to 38 % of beautician apprentices. Our study is the first to report occupational hand and forearm skin issues in the beautician apprentices and also suggests that more effort is needed to improve training about safety at work, which should be specifically tailored for these two trades.

KEY WORDS: hand eczema; occupational skin diseases; safety at work; transepidermal water loss; vocational training

Beauticians and hairdressers run a high risk of developing occupational skin diseases (OSD) (1). Beauticians are mainly at risk of developing allergic contact dermatitis due to contact with work-related allergens, mainly acrylates and methylisothiazolinones (2, 3). Hairdressers are at risk of developing irritant contact dermatitis due to wet work and contact with irritating chemicals as well as allergic contact dermatitis due to contact sensitisation to allergens such as paraphenylenediamine, nickel, preservatives, and fragrances (4–6).

Young workers and apprentices have been found to be more vulnerable to work-related illnesses, including OSD, than experienced workers (7). Around 70 % of hairdressers with hand eczema have their first skin symptoms as apprentices, and hand eczema is the main reason for leaving the trade (8). Studies with hairdressing apprentices, including our previous research in Croatian vocational schools, show high prevalence of skin symptoms on the hands, between 40 and 55 % (9–11). Data on the prevalence of hand eczema in beautician apprentices are scarce (12), and data about the status of skin barrier are missing. While we know a lot about the work tasks involved in the practical training of hairdressing apprentices, this cannot be said for beautician apprentices. In our previous study (12) Croatian beautician apprentices mostly cleaned the workplace, disinfected tools, massaged body and face, and removed unwanted hair (12).

One of the most common parameters of skin barrier function used to detect preclinical changes in skin is transepidermal water loss (TEWL). High TEWL has been suggested as an early sign of hand dermatitis related to occupational exposure to irritants in hairdressing apprentices (13), as it facilitates pro-inflammatory signalling leading to contact sensitisation (14). In our cross-sectional study of Croatian hairdressing apprentices (11) we found significantly higher hand TEWL in apprentices who reported washing their hands more than 20 times a day. No such information is available for beautician apprentices. To address this gap, we compared the prevalence of skin symptoms and skin barrier condition between hairdressing and beautician apprentices at the end of their vocational training.

PARTICIPANTS AND METHODS

Participants

This study is an extension of our previous research, wherein the recruitment protocol was described in detail

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(11, 12, 15). Briefly, all final-year hairdressing and beautician apprentices of the Trade School for Personal Services in Zagreb, Croatia were invited to participate in the study via a presentation and flyers distributed at the school. Hairdressing apprentices were recruited in May 2015, and beautician apprentices in May 2015 and 2016 due to the low total number of apprentices enrolled per year. Adult participants and parents of minor participants (<18 years of age) signed informed consent form before enrolment (parents were informed during a parent-teacher meeting and received information flyers). The ethical approval was granted by the Ethics Committee of the Institute of Medical Research and Occupational Health, Zagreb and by the Ethics Committee of the School of Medicine, University of Zagreb, Croatia. The response rate of hairdressing apprentices was 81 % (N=104) and of beautician apprentices 79 % (N=76). The only three male hairdressing apprentices were excluded to avoid confounding results, and the final sample consisted of female participants only: 101 hairdressing and 76 beautician apprentices. Age distribution was the same in both groups of apprentices: median age 17 years, range 16–19 years.

Study protocol

The protocol has been described in detail in our previous study with hairdressing apprentices (11). Briefly, the participants answered questions about history of skin symptoms on the hands, wrists, and forearms translated into Croatian from the Nordic Occupational Skin Questionnaire, long version (NOSQ-2002) (16) and questions about skin dryness on the whole body and on the hands, which were adapted from Thyssen et al. (17). In addition, occupational physicians clinically examined participants' hand skin and scored their findings using a validated Osnabrück Hand Eczema Severity Index (OHSI), designed to determine the presence of six morphological characteristics – erythema, scaling, papules, vesicles, infiltration, and fissures – and the affected skin area (18, 19). Transepidermal water loss (TEWL) was measured on the forearm and back of the hand with a Tewameter® TM 300 measuring device (Courage + Khazaka Electronic, Cologne, Germany) following manufacturer's instructions.

Statistical analysis

Differences between apprentices with regard to hand washing frequency (modified from NOSQ-2002), self-reported skin symptoms, skin changes found by occupational physicians, OHSI score, self-reported severity of skin symptoms, and TEWL values were analysed with Pearson's chi-squared test (or Fisher's exact test if the subgroup frequency was <5) for categorical variables, and Mann-Whitney test for non-normally distributed continuous variables. For the analysis of self-reported skin symptoms, the participants were divided into three groups: (i) those who reported never having had hand/wrist eczema or urticarial symptoms or hand skin dryness; (ii) those who reported having had hand/wrist eczema or urticarial symptoms; and (iii) those who reported having had hand skin dryness but not symptoms of hand/wrist eczema or urticaria). Significance of difference in the frequency of self-reported symptoms between hairdressing and beautician apprentices was then tested against the group of participants who self-reported no symptoms or dry skin. The association of hand or forearm TEWL (as a dependent variable) with relevant predictors (beautician vs hairdressing trade, washing hands >20 times/day, self-reported history of hand/wrist eczema or urticarial symptoms, self-reported history of dry hands without eczema or urticaria, one or more skin changes on clinical examination) was then analysed in multiple linear regression models adjusted for hand washing within 2 h before measurement. In these models, TEWL values were logarithmically transformed to achieve normal distribution of residuals. The associations were considered to be statistically significant at a P-value of <0.05. Analyses were performed with the statistical software R Studio (Boston, MA, USA) (20) and STATA/SE 11.2 for Windows (College Station, TX, USA) (21).

RESULTS

Skin symptoms

Hairdressing apprentices reported significantly more hand/wrist eczemas or urticarias than beautician apprentices (Table 1). Most hairdressing apprentices who reported eczema on hands and/or wrists (N=24) complained of eczema exacerbation during practical training (N=20, 83 %) compared to only a third of beautician apprentices (5 of 13, 38 %).

Most apprentices, regardless of the group, reported that the symptoms of hand/wrist eczema appeared after enrolment to school. Only six hairdressing and five beautician apprentices reported eczema symptoms before enrolment.

Figure 1 shows self-reported ratings of current eczema severity and of severity when the eczema was the most severe. Ratings by beautician apprentices were significantly lower (Mann-Whitney test, P<0.001 for both scales).

Occupational physicians found one or more hand skin symptoms in 40 % of hairdressing and 36 % of beautician apprentices, and their severity was generally mild, judging by relatively low OHSI scores. The groups did not differ significantly in these two respects (Table 1). However, hairdressing apprentices had more severe skin symptoms (fissures, papules, and vesicles) than beautician apprentices (Figure 2). Nine hairdressing apprentices had fissures, in contrast to three beautician apprentices.

Clinical examination also revealed skin changes in participants of both groups (five among hairdressing and seven among beautician apprentices) who reported no

Table 1 Frequency of hand washing, skin symptoms, and transepidermal water loss among hairdressing and beautician apprentices

	Hairdressing apprentices (N=101)	Beautician apprentices (N=76)	Difference between hairdressing and beautician apprentices
Washing hands >20 times/day N (%)	28 (28)	20 (26)	P=0.835
Self-reported history of hand/ wrist eczema or urticaria N (%)	**35 (35)**	**19 (25)**	**P=0.041**
Self-reported history of dry hands (without eczema or urticaria) N (%)	37 (37)	23 (30)	P=0.082
Without history of self-reported symptoms (eczema, urticaria, dry hands) N (%)	29 (29)	34 (45)	–
One or more skin changes on clinical examination N (%)	40 (40)	27 (36)	P=0.579
OHSI Median (IQR)	3 (2–4)	3 (2–4)	P=0.774
TEWL hand [g/m²/h] Median (IQR)	19.6 (16.7–24.8)	18.6 (13.7–23.0)	P=0.085
TEWL forearm [g/m²/h] Median, (IQR)	12.2 (9.9–15.1)	12.2 (10.3–15.0)	P=0.858

IQR – interquartile range; N – number of apprentices; TEWL – transepidermal water loss; OHSI – Osnabrück Hand Eczema Severity Index. P<0.05 – statistically significant difference between groups (Pearson's chi square or Fisher test for categorical variables; Mann Whitney or *t*-test for continuous variables). Significance of difference in the frequency of self-reported symptoms was tested in comparison to the control group without any self-reported symptoms or dry skin

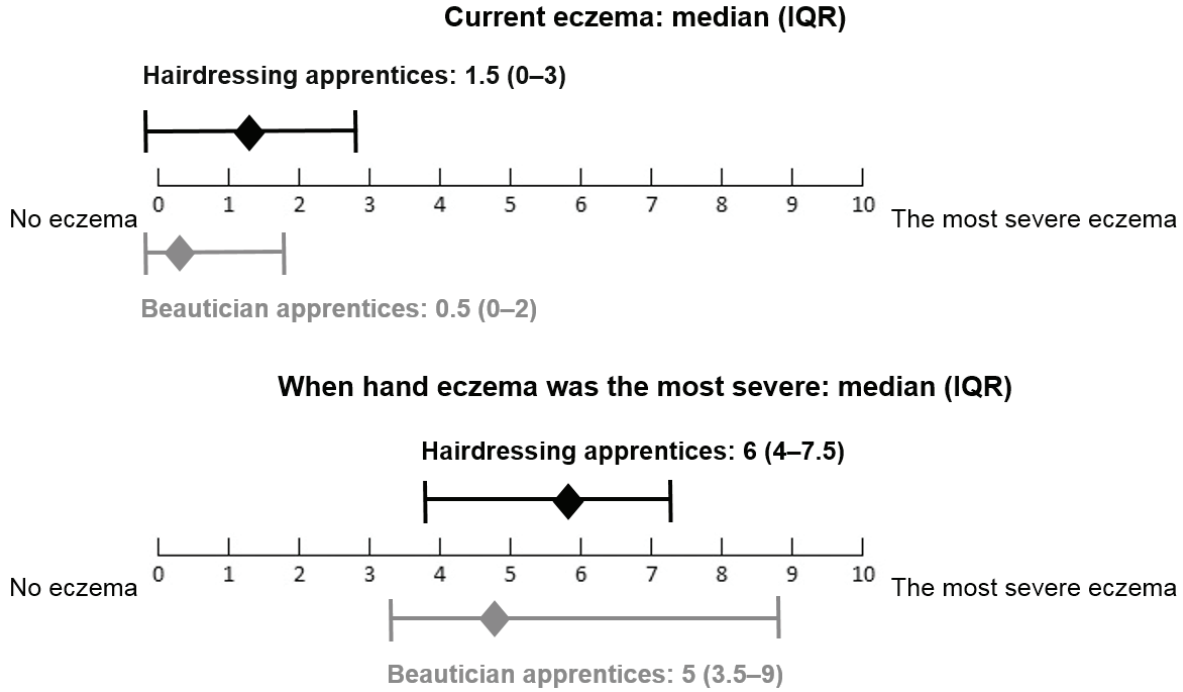

Figure 1 Self-reported ratings of hand eczema severity. The differences between the two trades in self-rated severity scores were significant (P<0.001 Mann-Whitney test) for both scales

history of hand/wrist eczema or urticarial symptoms or dry hands.

Transepidermal water loss

Hand TEWL values were slightly higher in hairdressing than beautician apprentices (Table 1), but not significantly. Washing hands more than 20 times a day was similar (Table 1) and significantly associated with higher TEWL hand values in both groups (P=0.013). Other variables were not significantly associated with TEWL (Table 2).

Among hairdressing apprentices who washed their hands >20 times a day median hand TEWL was 24.4 g/m^2/h (IQR 19.7–33.7 g/m^2/h), that is, significantly higher than 18.7 g/m^2/h (IQR 16.4–21.2 g/m^2/h) in those who washed their hands less often (Mann-Whitney test, P<0.001). Beautician apprentices who washed their hands >20 times a day had lower TEWL 18.8 g/m^2/h (IQR 15.4–23.2 g/m^2/h), which was significantly higher than the 17.6 g/m^2/h (IQR 13.4–22.8 g/m^2/h) in those who washed their hands less often (Mann-Whitney test, P<0.001). Also, hand TEWL values in hairdressing apprentices who washed their hands >20 times a day were higher than in beautician apprentices with the same habit (median, IQR: 24.4 g/m^2/h, 19.7–33.7 g/m^2/h vs 18.8 g/m^2/h, 15.4–23.2 g/m^2/h, Mann-Whitney test, P<0.001).

DISCUSSION

To the best of our knowledge, this is the first study to assess the condition of hand skin barrier among the final-year beautician apprentices and to compare them with apprentices in a similar trade. Its main finding is a poorer state of skin health and skin barrier function in hairdressing apprentices. This and the high proportion of beautician apprentices with clinically observed skin symptoms on the hands/wrists (36 %) raise the issue of their protection at work, which we shall address later.

The prevalence of self-reported symptoms in hairdresser apprentices (35 %) is similar to earlier reports in Danish hairdressing apprentices (9, 22). No such data have been reported earlier for beautician apprentices, and we hope our study will raise some concern for this trade as well. The prevalence of skin changes observed by occupational physicians in hairdresser apprentices (40 %) is somewhat lower than reported in a methodologically similar German (23) (55 %) and Danish study (22) (60 %). The reasons are open for speculation and further investigation. What we know, however, is that the prevalence of filaggrin null mutations, which increase skin susceptibility to irritation, decreases from northern to southern Europe (24). Such constitutional resistance in southern European populations, including Croatian, can alleviate the harmful effect of poor compliance to personal protective measures. Namely, unlike German and Danish studies, earlier studies of Croatian apprentices reported that they tend to not wear gloves during practical training (11, 22, 23).

Although skin changes observed in our study were mild and mostly took less severe forms, such as erythema, induration, and/or desquamation, they are the initial signs of irritant contact dermatitis and call for concern. Serious skin changes (fissures, papules, or vesicles) were uncommon in both trades, which is to be expected so early in one's career, but even so, call for more attention on hairdresser protection.

As an objective measure of impaired skin barrier function, hand TEWL did not differ significantly between hairdressing and beautician apprentices, possibly due to our small sample sizes, but hairdressing apprentices still showed

Table 2 Predictor association with hand and forearm transepidermal water loss as outcomes

	Log hand TEWL P model=0.119, adjusted R^2=0.024		**Log forearm TEWL** P model=0.303, adjusted R^2=0.007	
Predictors	**Coefficient (95 % CI)**	**P**	**Coefficient (95 % CI)**	**P**
Beautician vs hairdressing apprentices	-0.04 (-0.09–0.02)	0.218	0.04 (-0.01–0.09)	0.140
Washing hands >20 times/day	**0.08 (0.02–0.14)**	**0.013**	0.03 (-0.02–0.08)	0.257
Self-reported history of hand/wrist eczema or urticaria	0.03 (-0.04–0.10)	0.414	0.04 (-0.02–0.10)	0.161
Self-reported history of dry hands (without eczema or urticaria)	0.002 (-0.06–0.07)	0.930	0.001 (-0.05–0.06)	0.953
One or more skin changes on clinical examination	0.01 (-0.05–0.06)	0.855	0.001 (0.05–0.05)	0.974
Washing hands within 2 h before measurement	0.01 (-0.02–0.14)	0.821	0.01 (-0.04–0.06)	0.660

TEWL – transepidermal water loss; CI – confidence interval. Hand and forearm TEWL values were logarithmically transformed to achieve normal distribution of residuals. P denotes significance of association of a predictor with outcome (logarithmically transformed hand or forearm TEWL)

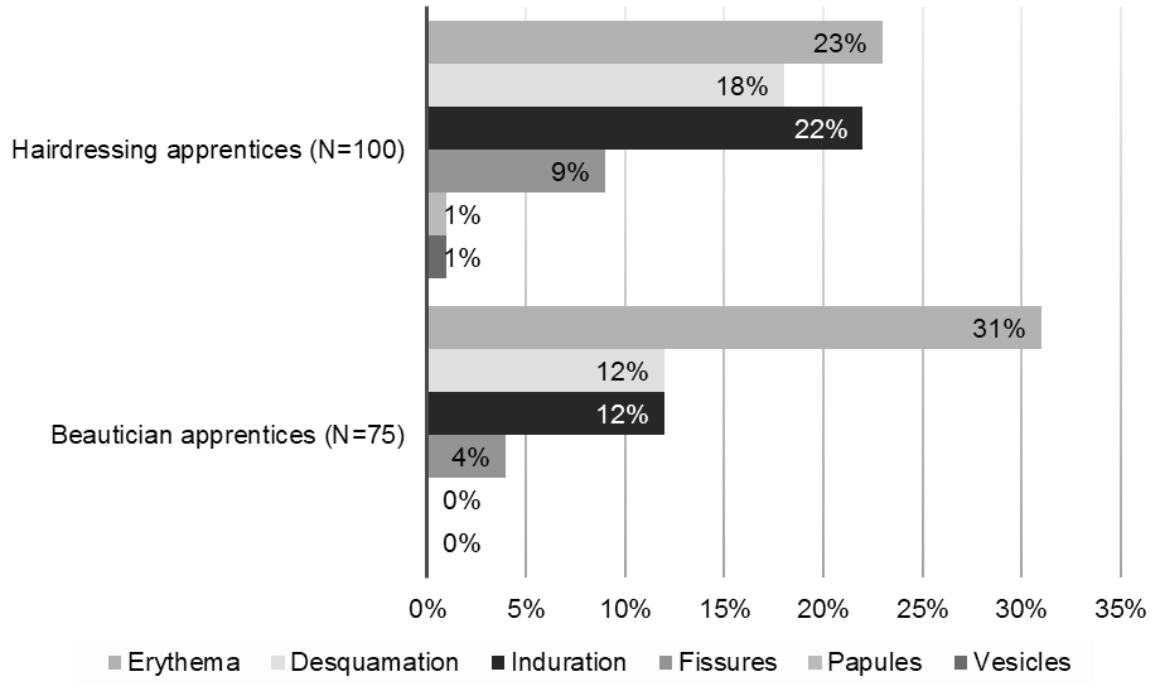

Figure 2 Skin symptoms found during clinical examination of hands/wrists. One apprentice from each group did not complete skin examination. There was no significant statistical difference in proportions of each symptom between the hairdressing and beautician apprentices

a higher trend in that respect. Future research should include larger samples to address this issue. However, TEWL did show a significant association with hand washing >20 times a day, regardless of the trade, and hairdressing apprentices who washed their hands >20 times a day had higher hand TEWL than beautician apprentices. This result indicates poorer skin barrier function in hairdresser apprentices, who are – in contrast to beauticians – exposed to various chemical skin irritants in addition to wet work. We must admit, however, that TEWL should be interpreted with caution because of variability in classroom temperatures during testing and generally higher classroom temperatures than those recommended by the TEWL probe manufacturer, which may have affected TEWL results. In addition, the reliability of TEWL in predicting skin symptom development has been disputed (25).

Altogether, our findings suggest that practice, which accounts for about half of the three-year vocational training programme in Croatia (11, 12) puts future hairdressers and beauticians at risk of early hand skin damage that may only get worse with years of work. In other words, apprentices are significantly exposed to occupational hazards from the beginning of training. Our results corroborate reports from other European studies on hairdressing apprentices (22, 23) and clearly suggest that more effort is needed to protect these students from the start. Our previous research (11) has shown that Croatian hairdressing apprentices do not recognise that exposure to water and chemicals leads to skin irritation, as only a small percentage wore gloves for hair washing and only a half wore gloves for rinsing hair dye. The use of gloves among Croatian beautician apprentices is not very common either (12). It is therefore not surprising that most apprentices of both trades reported first symptoms after enrolment to school. All this points to the need to reinforce protective measures and safety at work training from the start, wearing protective gloves in particular (26). The current COVID-19 pandemic may bring some positive change in that respect, as the awareness of the risks of infection has already changed practices in these trades and improved contact protection.

Another worrisome finding is the underestimation of skin symptoms: 21 % of beautician and 17 % of hairdressing apprentices who reported no history of skin symptoms had skin changes at medical examination. This is in line with the findings reported by Bregnhøj et al. (27) and suggests that apprentices of both trades either fail to recognise an abnormal skin condition or are reluctant to acknowledge it.

We intend to present the results of our study to the relevant authorities in hope that they will revise the current regulation (28) regarding health surveillance of workers, which at the moment does not include apprentices enrolled in vocational programmes with special working conditions. In addition, many allergenic hairdressing and cosmetic chemicals have warning labels stating that they are unacceptable for use by minors (29, 30). These include *p*-phenylenediamine and resorcinol used in hair dyes, epoxy resin in artificial nails, methyl methacrylate in nail polish, and Peruvian balsam used in massage oils. We therefore hope to encourage meaningful revision of current, but quite old regulations to ensure better safety for apprentices and young workers at risk of contact with harmful substances and to introduce health examinations prior to enrolment to

vocational training for high-risk jobs, regular health surveillance of apprentices, and better school curricula in regard to hazardous occupational exposure and safety at work.

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Zdravlje kože i funkcija kožne barijere u kozmetičarskih i frizerskih učenica

Frizerski i kozmetičarski učenici izloženi su velikom riziku od profesionalnih kožnih bolesti. Cilj rada bio je usporediti učestalost kožnih promjena i stanje kožne barijere između frizerskih i kozmetičarskih učenika na kraju stručnoga srednjoškolskoga obrazovanja. U istraživanje je bilo uključeno 76 kozmetičarskih i 101 frizerska učenica (medijan dobi 17 godina). Podatci o samoprijavljenim kožnim simptomima prikupljeni su upitnikom (*Nordic Occupational Skin Questionnaire*, NOSQ-2002), a pri kliničkom pregledu kože šaka korišten je validiran indeks (*Osnabrück Hand Eczema Severity Index*, OHSI). Transepidermalni gubitak vode (*Transepidermal Water Loss*, TEWL) izmjeren je standardnim postupkom. Rezultati su u frizerskih učenica u odnosu na kozmetičarske učenice pokazali veću prevalenciju samoprijavljenog ekcema šake/zapešća ili urtikarije (35 % vs 25 %, *P*=0,041), procjenu značajno težeg samoprijavljenog ekcema kože šaka (za trenutni ekcem medijan (raspon) 1,5 (0–8) vs 0,5 (0–4), *P*<0,001) te više vrijednosti TEWL-a na koži šaka u učenica koje su prijavile da peru ruke >20 puta na dan [medijan (interkvartilni raspon): 24,4 (19,7 – 33,7) g/m^2/h vs 18,8 (15,4 – 23,2) g/m^2/h; P<0.001)]. Osim toga, u frizerskih su učenica kliničkim pregledom kože šaka utvrđeni teži simptomi, a većina (83 %) prijavila je pogoršanje ekcema tijekom stručne prakse, u odnosu na 38 % kozmetičarskih učenica. Zaključno, rezultati sugeriraju da je potrebno uložiti više napora u obrazovanje u području zaštite zdravlja kože na radnom mjestu, što bi trebalo biti prilagođeno profesiji.

KLJUČNE RIJEČI: ekcem šaka; profesionalne bolesti kože; strukovno obrazovanje; transepidermalni gubitak vode; zaštita na radu