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SENSITIZATION TO OCCUPATIONAL ALLERGENS IN HAIRDRESSING APPRENTICES DIAGNOSED ALREADY BEFORE ENTERING VOCATIONAL TRAINING

UCZULENIE NA ALERGENY ZAWODOWE WŚRÓD UCZNIÓW FRYZJERSKICH
PRZED ROZPOCZĘCIEM PRAKTYCZNEJ NAUKI ZAWODU

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ABSTRACT

Background: Hairdressers are occupationally exposed to many allergenic and irritating substances. Additionally, hairdressing apprentices are exposed to the same allergens as professional hairdressers, due to the fact that vocational training starts in the beginning of the education. This study was undertaken to investigate early occurrence of sensitization to occupational allergens in hairdressing apprentices before the onset of the vocational training. **Material and Methods:** Three hundred and seven hairdressing apprentices were assessed using a questionnaire and skin prick tests (SPTs) to common and occupational allergens. The level of total and serum specific immunoglobulin E (IgE) to occupational allergens was evaluated and spirometry was performed. **Results:** At least one skin and/or respiratory and/or conjunctival symptom was reported by 29.9% of subjects. Among subjects with at least one symptom, 28.2% of them were atopic whereas among 43.4% of them total IgE level was elevated. Atopy was found in 20% cases. In the case of one apprentice, positive SPT for paraphenylenediamine was found. Nearly 33% of apprentices had elevated total IgE level and 5 of them had specific IgE for occupational allergens. **Conclusions:** The study revealed that hairdressing apprentices might be sensitized to occupational allergens even before the beginning of vocational training, due to prior non-professional exposure to hairdressing agents. Furthermore, many of them report skin, respiratory and conjunctival symptoms, often connected with chronic disease diagnosis. Thus, candidates for hairdressers should be examined thoroughly before the start of the education and tests for allergy to hairdressing substances are indicated. *Med Pr 2016;67(5):567–575*

Key words: vocational training, hairdressers, professional exposure, apprentices, occupational allergens, hairdressing allergens

STRESZCZENIE

Wstęp: Praca w zawodzie fryzjera związana jest z narażeniem na wiele substancji o działaniu alergizującym i drażniącym. Uczniowie fryzjerscy są narażeni na te same alergeny co fryzjerzy profesjonalni, ponieważ praktyczna nauka zawodu zaczyna się na początku nauki w szkole zawodowej. Celem badania było wykrycie uczulenia na alergeny zawodowe u uczniów fryzjerskich obecnego u nich przed rozpoczęciem praktyk zawodowych. **Materiał i metody:** U 307 uczniów fryzjerskich przeprowadzono badania kwestionariuszowe i spirometryczne, punktowe testy skórne (PTS) z pospolitymi aeroalergenami i alergenami zawodowymi. Oznaczono też poziom całkowitej immunoglobuliny E (IgE) i swoistych IgE dla alergenów zawodowych w surowicy krwi. **Wyniki:** Występowanie przynajmniej jednego objawu ze strony skóry i/lub układu oddechowego, i/lub spojówek zgłosiło 29,9% badanych. Wśród 28,2% z nich stwierdzono atopię, a u 43,4% podwyższony poziom całkowitej IgE. W całej grupie badanej atopia występowała u 20% uczniów, a podwyższony poziom całkowitej IgE u 32,8%. U 1 osoby stwierdzono dodatnie wyniki PTS dla parafenylendiaminy, a u 5 osób obecność swoistych IgE dla fryzjerskich alergenów zawodowych. **Wnioski:** Badanie wykazało, że uczniowie fryzjerscy mogą być uczuleni na alergeny zawodowe już przed rozpoczęciem praktycznej nauki zawodu, co jest związane z dużą pozazawodową ekspozycją na alergeny fryzjerskie. Ponadto wielu z nich jeszcze przed ekspozycją zawodową zgłasza dolegliwości ze strony skóry, układu oddechowego i spojówek, co jednak często wynika z wcześniej rozpoznanych chorób przewlekłych. Z tego powodu ważne jest przeprowadzanie wnikliwych badań, w tym testów alergologicznych, wśród kandydatów do szkół fryzjerskich przed rozpoczęciem przez nich nauki. *Med. Pr. 2016;67(5):567–575*

Słowa kluczowe: szkolenie zawodowe, fryzjerzy, narażenie zawodowe, uczniowie, alergeny zawodowe, alergeny fryzjerskie

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Received: April 20, 2015, accepted: March 22, 2016

INTRODUCTION

Hairdressing is one of the most common and developing service industry in Poland. According to the Polish Educational Information System (System Informacji Oświatowej – SIO) in 2004 only 14 000 hairdressing apprentices were registered in Poland whereas in 2012 over 23 000 young people were being trained in this profession. Hairdressers are occupationally exposed to many substances, both allergenic and irritating and the continuous development of this kind of services brings about new risks. Hairdressing apprentices are exposed to the same allergens as professional hairdressers, due to the fact that vocational training starts in the beginning of the education [1].

There are some studies indicating that apprentices exposed to some allergens at work (e.g., bakers, animal breeders, grain workers, etc.), who are thence at risk of allergic diseases, may develop health disorders very early, even during their occupational training [2–4]. However, Walusiak et al. indicates that almost 2% of examined baker apprentices were sensitized to bakers' allergens when they started the occupational training [2]. While bakers are generally exposed to high molecular weight (HMW) agents [2], hairdressers' occupational allergens are mainly low molecular weight (LMW) substances, contained in dyes, bleachers and other preparations [5].

High prevalence of hairdressing cosmetics may suggest that young people might have developed the sensitization to these allergenic agents before the vocational training starts [1,6]. Furthermore, symptoms of allergic diseases, that have been diagnosed before the onset of the apprenticeship, may deteriorate due to irritating and/or allergenic substances [7].

The study has been scheduled as a prospective one. The evaluation of apprentices has been planned to be performed on the entry to vocational training (stage 0), after the first year (stage I), the second year (stage II) and in the third year (stage III) of vocational training. The aim of this paper is to investigate early occurrence of sensitization to occupational allergens in the case of hairdressing apprentices before the onset of the vocational training for further follow up observations.

MATERIAL AND METHODS

Study group

The study population consists of hairdressing apprentices attending the vocational training school located in Łódź, central Poland, in the beginning of the first year of their training. The recruitment was done in the last week of the summer holidays, during the parent–teacher meetings. All first-year apprentices attending the school were invited to take part in the study (379 subjects) and were asked to deliver written informed consents to participation in the study signed both by the participants themselves and their caretakers, what was done by 321. Upon the agreement of the management board of the school, days of examination were established and announced in the school. On these days a group of research workers from the Nofer Institute of Occupational Medicine (Łódź, Poland), comprising an occupational medicine physician, 3 laboratory workers and a nurse, came to the school and conducted the examinations. The testing had been run in the first week of the education, before the vocational training started. Eventually, 307 apprentices (81% participation rate) entered into the study.

Questionnaire

The interview with the occupational medicine physician was the first step of every examination. The subjects were administered a questionnaire that included questions necessary to collect information about the presence of skin, respiratory, and conjunctival symptoms. The following respiratory symptoms were inquired of: cough, sneezing and/or runny nose, dyspnoea on exertion and/or dyspnoea at rest. The hairdressing apprentices were also asked about suffering from any chronic disease, taking medicines, sensitizations to common allergens and drugs, that they were aware of, and family history of allergic diseases. Finally, information about smoking habits, bleaching and dyeing hair, piercing and tattoos (temporary and permanent) was acquired.

Skin prick tests

The skin prick tests (SPTs) were performed on the volar part of the forearm with a standard battery of common aller-

gens (Allergopharma, Germany, and Stallergenes, France) and allergens typical of hairdressers' working environment. Common allergens included: mites (*Dermatophagoides pteronyssinus*, *Dermatophagoides farinae*), pollens (mixed trees – alder, hazel, poplar, elm, willow, birch, oak, beech, plane; mixed grass – holcus, festuca, orchard grass, rye grass, timothy grass, bluegrass; mixed weeds – sagebrush, nettle, dandelion, narrow leaf plantain), mixed moulds and feathers (of goose, duck and hen). Occupational allergens included 0.01%, 0.1% and 1% solutions of 1.4-paraphenylenediamine (PPD) and 0.01%, 0.1% and 1% solutions of potassium peroxodisulfate. The SPTs were performed according to standardized techniques [8] and assessed after 15 min. Positive reaction was defined as a wheal diameter equal to or greater than 3 mm in the absence of a reaction to the control diluents and in the presence of positive reaction to histamine [2].

Pulmonary function tests

Lung function was measured with a calibrated portable spirometer (MicroLab ML 350, Micro Medical Ltd., Great Britain). The test was performed in a sitting position and conducted by a trained operator. The manoeuvre was repeated 3 times to select the best result. The following parameters were recorded: forced vital capacity (FVC), forced expired volume in 1 s (FEV_1) and the ratio of FEV_1 to ventilatory capacity (VC) (Tiffeneau index).

Blood sampling

Blood samples were taken to determine total immunoglobulin E (IgE) by the Phadia method (ImmunoCap-100 System, Phadia, Sweden). Total IgE level > 100 kU/l was considered as elevated. Specific serum IgE (sIgE) was evaluated using the methods of Phadia (ImmunoCap-100 System, Phadia, Sweden) and Biomedica (HY-TEC 288 Analyzer, Hycor Biomedical GmbH, USA). The IgE antibodies specific for the following occupational allergens were registered: henna (c613, Biomedica, USA), ammonium persulfate (c604, Biomedica, USA), chrome (c609, Biomedica, USA), nickel chloride (c628, Biomedica, USA), latex (k82, Phadia, Sweden), disinfectants (pax6: chloramine, formaldehyde, glutaraldehyde, phthalane anhydride, Phadia, Sweden) and formaldehyde (k80, Phadia, Sweden). Immunoglobulin E level higher than 0.350 kU/l was regarded as positive.

Diagnostic criteria

Atopy was defined by at least one positive SPT response to common allergens [1]. The subjects were classified as nonsmokers if they had never smoked daily. Ex-smokers

were those who had been smoking daily and quit smoking before the study. Smokers were those who smoked daily at the time of the study [8]. Skin diseases were recognized in subjects reporting skin symptoms (contact dermatitis, urticaria, acne symptoms, psoriasis symptoms). Recognition of respiratory disorders was based on the presence of cough, sneezing or runny nose, dyspnoea on exertion and/or dyspnoea at rest. Conjunctival symptoms were recognized in subjects reporting tearing, sore eyes, conjunctivitis. Chronic disease was defined as a non-allergic chronic disease reported by subjects, diagnosed prior to this study, who required or not required the treatment (cardiac arrhythmia, epilepsy, mental diseases, thyroid diseases, acne, psoriasis).

Three hundred and five of 307 participants did not receive any systemic or local medication. In the case of 2 subjects treatment with drugs blocking histamine H₂ receptors could not have been stopped due to chronic diseases.

Statistical analysis

Continuous variables were presented as mean values (M) ± standard deviations (SD) and the nominal variables as numbers and percentages. All the calculations were performed with the Statistica 8 Software.

The project obtained approval from the local Bioethical Commission (No. 17/2008).

RESULTS

Final outcomes of examinations of 307 apprentices (281 girls, 26 boys) were analyzed. The mean age of the study participants was 16.29±0.52 years old (range: 15–18 years).

Characteristics of the study group, information on medical and family history as well as information on habits that may affect an atopic status are shown in the Table 1.

Ninety-two subjects (29.9%) reported at least one skin and/or respiratory and/or conjunctival symptom, that had been appearing systematically, or at least once during the lifetime, due to specific agent. Analysis of reported symptoms is presented in the Table 2.

The most common in this group were skin symptoms (55.4%), and the least often dyspnoea was reported (10.8%). Thirty-seven apprentices with diagnosed chronic diseases lodged at least one symptom. Nineteen of them had an allergic disease, and 14 – non-allergic chronic disease. The relation between reported symptoms and presence of chronic disease is shown in the

Table 1. Characteristics of the studied hairdressing apprentices
Tabela 1. Charakterystyka badanych uczniów fryzjerskich

Characteristics Charakterystyka	Study group Grupa badana (N = 307) [n (%)]
Sex / Płeć	
males / mężczyźni	26 (8.4)
females / kobiety	281 (91.6)
Age [years] / Wiek [w latach]	
18	9 (2.9)
17	72 (23.5)
16	225 (73.3)
15	1 (0.3)
Smoking habits / Palenie tytoniu	
non-smokers / niepalący	157 (51.1)
current or ex-smokers / palący obecnie lub w przeszłości	150 (48.9)
Family history of atopy / Wywiad rodzinny w kierunku atopii	84 (27.4)
Hair bleaching or dying currently or in the past / Rozjaśnianie lub farbowanie włosów obecnie lub w przeszłości	233 (75.9)
Piercing (at least 1 part of body) currently or in the past / Kolczykowanie (przynajmniej 1 części ciała) obecnie lub w przeszłości	275 (89.6)
Tattoo (temporary and/or permanent) / Tatuaż (tymczasowy i/lub permanentny)	86 (28.0)
Chronic diseases / Choroby przewlekłe	50 (16.3)
respiratory allergic diseases (asthma, rhinitis, seasonal rhinitis/rhinoconjunctivitis) / alergiczne choroby dróg oddechowych (astma, alergiczny nieżyt nosa, pyłkowica)	20 (6.5)
other allergic diseases (atopic dermatitis, atopic conjunctivitis) / inne choroby alergiczne (alergiczne zapalenie skóry, alergiczne zapalenie spojówek)	7 (2.2)
skin diseases (acne, psoriasis) / choroby skóry (trądzik, łuszczyca)	14 (4.5)
other chronic diseases (cardiac arrhythmia, epilepsy, mental diseases, thyroid diseases) / inne choroby przewlekłe (zaburzenia rytmu serca, padaczka, choroby psychiczne, choroby tarczycy)	12 (3.9)

Table 2. Five of the apprentices with skin symptoms had diagnosis of atopic dermatitis, 4 subjects suffered from seasonal rhinitis/rhinoconjunctivitis, and in 4 cases skin problems were reported by apprentices with diagnosed asthma and/or allergic rhinitis. Among subjects with non-allergic chronic diseases, who reported skin symptoms, 10 suffered from acne and 3 – from psoriasis.

Dyspnoea was usually connected with diagnosis of bronchial asthma or seasonal rhinitis/conjunctivitis. As far as cough and runny nose and sneezing were concerned, asthma had been diagnosed for 5 subjects, allergic rhinitis – for 6 subjects and seasonal rhinitis – for 3 subjects. Seven apprentices with conjunctival symptoms suffered from seasonal conjunctivitis, in the case of 2 of them the diagnosis of atopic conjunctivitis had been established.

Fifty-five apprentices, who reported at least one skin, respiratory and/or conjunctival symptoms, had not had diagnosed any chronic diseases. However, 28 subjects lodged symptoms typical of seasonal rhinitis/rhinoconjunctivitis (running nose and sneezing and/or conjunctivitis repeatable annually), and 8 – contact dermatitis (skin disorders in contact to specific agent). The other reported symptoms were non-characteristic.

Twenty-six of 92 (28.2%) subjects with at least one symptom were atopic whereas in the case of 40 of them (43.4%) total IgE level was elevated.

Analysis of the relation between reported symptoms and medical, family and environmental history is presented in the Table 3. The most obvious was the relation between piercing and reported symptoms – over 90% of apprentices with each symptom had had

Table 2. Symptoms reported by studied hairdressing apprentices
Tabela 2. Dolegliwości zgłaszane przez badanych uczniów fryzjerskich

Reported symptoms Zgłaszane dolegliwości	Hairdressing apprentices Uczniowie fryzjerscy [n (%)]			
	total ogółem (N = 307)	with symptoms z dolegliwościami (N = 92)	with allergic diseases z chorobami alergicznymi (N = 27)	with chronic diseases z chorobami przewlekłymi (N = 26)
Skin symptoms / Objawy skórne	51 (16.6)	51 (55.4)	12 (44.4)	13 (50.0)
due to metal jewellery or clothes elements / spowodowane biżuterią lub metalowymi elementami ubrań	9 (2.9)	9 (9.7)	–	–
due to cosmetics / spowodowane kosmetykami	6 (1.9)	6 (6.5)	–	–
Cough / Kaszel	15 (4.8)	15 (16.3)	6 (22.2)	1 (3.8)
Runny nose and sneezing / Katar i kichanie	30 (9.7)	30 (32.6)	8 (29.6)	4 (15.3)
Conjunctival symptoms / Objawy spojówkowe	26 (8.4)	26 (28.2)	9 (33.3)	2 (7.6)
due to cosmetics / spowodowane kosmetykami	6 (1.9)	6 (6.5)	–	–
Dyspnoea / Dusznosc	10 (3.2)	10 (10.8)	7 (25.9)	2 (7.6)

at least one part of their body pierced. On the other hand, tattoos (permanent or temporary) seemed to be the least relevant factor with reference to reported skin

symptoms, conjunctival symptoms, runny nose and sneezing as well as dyspnoea and atopy – to cough and conjunctival symptoms.

Table 3. Relation between symptoms reported by studied hairdressing apprentices and data from medical and family history, and lifestyle of the respondents

Tabela 3. Zależność między dolegliwościami zgłaszanymi przez badanych uczniów fryzjerskich a danymi z wywiadu medycznego i rodzinnego oraz stylem życia badanych

Variable Zmienna	Hairdressing apprentices reported symptoms Uczniowie fryzjerscy zgłaszający dolegliwości (N = 92) [%]				
	skin symptoms objawy skórne (N = 51)	cough kaszel (N = 15)	runny nose and sneezing katar i kichanie (N = 30)	conjunctival symptoms objawy spojówkowe (N = 26)	dyspnoea dusznosc (N = 10)
Smoking / Palenie tytoniu	54.9	53.3	60.0	46.1	80.0
Hair bleaching or dying currently or in the past / Rozjaśnianie lub farbowanie włosów obecnie lub w przeszłości	82.3	60.0	83.3	80.7	70.0
Piercing (at least 1 part of body) currently or in the past / Kolczykowanie (przynajmniej 1 części ciała) obecnie lub w przeszłości	94.1	93.3	93.3	92.3	90.0
Tattoo (temporary and/or permanent) / Tatuaz (tymczasowy i/lub permanentny)	11.7	33.3	30.0	42.3	30.0
Positive family history of atopy / Pozytywny wywiad rodzinny w kierunku atopii	35.2	60.0	36.6	53.8	60.0
Atopy / Atopia	21.5	20.0	50.0	42.3	50.0
IgE > 100 kU/l	45.0	53.3	60.0	53.8	40.0

IgE – immunoglobulin E / immunoglobulina E.

Table 4. Positive skin prick test results and reporting symptoms by studied hairdressing apprentices
Tabela 4. Dodatnie punktowe testy skórne a zgłaszanie dolegliwości przez badanych uczniów fryzjerskich

Variable Zmienna	Hairdressing apprentices with SPT positive result Uczniowie fryzjerscy z dodatnim wynikiem PTS [n (%)]	
	total ogółem (N = 305)	reporting symptoms zgłaszający dolegliwości (N = 92)
At least one common aeroallergen / Przynajmniej jeden powszechny aeroalergen	61 (20.0)	26 (28.2)
Common aeroallergens / Powszechny aeroalergeny		
grass pollens / pyłki traw	32 (10.5)	6 (6.5)
trees pollens / pyłki drzew	8 (2.6)	1 (1.0)
mites / roztocza	32 (10.5)	7 (7.6)
feathers / pierze	3 (0.9)	0
moulds / pleśnie	9 (2.9)	3 (3.2)
weeds / chwasty	17 (5.5)	1 (1.0)
Occupational allergens / Alergeny zawodowe		
potassium persulfate / nadsiarczan potasu	0	0
paraphenylenediamine / parafenylendiamina	1 (0.3)	1 (1.0)

SPT – skin prick test / PTS – punktowy test skórny.

The skin prick tests were obtained from 305 apprentices. Two girls were excluded from the test due to lack of reaction to histamine. Atopy was found in 61 cases (20%). The most often causing reaction allergens were grass pollens and mites (both 10.5%) and the least often – feathers (0.9%). In the case of one apprentice positive SPT for occupational allergen – paraphenylenediamine (PPD) was found (Table 4).

Blood samples were obtained from 298 subjects. Six girls refused to undergo this test due to fear of needle. In 3 cases volume of blood collected was insufficient to perform test. Ninety-eight apprentices (32.8%) had elevated total IgE level (> 100 kU/l) and 5 of them had specific IgE for occupational allergens (Table 5). Subject No. 5 was the one with positive SPT result for PPD. The mean level of total IgE for the whole group was 82.8 ± 107 kU/l. Forty of 98 (40.8%) apprentices with elevated total IgE level reported at least one symptom.

Three hundred and three apprentices participated in pulmonary function test. Four girls refused to take part in this examination without any particular reason. Three hundred and two results of the test were taken into consideration, due to lack of cooperation with one subject. We did not observe any significant aberration in spirometry, even in the case of subjects with diagnosed asthma. The average percentage of FVC was 104.4 ± 16.3 , $FEV_1 = 106.1 \pm 17.5$, and $FEV_1/VC = 99.1 \pm 11.4$.

DISCUSSION

Many studies on apprentices exposed to occupational allergens have been published [1,4,6,7,9–13], however, the subjects had been examined after the beginning of vocational training. Only few researchers focus on atopic status and symptoms reported by young people before starting the vocational training [2]. In our study in the case of 5 apprentices specific IgE for occupational allergens were detected, and in the case of 1 – the skin prick test for paraphenylenediamine (PPD) was positive, despite the fact, that they had not started their hairdressing classes yet. Alike in bakers apprentices study of Walusiak et al., if these apprentices were examined after the beginning of their vocational training, we would probably make the assumption that they had developed their hypersensitivity during the training, and thence the incidence of sensitization attributed to occupational exposure would be overestimated [2]. In the meantime, the observed sensitization in the case of our subjects seems to be due to prior non-professional exposure to hairdressing allergens. What is even more important, sensitization to hairdressing occupational allergens is a risk factor for asthma, rhinitis and contact dermatitis, thus sensitive apprentices should be monitored exceptionally carefully [10,11,14,15–17].

Table 5. Questionnaire, skin prick test and sIgE level among the 5 hairdressing apprentices with confirmed allergy to occupational allergens
Tabela 5. Badanie ankietowe, punktowy test skórny i poziom sIgE u 5 uczniów fryzjerskich ze stwierdzonym uczuleniem na alergeny zawodowe

Variable Zmienna	Hairdressing apprentices Uczniowie fryzjerscy				
	No. nr	No. nr	No. nr	No. nr	No. nr
	1	2	3	4	5
Sex / Płeć					
males / mężczyźni				+	
females / kobiety	+	+	+		+
Reported symptoms / Zgłaszane dolegliwości	-	-	+	-	-
conjunctival symptoms / objawy spojówkowe			+		
Positive family history of atopy / Pozytywny wywiad rodzinny w kierunku atopii	-	-	-	+	+
Current or ex-smoker / Palący obecnie lub w przeszłości	+	-	-	-	-
Hair bleaching or dying currently or in the past / Rozjaśnianie lub farbowanie włosów obecnie lub w przeszłości	+	+	+	-	+
Piercing (at least 1 part of body) currently or in the past / Kolczykowanie (przynajmniej 1 części ciała) obecnie lub w przeszłości	+	+	+	-	+
Tattoo (temporary and/or permanent) / Tatuż (tymczasowy i/lub permanentny)	+	+	-	-	-
Atopy / Atopia	-	-	+	+	+
Positive SPT for occupational allergen (PPD and/or potassium peroxodisulfate) / Dodatni PTS dla alergenu zawodowego (PPD i/lub nadsiarczan potasu)	-	-	-	-	+
Total IgE level / Poziom całkowitej IgE [kU/l]	152.30	149.00	444.00	307.90	128.00
sIgE level [kU/l] / Poziom sIgE [kU/l]					
henna concentration (class) / henna (klasa)	0.65 (1)	-	0.53 (1)	-	-
ammonium persulfate (class) / nadsiarczan amonu (klasa)	0.56 (1)	-	-	-	0.60 (1)
latex (class) / lateks (klasa)	-	-	0.96 (2)	1.10 (2)	-
chrome (class) / chrom (klasa)	0.59 (1)	-	-	-	-
nickel chloride (class) / chlorek niklu (klasa)	-	0.91 (2)	-	-	-
formaldehyde (class) / formaldehyd (klasa)	-	26.40 (4)	-	-	-
disinfectants / środki odkażające	+	+	-	-	-

PPD – paraphenylenediamine / parafenylendiamina, sIgE – specific immunoglobulin E / swoista immunoglobulina E.

“+” – positive result / wynik dodatni, “-” – negative result / wynik ujemny.

Other abbreviations as in Table 3 and 4 / Inne skróty jak w tabeli 3 i 4.

The specific sensitization to some allergens may be related to lifestyle habits and attitudes. Two apprentices with presence of specific IgE for agents contained in hair dyes and bleaches (PPD, ammonium persulfate) had already had their hair colored. In the whole study group, 233 subjects (75.9%) had dyed or bleached their own hair – currently or in the past, however we expect that this percentage will increase during the next years of education. Bregnhøj et al. revealed that significantly more

hairdressing apprentices had dyed their hair at the beginning of their education, the apprentices were younger at the time of their first dye use and dyed their hair more times per year than the matched control group [1]. Having a significant occupational exposure to hair dye chemicals, hairdressing apprentices may have a higher (in comparison to general population) frequency of skin [14] and respiratory [15] disorders that may develop very early, even during their apprenticeship [2–4].

The risk of developing severe skin allergic symptoms caused by PPD is higher if one exposed to hair dyes had also had a semi-permanent tattoo [14]. Paraphenylenediamine may be added to henna tattoos, which accelerates the dyeing process, strengthens and darkens the color and enhances the design pattern of the tattoo [16]. Several reports on exposure to temporary black henna tattoos and the development of severe allergic reactions have been published [14,16]. Our subject, allergic to PPD, had not had any tattoo, neither temporary nor permanent. She was instructed on complications, that the tattoo may cause to her. One of the two apprentices sensitized to henna, have already had a permanent tattoo (temporary tattoo twice in the past), however she did not report any skin disorders.

In this study nearly 90% of the subjects had had pierced at least one part of their body which usually was done in their childhood. It makes them more prone to either irritant and allergic dermatitis caused by nickel ions contained in the hairdressing tools, which may appear very early in their training, even after few months of occupational exposure [17]. Nine apprentices reported skin problems due to metal jewellery and/or clothes elements. They all had had at least one part of their body pierced. The subject, allergic to nickel, had had also ears, tongue and belly button pierced, which, we assume, had caused the sensitization. Krecisz et al. revealed that nickel was the most frequently sensitizing skin allergen in the hairdresser apprentices group. It is thought to be rather non-occupational sensitization, resulting from skin exposure to metal objects, such as jewellery, clothing accessories and particularly from piercing [17], however the release of nickel ions from nickel-containing tools exposed to thioglycolic acid in permanent wave solutions may also contribute to the high prevalence of sensitization in this professional group [18].

Twenty-seven of our subjects had diagnosis of at least one chronic allergic disease. Sensitization to common allergens was detected in 20% of our subjects, which is comparable to the results of another study of Polish apprentices that revealed frequency of atopy at the beginning of their training to be 19.2% [2]. Nevertheless, our outcome was much lower than for general population, where prevalence of atopy is estimated to be nearly 50% [19]. It may be due to healthy worker effect, however our results are scarce to confirm that theory unambiguously. Notwithstanding, there are a few researches that indicate, that healthy worker effect is present among hairdressing apprentices [7,20].

Ninety-two examined apprentices reported at least one symptom, 19 (20.6%) had diagnosis of chronic allergic disease, 26 (28.2%) of them were atopic and 40 (43.4%) of them had elevated total IgE level. Although researchers are consentaneous that atopy is a relevant risk factor only for these occupational allergic diseases that are caused by HMW factors [2,21,22] whereas most of hairdressers' occupational allergens are LMW substances, Leno et al. revealed that the risk of leaving the profession was approximately 20% higher for hairdressers who had suffered at some point in their lives from an atopic disease [23]. It is clear that sensitive individuals cannot be debarred from vocations with high risk of allergy, due to high prevalence of atopy in general population, as well as widespread usage of hairdressing cosmetics. However, our study indicates that screening for allergy before the onset of study may be the useful method for identifying and further monitoring such subjects.

CONCLUSIONS

The study revealed that hairdressing apprentices may be sensitized to occupational allergens even before the beginning of vocational training, due to prior non-professional exposure to hairdressing agents. Furthermore, many of them report skin, respiratory and conjunctival symptoms, often connected with chronic disease diagnosis. Thus, candidates for hairdressers should be examined thoroughly before the start of the education and tests for allergy to hairdressing substances are indicated. Equally important is to educate young people about the sensitizing agents connected with their future occupation.

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