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CHEMICAL EXPOSURE AND OCCUPATIONAL SYMPTOMS AMONG PORTUGUESE HAIRDRESSERS

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Hairdressing is predominantly a female activity, in which several chemicals are handled, some of which are known to be allergenic and potentially carcinogenic. Several epidemiological studies showed an association between occupational exposure to chemicals in hairdressing salons and skin and respiratory-tract conditions. The aim of this study were to characterize the occupational exposure to total volatile organic compounds (VOC) and ammonia (NH₃) in 50 Portuguese hairdressers' salons and to analyze the prevalence of respiratory and skin symptoms in 134 hairdressing professionals. Data indicated that internal sources of total VOC are mainly due to indoor sources, with average concentrations (1.4 mg/m³) above the Portuguese reference levels (0.6 mg/m³). Of the hairdressers' salons studied, 4% had a mean NH₃ concentration higher than Portuguese (20 ppm) and American Conference of Industrial Hygienists (ACGIH) (25 ppm) reference levels. Hand dermatitis was the occupational symptom most reported by hairdressers (50%), followed by eye irritation (43%). The results of this study suggest that hairdressers' occupational activities are linked with higher risk of developing hand and wrist/arm dermatitis and symptoms in the upper respiratory tract. The proper use of disposable gloves, hands, wrists, and arms skin monitoring, and the frequent use of moisturizers in the workplace are effective measures to prevent the occurrence of dermatitis in these professionals. Displacement ventilation and/or local exhaust with adequate air exchange rate are recommended particularly in technical areas where hairdressing chemicals are mixed.

Barbers and hairdressers are subjected to various occupational health risks. Problems such as poor posture, mechanical load on the joints, prolonged standing, longer working hours, missed meals, and not taking breaks during work, as well as being subjected to physical factors such as noise and high temperatures, are important occupational health hazards encountered (Hollund et al. 2001; Mandiracioglu et al. 2009). Hairdressing is predominantly an activity involving females and is not limited to the traditional hair washing and

cutting. Hairdressing also includes other activities such as dyeing, drying, and curling hair. In these activities, the professionals handle various chemicals, some of which are known to be allergenic or potentially carcinogenic, especially for bladder cancer (Hollund and Moen 1998; Rollison et al. 2006; Golka et al. 2008; Chua-Gocheco et al. 2008). A few of these substances stand out in terms of the amounts used, such as organic compounds, including alcohols, glycols, aldehydes, and amines (Rollison et al. 2006).

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Cosmetic products such as shampoos, creams, hair dyes, sprays, and hair conditioners that are used in barbers' and hairdressers' salons contain a range of chemicals and potentially expose professionals to *p*-benzenediamine, *o*-benzenediamine, *p*-phenylenediamine, *p*-toluenediamine, toluene-2,5-diamine, *p*-aminophenol, *m*-aminophenol, parabens, formaldehyde, methylisothiazolinones, ethanol, isopropanol, ammonia, phenols, alcohols, persulphates monoethanolamine, glyceryl monothioglycolate, ammonium thioglycolate, ammonium chloride or ammonium phosphate, hydrogen peroxide, formaldehyde, carbon dioxide, and carbon monoxide (Mandiracioglu et al. 2009). According to Tsigonia et al. (2010), the predominant volatile organic compounds (VOC) found in the salons are (1) aromatics (toluene, xylene) and esters and ketones (ethyl acetate and acetone), which are used as solvents in various beauty products; (2) terpenes (pinene, limonene, camphor, menthenol), which have a particular odor; and (3) others, like camphor, that have specific properties. Total VOC and ammonia (NH₃) are present in numerous products used by hairdressers daily. Total VOC are mainly found in air sprays, shampoos, and other products that treat and shape the hair. NH₃ is a characteristic compound of the permanent hair dyes and enables hair color enhancement.

The use of these chemicals associated with unsuitable ventilation facilities for hairdressing salons creates a hazard to the health of these professionals. Several studies showed that occupational exposure to chemicals in hairdressing salons is associated with dermal diseases (Dickel et al. 2002; Smith et al. 2002) and airway disorders (Albin et al. 2002). In this type of activity, the main routes of chemical exposure are dermal and inhalation. Another important factor associated with health problems in these professionals is inadequate personal protection.

Hairdressers have an increased risk of developing occupational skin diseases due to exposure to skin irritants and sensitizers (Lind et al. 2004; Khumalo et al. 2006). Irritant

dermatitis and eczema are the most prevalent occupational skin diseases (Doutre 2005). In addition, hairdressers are exposed to extensive wet work that results in irritant contact dermatitis, and daily skin contact with many cosmetic products containing compounds is known to produce contact allergy (Lind 2005). Hairdressing is thus considered one of the most hazardous occupations for skin (Dickel et al. 2002). Other studies have also reported health problems among barbers and hairdressers related to occupational chemical exposure (Ronda et al. 2009), manifested as allergenic and irritant effects frequently inducing respiratory tract reactions, asthma, rhinitis, and ocular diseases. It is also known that chemicals affect hairdressers' reproductive health and contribute to indoor air pollution (Mandiracioglu et al. 2009).

Based upon data from Leino et al. (1997) and Consonni et al. (2010), examining working conditions and exposures in hairdressing salons more studies is warranted with respect to adverse health risks. Following guidelines from studies in Norway (Hollund and Moen 1998; Kersemaekers et al. 1998; Hollund et al. 2001), Sweden (Lind et al. 2004; 2005), France (Mounier-Geyssant et al. 2006), and Spain (Ronda et al. 2009), the present study was undertaken to environmental monitor salon indoor air and evaluate self-reported symptoms of employees associated with their workplace, in particular the incidence of dermatitis and respiratory disorders.

METHODS

Subjects and Hairdressers Studied

One hundred and thirty-four female and male hairdressers working at 50 different hairdressing salons in Porto, Portugal, participated in the study, which was undertaken during April to September 2008. The subjects were recruited as volunteers at randomly selected salons in the center of Porto. The study included the analysis of questionnaires completed by the hairdressers, walk-through surveys of health symptoms and work and lifestyle

habits, and indoor chemical exposure to total (VOC) and ammonia (NH_3). A ventilation survey was carried out to characterize the working areas of the hairdressers' establishments. This survey evaluated the buildings' and areas' construction characteristics, ventilation systems, and materials used for finishing.

Questionnaires

Hairdresser professionals were invited to fill out a health questionnaire. The questionnaire included a section devoted to demographic data, smoking status, and number of years working in the corresponding salon. The rest of the questionnaire addressed comfort and health-related complaints. The following groups of symptoms were considered: group 1 (G1), dermal irritation (hand and wrists/arms dermatitis), and group 2 (G2), mucosal irritation/upper respiratory problems (allergic rhinitis, asthma, dry throat, eye irritation, nose irritation, and sinusitis).

Occupational Monitoring

Indoor and outdoor air sampling were carried out during work time (from 9:00 a.m. to 7:00 p.m.). The measurements were performed on Saturdays, when the hairdressers are usually busy and a considerable amount of technical work takes place (Li and Lee 2003). Indoor samplers were placed in representative locations (at least 0.6 m above the floor, below the ceiling, and away from windows and doors) in three strategic areas of the hairdressers' establishments: rinsing, drying, and technical areas. The total VOC samplers were placed in all of the three strategic hairdressing areas, sampling during 45 min at each site using duplicates and one blank per site. The NH_3 samplers were placed only in technical areas (storage and handling of the hair dye mixtures and performing area of dye hair application) for 30 min. Total VOC air samples were also collected outside of each hairdresser salon to compare outdoor and indoor contaminant levels.

Total VOC were collected on TENAX GR tubes using a personal air sampling pump at a flow rate of 0.05 L/min. Analyses were performed by automatic thermal desorption

coupled with gas chromatography (GC) using Perkin Elmer equipment (ATD 400 and AutoSystem GC fitted with flame ionization detector and one apolar column) according to ISO 16000-6:2004. Total VOC were quantified using the toluene response factor; the concentration was calculated as the sum of concentrations of identified and unidentified compounds eluting between hexane and hexadecane (included), expressed as toluene. NH_3 levels were measured using a portable monitor of direct reading static sampler with electrochemical sensor (TETRA—CROWCON). After equipment stabilization, reading values were registered and transferred to an informatics system using PCLogger software.

Data Analysis

The values of the monitored parameters were compared with the current evaluation criteria: (1) total VOC: 0.6 mg/m³ (Portuguese reference level-Decree-Law No. 79/2006 of April 4th), and (2) NH_3 , 20 ppm (Portuguese reference threshold limit value-time weighted average [TLV-TWA] - Decree-Law No. 305/2007 of August 24th) and 25 ppm (American Conference of Industrial Hygienists [ACGIH] TLV-TWA reference).

RESULTS

Building Characteristics and Environmental Monitoring

The 50 evaluated hairdressers' salons had a mean area of 71 m² with an average staff occupation of 3 hairdressers. While salons often had open windows (62%), 20% had mechanical ventilation systems and 62% had air conditioning. Table 1 illustrates the results of the chemical environmental monitoring completed at the 50 hairdressers' salons participating in the study, compared with the national reference values for each parameter and the results obtained for outdoor monitoring.

Of the 50 hairdressers studied, 66% have a mean total VOC concentration above the reference value in the legislation (0.6 mg/m³) and 4% have a mean NH_3 concentration higher than the TLV-TWA Portuguese reference

TABLE 1. Environmental Monitoring Results of the 50 Hairdresser Salons Studied

	Number of samples	Reference values	Indoor ^a	90th Percentile value, indoor	90th Percentile value, outdoor ^a
TVOC (mg m ⁻³)	293	0.6	1.4 ± 1.2 (0.02–4.7)	3.3	0.4 ± 0.5 (0.03 – 2.5)
NH ₃ (ppm)	2.585	20	2.3 ± 2.2 (0.01–316.6)	3.0	—

^aMean ± SD (min–max).

(20 ppm) and ACGIH reference (25 ppm). A number of reasons may explain the range of concentrations found including number of clients, characteristics of rinsing, cutting, drying and technical work, and number of employees working and applying products simultaneously. The total VOC mean concentration (1.4 mg/m³) is 2.3-fold higher than the reference value (0.6 mg/m³) (Table 1). In contrast, NH₃ mean concentration (2.3 ppm) is about 9-fold lower than the TLV-TWA reference value (20 ppm) (Table 1). These values may be correlated with current use of low NH₃ hair dyes.

The mean levels of total VOC on the three studied indoor areas were approximately four-fold higher than mean outdoor levels. The comparison between indoor and outdoor concentrations indicates indoor sources of total VOC (Figure 1), such as spray lacquers, dyes, and shampoos applications. The total VOC

mean concentration of each assessed area is about twofold (rinsing 1.3 mg/m³, drying 1.4 mg/m³, and technical 1.5 mg/m³) above the reference value in the Portuguese legislation (0.6 mg/m³).

Occupational Symptoms and Work Environment

The demographic characteristics and the occupational and lifestyle data of the studied population are presented in Table 2. In agreement with previous studies, the results in Table 2 show a predominance (90%) of female hairdressers. The average work years of the studied population was approximately 13 years. Thus, it is important to recognize the potential harmful effects to the health of these professionals. Most hairdressers (71%) reported that they used gloves as personal

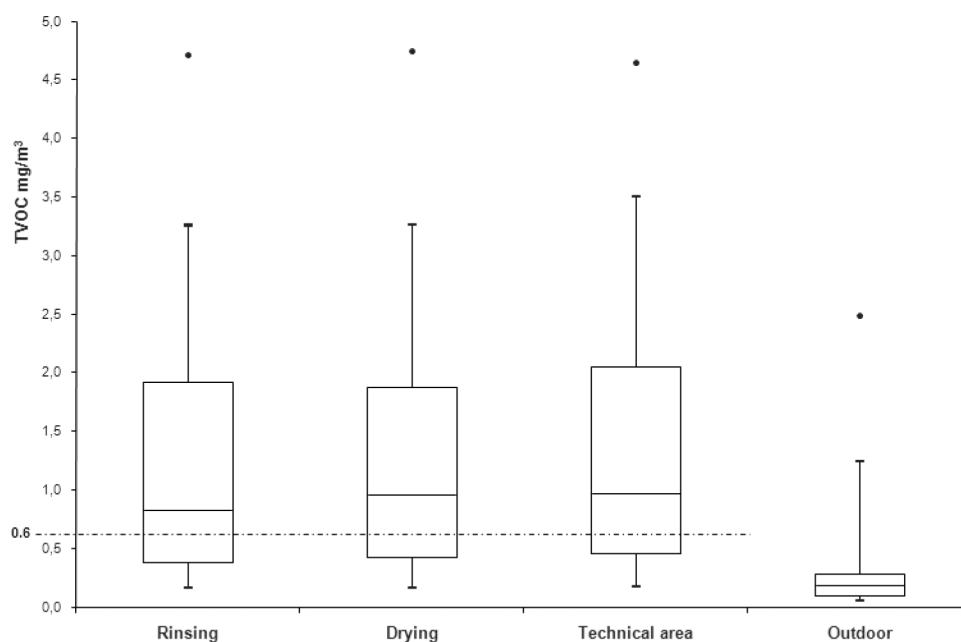
**FIGURE 1.** Box plot showing TVOC indoor and outdoor concentrations (— median; ● outlier; - - - reference level).

TABLE 2. Demographic Characteristics and Occupational Lifestyle Data

Age (yr) ^a	34.6 ± 9.0 (17–62)
Gender (%)	
Female	90
Male	10
Smoking status (%)	
Smokers	27
Nonsmokers	73
Time working in hairdresser (yr) ^a	12.9 ± 9.4 (1–49)
Wear PPE (gloves) (%)	71

^aMean ± SD (min–max).**TABLE 3.** Percentage of Hairdressers Reporting Health Symptoms due to Work

Symptoms	%
Allergic rhinitis	21
Asthma	17
Dry throat	29
Eye irritation	43
Hand dermatitis	50
Nose irritation	37
Sinusitis	21
Wrist/arms dermatitis	21

protective equipment (PPE) when dyes and other products were handled and applied in technical work such as coloring, bleaching, rippling, and straightening, and also in shampooing.

The results obtained for the health questionnaire are summarized in Table 3. A relatively high number of hairdressers reported hand dermatitis (50%) and eye (43%), nose (37%), and throat irritation (29%) due to the work environment. When we classified the health symptoms reported by hairdressers in two groups, the results show G1 dermal irritation 56% and G2 mucosal irritation/upper respiratory problems 44%.

DISCUSSION

At present, there is a need to assess the health impacts of occupational exposure in the hairdressing sector. It is necessary to promote the continuous improvement of regulatory mechanisms, legislation, and good practice at work, with the aim of finding solutions for a better indoor environment, greater productivity, and better welfare of professionals.

The design and the scope of the study reported here were limited by the available budget and time.

Our group of hairdressers had a highly variable exposure to total VOC (0.02–4.7 mg/m³), and in 66% of the studied hairdressing salons the recommended reference value was exceeded, indicating that, for this group of workers, total VOC exposure was higher than the reference values, which may be correlated with respiratory self-reported symptoms seen in the hairdressers. Several studies in different countries like Finland (Leino et al. 1999), Sweden (Albin et al. 2002), the United States (Akpinar-Elci and Elci 2002), China (Gan et al. 2003), Italy (Moscato et al. 2005), the United Kingdom (Cherrie et al. 2007), France (Tossa et al. 2009), and Spain (Ronda et al. 2009) also showed high total VOC exposures in hairdressing salons, especially when mixtures for dye-based inks were handled. Total VOC are known to produce adverse health effects at the level of the respiratory and central nervous systems. Leino et al. (1997) demonstrated an increased prevalence of upper and lower respiratory symptoms among hairdressers. Hairdressing allergenic and irritant total VOC are the likely basis to explain the difference found in respiratory symptoms between hairdressers and the general population. Occupationally related reasons need to be considered when a hairdresser presents with airway symptoms. Ronda et al. (2009) noted that airway exposure was higher for several chemical compounds when hair dyeing was performed. It is well known that occupational asthma and bronchitis are systematically reported due to inhalation of total VOC in hairdressing salons, and therefore correctly sized ventilation and local exhaust systems are advised.

Unlike total VOC concentrations, NH₃ concentrations were lower than reference values in most studied hairdresser's salons. Nevertheless, concentration outliers were often found when hair dyeing was performed. This is in agreement with previous studies on hairdressers' salons (Hollund and Moen 1998; Ronda et al. 2009).

Mixtures of dye with other hair treatment products, the absence of use of disposable gloves to perform technical work, and frequent contact with water (wet work) (Uter et al. 1995) are causes for the incidence of self-reported dermatitis. Lind et al. (2005) observed that the skin of hairdressers is exposed to allergenic compounds during dyeing. This exposure occurs from dye application, from cutting newly dyed hair, and from background exposure. Iorizzo et al. (2002) conducted patch tests in a population of hairdressers, and both glyceryl monothioglycolate and ammonium persulfate were significant components of positive patch tests.

In this study more than half of the hairdressers population (71%) reported the use of gloves in the health questionnaire. Nevertheless, during the monitoring it was found that several hairdressers used their gloves incorrectly or did not use them at all. An example is the repeated use of disposable gloves, which were often turned inside out and reused or worn until they were torn. This contributes to the prevalence of dermal symptoms reported in our health questionnaires. Lodi et al. (2000) found prevalence evidence of contact dermatitis in women, in particular those who were hairdresser professionals (69%). Studies in Italy (Lodi et al. 2000; Iorizzo et al. 2002), Germany (Dickel et al. 2002), the United Kingdom (Shum et al. 2003), Sweden (Lind et al. 2004), France (Doutre 2005), South Africa (Khumalo et al. 2006), and Canada (Chua-Gocheco et al. 2008) reported higher incidence of allergic and contact dermatitis in studied hairdressers populations, relating such symptoms to the repeated use of hairdressing products, including long-lasting coloration dye with higher quantities of NH_3 and total VOC.

From our study one can conclude that hairdressers run a high risk of developing occupational dermatitis, as either irritant contact dermatitis or allergic contact dermatitis, or often a combination of both. Product substitution is not the only way to prevent contact dermatitis in hairdressers. The use of proper PPE, including disposable nonlatex gloves and hand moisturizer, prevents and reduces the

symptoms associated with dermatitis. Nonlatex gloves (HSE 2010) may be used to prevent exposure to wet work and allergens. Another way to reduce dermal contact with hair dyes is to alter the work routines—for instance, by cutting the hair before dyeing, and reducing background exposure.

CONCLUSIONS

To our knowledge, this is the first study conducted in Portugal to evaluate the professional hairdressers' exposure to indoor air chemical agents in salons. The results obtained in environmental monitoring are likely to be linked to dermal and respiratory symptoms reported by employees. The dermal symptoms, including hand, wrist, and arms allergic and contact dermatitis, are prevalent in this professional population. This higher incidence is consistent with data available in the literature concerning health and safety of these occupational professionals.

The results of the present study suggest that self-reported respiratory and dermal symptoms of hairdressers are consequences of frequent occupational exposure to several chemical mixtures, even in small quantities. Moreover, the "work intensity" (Akpinar-Elci and Elci 2002) is considered a risk factor in this profession, enhancing dermal and respiratory diseases. The study provides some further insights into the characterization of prevalence of dermal and respiratory symptoms among hairdressers. Hairdressers are at increased occupational risk of developing hand and wrist/arm dermatitis and symptoms in the upper respiratory tract. Advising, training, and promoting the employment of personal protective equipment are essential to improve the working conditions of professional hairdressers. Furthermore, this study can be expanded with further developments, such as gathering more information about the chemicals applied in the salons, VOC specification, and effects on human health, and comparing the health symptoms reported by hairdressers' workers to a different activity control group.

REFERENCES

- Albin, M., Rylander, L., Mikoczy, Z., Lillienberg, L., Dahlman Hoglund, A., Brisman, J., Toren, K., Meding, B., Kronholm Diab, K., and Nielsen, J. 2002. Incidence of asthma in female Swedish hairdressers. *Occup. Environ. Med.* 59: 119–23.
- American Conference of Governmental Industrial Hygienists. 2008. TLVs and BEIs Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. ACGIH, Cincinnati, Ohio.
- Akpinar-Elci, M., and Elci, O. C. 2002. Importance of work intensity on respiratory problems in hairdressers. *Occup. Environ. Med.* 59: 649–50.
- Chua-Gocheco, A., Bozzo, P., and Einarson, A. 2008. Safety of hair products during pregnancy: personal use and occupational exposure. *Can. Family Physician* 54: 1386–88.
- Consonni, D., De Matteis, S., Lubin, J., Wacholder, S., Tucker, M., Pesatori, A., Caporaso, N., Bertazzi, P., and Landi, M. 2010. Lung cancer and occupation in a population-based case-control study. *Am. J. Epidemiol.* 171: 323–33.
- Decree-Law No. 79/2006 of April 4th, Annex VII - Reference concentration levels of indoor pollutants within the existing buildings. DR I Série A n.º 67 of 4th April 2006, Ministry of Public Works, Transport and Communications.
- Decree-Law No. 305/2007 of August 24th - Annex: Limit values to occupational exposure chemicals. DR I Série n.º 163 of 24th August 2007, Ministry of Labour and Social Solidarity.
- Dickel, H., Kuss, O., Schmidt, A., and Diepgen, L. T. 2002. Impact of preventive strategies on trend of occupational skin disease in hairdressers: Population based register study. *Br. Med. J.* 324: 1422–23.
- Doutre, M. S. 2005. Occupational contact urticaria and protein contact dermatitis. *Eur. J. Dermatol.* 15: 419–24.
- Gan, H. F., Meng, X. S., Song, C. H., and Li, B. X. 2003. A survey on health effects in a human population exposed to permanent-waving solution containing thio-glycolic acid. *J. Occup. Health* 45: 400–4.
- Golka, K., Heitmann, P., Gieseler, F., Hodzic, J., Masche, N., Bolt, H. M., and Geller, F. 2008. Elevated bladder cancer risk due to colorants—A state-wide case-control study in North Rhine-Westphalia, Germany. *J. Toxicol. Environ. Health A* 71: 851–55.
- Health and Safety Executive (HSE), United Kingdom. 2010. *Hairdressing*. Available at: <http://www.hse.gov.uk/hairdressing/index.htm> (accessed 17 May 2010).
- Hollund, B. E., and Moen, B. E. 1998. Chemical exposure in hairdresser salon: Effect of local exhaust ventilation. *Ann. Occup. Hyg.* 42: 277–82.
- Hollund, B. E., Moen, B. E., Lygre, S. H., Florvaag, E., and Omenaas, E. 2001. Prevalence of airway symptoms among hairdressers in Bergen, Norway. *Occup. Environ. Med.* 58: 780–85.
- Iorizzo, M., Parente, G., Vincenzi, C., Pazzaglia, M., and Tosti, A. 2002. Allergic contact dermatitis in hairdressers: Frequency and source of sensitisation. *Eur. J. Dermatol.* 121: 179–82.
- International Organization for Standardization. 2004. *ISO 16000:2004, Indoor air—Part 6: Determination of volatile organic compounds in indoor and test chamber air by active sampling on Tenax TA sorbent, thermal desorption and gas chromatography using MS/FID*. http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=30147
- Kersemaekers, W. M., Verheijen, N., Kromhout, H., Roeleveld, N., and Zielhuis, G. A. 1998. Assessment of exposure to solvents among hairdressers: Reliability of a classification scheme and questionnaire. *Occup. Environ. Med.* 55: 37–42.
- Khumalo, N. P., Jessop, S., and Ehrlich, R. 2006. Prevalence of cutaneous adverse effects of hairdressing: A systematic review. *Arch. Dermatol.* 142: 362–64.

- Leino, T., Tammilehto, L., Luukkonen, R., and Nordman, H. 1997. Self reported respiratory symptoms and diseases among hairdressers. *Occup. Environ. Med.* 54: 452–55.
- Leino, T., Kähkönen, E., Saarinen, L., Henriks-Eckerman, M. L., and Paakkulainen, H. 1999. Working conditions and health in hairdressing salons. *Appl. Occup. Environ. Hyg.* 14: 26–33.
- Li, E., and Lee, S. C. 2003. Occupational exposure of hairdressers to air pollutants in Hong Kong. *Proceedings Book Healthy Buildings: Other indoor pollutants*, 188–94. *Proceedings Book of Healthy Buildings 2003*, 7th International Conference Energy-Efficient Healthy Buildings, Singapore, December 7–11 2003.
- Lind, M. L., Boman, A., Sollenberg, J., and Meding, B. 2004. A method for assessing occupational dermal exposure to permanent hair dyes. *Ann. Occup. Hyg.* 48: 533–39.
- Lind, M. L., Boman, A., Sollenberg, J., Johnsson, S., Hagelthorn, G., and Meding, B. 2005. Occupational dermal exposure to permanent hair dyes among hairdressers. *Ann. Occup. Hyg.* 49: 473–80.
- Lind, M. L. 2005. Dermatitis in hairdressers as a problem in chemical control. *Ann. Occup. Hyg.* 49: 457–59.
- Lodi, A., Mancini, L. L., Ambonati, M., Coassini, A., Ravanelli, G., and Crosti, C. 2000. Epidemiology of occupational contact dermatitis in a North Italian population. *Eur. J. Dermatol.* 10: 128–32.
- Mandiracioglu, A., Kose, S., Gozaydin, A., Turken, M., and Kuzucu, L. 2009. Occupational health risks of barbers and coiffeurs in Izmir. *Indian J. Occup. Environ. Med.* 13: 92–96.
- Moscato, G., Pignatti, P., Yacoub, M. R., Romano, C., Spezia, S., and Perfetti, L. 2005. Occupational asthma and occupational rhinitis in hairdressers. *Chest* 128: 3590–98.
- Mounier-Geyssant, E., Oury, V., Mouchout, L., Paris, C., and Zmirou Navier, D. 2006. Exposure of hairdressing apprentices to airborne hazardous substances. *Environ. Health* 5: 26.
- Rollison, D. E., Helzlsouer, K. J., and Pinney, S. M. 2006. Personal hair dye use and cancer: A systematic literature review and evaluation of exposure assessment in studies published since 1992. *J. Toxicol. Environ. Health B* 9: 413–39.
- Ronda, E., Hollund, B. E., and Moen, B. E. 2009. Airborne exposure to chemical substances in hairdresser salons. *Environ. Monitor. Assess.* 153:83–93.
- Shum, K. W., Meyer, J. D., Chen, Y., Cherry, N., and Gawkrödger, D. J. 2003. Occupational contact dermatitis to nickel: Experience of the British dermatologists (EPIDERM) and occupational physicians (OPRA) surveillance schemes. *Occup. Environ. Med.* 60:954–57.
- Smith, H. R., Armstrong, D. K., Holloway, D., Whittam, L., Basketter, D. A., Mcfadden, J. P. 2002. Skin irritation thresholds in hairdressers: Implications for the development of hand dermatitis. *Br. J. Dermatol.* 146: 849–52.
- Tossa, P., Bohadana, A., Demange, V., Wild, P., Michaely, J. P., Hannhart, B., Paris, C., and Zmirou-Navier, D. 2009. Early markers of airways inflammation and occupational asthma: Rationale, study design and follow-up rates among bakery, pastry and hairdressing apprentices. *BioMed Central Public Health* 9: 113.
- Tsiongia, A., Lagoudi, A., Chandrinou, S., Linos, A., Evlogias, N., and Alexopoulos, E. C. 2010. Indoor air in beauty salons and occupational health exposure of cosmetologists to chemical substances. *Int. J. Environ. Res. Public Health* 7: 314–24.
- Uter, W., Gefeller, O., and Schwanitz, H. J. 1995. Occupational dermatitis in hairdressing apprentices. Early-onset irritant skin damage. *Der Hautarzt* 46: 771–78.