La Medicina del Lavoro

Original article

Med. Lav. 2026; 117 (1): 18075
DOI: 10.23749/mdl.2026.18075

Breathing the Job: Impaired Pulmonary Function in Hairdressers due to Occupational Chemical Exposure

Zeliha Demir Giden[1], Elif Demir[2,*], Ramazan Giden[3], Hasret Yağmur Sevinç Akin[4]

[1]Harran University, Faculty of Medicine, Department of Chest Diseases, Sanliurfa, Turkey
[2]Harran University, College of Health, Department of Medical Biochemistry, Sanliurfa, Turkey
[3]Harran University, Faculty of Medicine, Department of Emergency Medicine, Sanliurfa, Turkey
[4]Harran University, College of Health, Department of Pediatric Nursing, Sanliurfa, Turkey

Keywords: Occupational Disease; Respiratory System; Hairdresser

Abstract

Background: *Hairdressers are occupationally exposed to harmful factors in the working environment and many cosmetic products. During the professional use of these products, there is exposure to many irritating, allergic, and carcinogenic chemicals, mainly through the skin and respiratory tract, and it is known that these occupational exposures are much more frequent and long-lasting than personal exposures. Hairdressing is one of the occupational groups with a high risk of respiratory diseases. In this study, we aimed to determine the extent to which the hairdressing profession affects respiratory functions.* **Methods:** *The present study included 50 people who had worked in hairdressing for at least three years, especially with hair products, had not been diagnosed with respiratory disease before this job, and did not smoke, and 50 healthy people with similar demographic characteristics. All respiratory complaints and sociodemographic information of the hairdressers were determined. Pulmonary function tests (PFTs) were performed on hairdressers and a healthy group, including FEV1, FVC, PEF, and FEV1/FVC ratio.* **Results:** *In the present study, we found that the hairdressing profession significantly increased the risk of respiratory symptoms. In addition, the increase in working hours as a hairdresser was associated with increased respiratory complaints, while hairdressers showed a statistically significant decrease in PFT values compared to the healthy group.* **Conclusions:** *Exclusion of smoking in our study reveals the occupational exposure more clearly. Our study provides additional evidence of a possible significant association between chemical exposure and increased respiratory symptom prevalence and decreased lung function.*

1. Introduction

Physical, chemical, biological, ergonomic and psychological hazards originating from the work environment adversely affect the health of the employee and cause occupational diseases and accidents. Hairdressers are periodically faced with the negative effects of various chemical and mechanical applications in the workplace by constantly working on their feet and intensively in closed environments such as hairdressers and beauty salons [1]. Thousands of chemicals are used in the production of cosmetic products. During the use of these products, there is exposure to a large number of irritant, allergic and carcinogenic potential chemicals mainly through the skin and respiratory tract. It is a known fact that occupational exposures are much more and long-lasting than personal exposures [2, 3]. The health of hairdressers is adversely affected by the chemicals they use. The products used (hair dye,

Received 20.10.2025 – Accepted 07.01.2026
*Corresponding author: Elif Demir; E-mail: e.deniz63@hotmail.com

hair spray, permanent oils, bleaching agents, shampoo, etc.) and workplace working conditions (dust, smoke, vapour, cigarette smoke, etc.) lead to occupational diseases with both allergen and irritant effects especially on inexperienced workers [4-6]. Specific chemicals frequently used and reported to have adverse effects on humans include formaldehyde in hair keratin treatments and shampoos, ammonium compounds in hair colours and nail cleaners, ammonium acetate, polyvinyl and ethanol in hair sprays, persulfate salts such as sodium persulfate and potassium persulfate in hair bleaches. There are ammonium, potassium, solvents and phenylene diamine in hair dyes, glycerol thioglycolate in permanent hair curlers, styrene and 1,4 dioxane in hair extension adhesives, phthalates as fixative, hydrogen peroxide in emulsions and creams [7, 8].

The most common chemicals used by hairdressers are hair dye and hair spray. People's well-groomed and healthy hair and hair style have a positive effect on their environment. For this reason, hair dyes used by the whole society, especially women, are used routinely and unconsciously, regardless of their negative effects on human health. The cosmetic industry has had to conduct research on the development and introduction of hair dyes to meet the demands of mankind [9]. The hair dyes used today took their new form with the development and application of synthetic dyes after the Second World War [10, 11]. Although different chemicals have been used in time, paraphenylenediamine, hydrogen peroxide solution, ammonia and other chemicals in hair dyes cause skin problems by penetrating through the scalp and intoxication, various health problems and even death by oral ingestion [12].

Especially in hair keratin care procedures, which have been increasing in recent years, formaldehyde in keratin-containing solutions above certain ratios may pose a health risk. Formaldehyde is a chemical whose use in cosmetic products is restricted and can be found in products for preservative purposes at a maximum of 0.2%. Formaldehyde is a substance recognised as carcinogenic by major cancer agencies. In addition to its long-term carcinogenic effects, formaldehyde entering the body through inhalation can cause throat and eye burns and respiratory complaints. In some states of the USA, Canada and the European Union, this practice known as Brazilian Blow Drying, which contains high formaldehyde, is prohibited. Studies have shown that most of the materials used in the market contain formaldehyde either above or very close to the threshold values [13]. The study of Pierce et al. shows that the formaldehyde concentration is 11.5% in Brazilian Blowout products, 8.3% in Global Keratin products and 3% in Coppola products, while it is stated that Brazilian Keratin Teratment and similar products sold in the USA and various other countries with the label "formaldehyde free" contain formaldehyde at unacceptably high values (up to 11%) [14]. In a report prepared by the Centre of Disease Control in the USA, according to the results of a field study conducted in a hairdressing salon in Ohio, it is shown that there is almost 11% formaldehyde in products sold as formaldehyde free and that this creates very serious risks [15].

In this study, our aim is to investigate how and to what affect the chemicals in products used by hairdresser employees of Turkey have health risks and to determine how much the chemicals in the products used affect the respiratory functions of hairdresser employees as a result of long-term exposure by pulmonary function test.

2. Methods

This study was received the necessary permissions and ethics approval. The study included 50 people who had worked in hairdressers for at least 3 years, especially those who worked with hair products, did not have a diagnosis of respiratory disease before doing this job, did not smoke and passive smoke and 50 healthy people with similar demographic characteristics. The sample size was determined based on feasibility and availability, with the aim of ensuring equal numbers in both groups to increase statistical comparability. All respiratory complaints and sociodemographic information of hairdresser employees were determined. Forced expiratory first second volume (FEV1), forced vital capacity (FVC), peak flow rate (PEF) and FEV1/FVC ratio were determined in the pulmonary function tests measured with "Geratherm Spirostik Blue" mobile spirometry of the hairdresser group and the control group. These values were compared between both groups.

2.1. Statistical Analyses

A statistical analysis of the data was performed using IBM SPSS 25.0. Age, height, weight, BMI, gender, respiratory complaints, FEV1, FVC, PEF, and FEV1/FVC values were analyzed. Descriptive statistics for continuous variables with a normal distribution are reported as mean and standard deviation; for non-normally distributed variables, median and Q1–Q3 are reported. For normally distributed parameters, an independent-samples t-test was used, and for non-normally distributed parameters, a Mann–Whitney U test was used. Cohen's d was used to calculate effect size for parametric tests ($0.2 \le d < 0.5$ for minor effects, $0.5 \le d < 0.8$ for medium effects, and $d > 0.8$ for large effects), and Rank Biserial Correlation was used to calculate effect size for nonparametric tests ($0.1 \le r < 0.3 \rightarrow$ Small effect, $0.3 \le r < 0.5 \rightarrow$ Medium effect, $r \ge 0.5 \rightarrow$ Large effect). For comparisons of more than two groups, a one-way ANOVA was used for data fitting the normal distribution, and a Kruskal–Wallis test was used for data not fitting the normal distribution. Pearson and Spearman analyses were used for correlational comparisons.

3. Results

One hundred and seven hairdressers from different regions of the province were visited, and the necessary information was given. In our region, hairdressers do not routinely receive regular examinations by occupational health physicians unless they work in large registered workplaces. All participating hairdressers work in their own small workplaces. Fifty hairdressers who met our inclusion criteria and 50 healthy controls with similar demographic characteristics were included in the study. In our healthy group, people similar to the hairdresser group in terms of gender, age, height, weight, and BMI were included in the study. Demographic data of both groups are given in Table 1.

When we looked at the working years of the hairdressers, the minimum was 3 years, the maximum was 30 years, and the average was 14.41±8.06. The number of hairdressers working between 3-7 years was 15, no hairdressers were working between 8-11 years, and the number of hairdressers working between 12-30 years was 35. Ten of the hairdressers started this job as children. Among the hairdressers, 20 were primary school graduates, 24 were high school graduates, and 6 were university graduates. All hairdressers received master-apprentice training as vocational training. Officially, 27 of them received hairdressing training through apprenticeship programs at vocational training centers, eight graduated from the hairdressing department of vocational high schools, and two graduated from the Hair Care and Beauty Services department of a college. In contrast, 13 of them did not receive any formal education.

When we look at the respiratory complaints of hairdressers such as shortness of breath, wheezing, cough and sputum before and after performing this profession; hairdressers did not have these complaints before performing this profession, but after performing this profession, four people were diagnosed with asthma (The asthma diagnoses were based on previously documented medical records of participants. These diagnoses did not distinguish between allergic and irritant asthma), 1 of them was from hairdressers working between 3-7 years, the others were from hairdressers working 12 years or more. Eleven hairdressers had shortness of breath;

Table 1. Demographic data of the groups.

	Hairdressers Group (n:50)	Control Group (n:50)
Age (years, mean ± SD)	35.86±9.64	34.22±8.98
Gender (F/M)	39/11	39/11
Height (cm, mean ± SD)	162.95±8.02	166.77±7.55
Weight (kg, mean ± SD)	70.14±11.03	69.64±10.45
BMI (kg/m^2, mean ± SD)	26.41±3.27	24.93±2.66

two of them had been working between 3 and 7 years, and the others had been working 12 years or more. Six hairdressers had cough, seven had wheezing, and six had sputum complaints, all of whom had worked for 12 years or more. Four hairdressers had a runny nose, 2 of them were from hairdressers working between 3-7 years, the others were from hairdressers working 12 years or more. These complaints were found to be exacerbated by hair dyeing and colouring procedures, especially keratin application, and hair sprays sprayed during hair styling.

We found that hair salons lacked designated areas for hair dyeing, bleaching, coloring, or keratin treatments. Indoor ventilation was provided through doors, windows, pedestal fans, and air-conditioning units. Hair salons located in residential areas with higher socioeconomic status were equipped with air-conditioning-based ventilation systems. In contrast, in areas with lower socioeconomic status, ventilation was mainly achieved by keeping the salon door open or, when available, through windows. Among the 32 hair salons equipped with air-conditioning systems, only two additionally had dedicated ventilation systems designed to remove unpleasant odors, fumes, or airborne gaseous and particulate contaminants from the indoor environment. Eleven salons used pedestal fans for air circulation, while the remaining seven relied solely on natural ventilation by opening doors or windows. Although salons were generally operated in enclosed indoor environments during hair treatments, some hairdressers performed keratin treatments outdoors due to the severe discomfort caused by chemical volatiles. Based on commonly used workplace product labels in our study, the most frequently encountered chemicals were formaldehyde derivatives, ammonia, persulfates, toluene, alcohols, acids, parabens, silicone derivatives, acetone, and peroxides. No dust or chemical measurements of indoor air have ever been carried out in any of the hairdressing salons. Hairdressing salons were only inspected for hygiene during the COVID-19 pandemic. Apart from this inspection, no inspection has been carried out so far.

It was determined that hair dyeing, colouring, and keratin procedures were performed more frequently in hairdressing salons in residential centres with high socio-economic levels. In contrast, in those with low socio-economic levels, they were performed very rarely. When we asked our participating hairdressers about the frequency of the specific tasks they perform, they could not provide precise numbers. However, when we ranked the most frequently performed procedures from highest to lowest, hair dyeing came first, followed by hair bleaching and coloring, and keratin treatment came third. Regarding the use of protective safety measures in hairdressing salons, we found that they wear work clothes and gloves during hair dyeing and colouring, they wear both gloves and masks during the keratin process, but sometimes they wear work clothes, and in summer, they do not wear masks; otherwise, no protective safety measures are taken.

The FVC (expected %) value, FEV1 (expected %) value, FEV1/FVC (%) ratio, and PEF (expected %) value for both groups are given in Table 2. When we looked at the respiratory function tests that were lower limit of normal in both groups, one hairdresser had an FEV1 value of 73%, three hairdressers had an FEV1/FVC ratio between 70-80%, four hairdressers had a PEF value below 80%, 24 hairdressers had a PEF value below 70%, and 10 healthy individuals had a PEF value below 70%. When comparing the two groups, FVC, FEV1, PEF, and FEV1/FVC values were statistically significantly lower in the hairdresser group than in the healthy group. This significant difference had a large effect size in FVC and FEV1 values, and a medium effect size in FEV1/FVC and PEF values (Table 2).

Table 2. Spirometric data of the groups.

	Hairdressers Group (n:50)	Control Group (n:50)	P	Effect size
FVC (%)	84.46±16.41	98.43±11.8	0.002	0.977
FEV1 (%)	79.35±11.58	94.52±13.31	<0,001	1.216
FEV1/FVC	85.85(81.69-91.50)	93.10(88.2-97.38)	0.004	0.436
PEF (%)	46.58(39.44-60.47)	60.75(48.56-78.08)	0.014	0.372

When the groups were compared in terms of age, FVC values (p=0.005) and FEV1 values (p=0.002) of the hairdressers over 25 years of age were significantly lower than the healthy group over 25 years of age, while no statistical significance was found between the groups aged 25 years and under. When the groups were compared in terms of gender, no statistical significance was found. It was observed that respiratory complaints of hairdressers increased with increasing age and working years, but there was no correlation between PFT values and age and working years.

4. Discussion

When we look at the studies, the results we obtain are consistent with the literature. In these studies, various types of acute respiratory symptoms, as well as chronic and recurrent asthma symptoms, were detected shortly after exposure to low molecular weight chemicals in hairdressing salons [16]. In Hollund's survey of adult hairdressers, a remarkable increase in respiratory complaints related to contact with occupational chemicals was observed compared with previous years. In the data obtained, the most common complaints were 71% runny nose, 41% shortness of breath, 39% tearing, 37% wheezing, and 34% cough lasting longer than two weeks, along with 34% eczema [1]. In Moscato's study, it was found that the most common agent causing asthma was ammonium persulfate salts, and half of the 47 hairdressing patients who came with suspicion of occupational asthma were diagnosed with asthma. In contrast, the respiratory complaints in the other half were evaluated as irritative, temporary reactions to specific agents used in hairdressing salons [17]. It is reported that among occupational diseases among hairdressers, respiratory diseases are increasing [18-20]. It is stated that the rate of occupational asthma is 29% of all occupational lung diseases, and this rate will increase, especially in developing countries [21, 22]. In addition to the chemical products, the concentrations of volatile organic compounds in hairdressing and beauty centres are also substantial. Some of the volatile organic compounds that may cause occupational exposure are isopropyl acetate, ethanol, acetone, methyl and ethyl methacrylate, n-butyl acetate, ethyl acetate, 2-butane, 2-propanol, hexamethyl disiloxane, toluene, and xylene. It is stated that the effect of low-level occupational exposure to volatile organic compounds (such as ethanol, acetone, toluene, 2-propanol, 2-butanone, ethyl acetate, and n-butyl acetate) should not be ignored in the irregularities in oxidative stress and DNA damage indicators observed in beauty salon workers [23].

In this study, specifically identifying hairdressers who were non-smokers and not exposed to passive smoking was particularly challenging. This significantly reduced the number of eligible participants and resulted in a relatively small sample. Sample size will affect generalizability, but strict selection criteria have strengthened internal validity by minimizing critical confounding factors.

In our study, we were unable to measure chemical concentrations in indoor air; however, according to the hairdressers' statements, powerful, pungent odors were present, particularly during bleaching, dyeing, and keratin treatment procedures. These odors caused eye irritation and tearing, as well as nasal burning and a runny nose. In this study, we found that hairdressers' respiratory complaints increased significantly. In addition, the increase in working hours as a hairdresser was associated with an increase in respiratory complaints. When the PFT values of hairdressers were compared with those of the healthy group, a statistically significant decrease was observed: shortness of breath, cough, wheezing, and sputum complaints were more common among hairdressers who had worked for 12 years or more. While the PFT values of hairdressers over the age of 25 were much lower than those of the healthy group in the same age group, there was no significant difference between the groups aged 25 and under. According to our study, we did not observe any effect of gender. Smoking is one of the most critical factors affecting respiratory functions. The most crucial distinction between our study and others is that our study group consisted of non-smokers, non-passive smokers, and hairdressers without any prior respiratory complaints or diagnoses. Excluding these features from our study group reinforces the possibility of a causal role for occupational exposure.

5. Conclusions

As a result of this study, there is potentially high exposure from frequent use of chemical hair products, particularly during hair bleaching and coloring, and hair keratin treatments. The decrease in lung function among hairdressers may also be influenced by unmeasured factors, and longitudinal studies are definitely needed to determine causality. Our study provides clear additional evidence that there may be significant associations between the hairdressing profession and increased prevalence of respiratory symptoms and decreased lung function. This evidence suggests that insufficient attention is being paid to the occupational respiratory risks encountered in hairdressing in the developing world. The training of hairdressers and workplace preventive measures need to be updated in light of these results. Effective measures to reduce these occupational risks among hairdressers include the use of less harmful substances, as well as emphasising the use of appropriate personal protective equipment, improving salon ventilation conditions, regulating and inspecting working conditions in hairdressing salons, and periodic occupational physician evaluations for hairdressers. Safety assessments of hair products are primarily aimed at consumers, but exposure among professional hairdressers who do this work regularly is significantly higher. These data reveal that regulations for these chemicals used in hairdressing salons need to be improved. It is necessary to raise awareness among everyone, especially members of the profession, about this issue. Occupational exposure should be considered in the safety assessment of hairdressing products, and the assessment should not focus solely on consumer safety. We regret to report that none of the hair salons we surveyed had measured dust or chemical levels in their indoor air. Unfortunately, due to financial constraints, we were unable to conduct environmental monitoring and biomarker analyses in our study. This is one of the most critical limitations of the study. Air quality measurements should be undertaken frequently and monitored in hair salons. The production of the cosmetic products used must be controlled, and their contents must be inspected. The use of HEPA-filtered vacuum cleaners and HEPA-filtered air conditioners should be a priority in hairdressing salons. Finally, the adequacy of hairdressing training in terms of health and safety should be ensured and legalised.

Funding: This research was funded by Harran University (Project Number: 22291).

Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Harran University Ethics Committees. (Reference No. HRU/22.06.27).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Acknowledgments: We are grateful to all the hairdressers who participated in our study.

Declaration of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

Author Contribution Statement: Z.D.G. was involved in the design of the study, investigation, data collection, curation, interpretation, and analysis, writing- original draft, and writing – review & editing. E.D. was involved in the design of the study, investigation, data collection, curation, and analysis, writing- original draft, and Writing - review & editing. R.G. was involved in the study design, data interpretation, and writing the original draft. H.Y.S.A. was involved in data collection, writing the original draft, and review & editing. All authors have read and approved the final article.

References

1. Hollund BE, Moen BE, Lygre SH, et al. Prevalence of airway symptoms among hairdressers in Bergen, Norway. *Occup Environ Med.* 2001;58:780-5. Doi: https://doi.org/10.1136/oem.58.12.780
2. Silverman DT, Morrison AS, Devesa SS. Bladder Cancer. In: Schottenfeld D, Fraumeni JF, eds. Cancer Epidemiology and Prevention. New York: Oxford University Press 1996;1156-1179.
3. IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. Occupational exposures of hairdressers and barbers and personal use of hair colourants. In Occupational Exposures of Hairdressers and Barbers and Personal Use of Hair Colourants; Some

Hair Dyes, Cosmetic Colourants, Industrial Dyestuffs and Aromatic Amines. International Agency for Research on Cancer. IARC Monogr Eval Carcinog Risks Hum 1993;57:43118.
4. Winder C. Chemical hazards and health effects of hairdressing. *J Occup Health Safety*. Aust NZ 1993;9:359-371.
5. Hollund BE, Moen BE. Chemical exposure in hairdresser salons: effect of local exhaust ventilation. *Ann Occup Hyg*. 1998;42:277-281. Doi: https://doi.org/10.1093/annhyg/42.4.277
6. Babish JG, Scarlett JM, Voekler SE, et al. Urinary mutagens in cosmetologists and dental personnel. *J Toxicol Environ Health.* 1991;34: 197-206. Doi: https://doi.org/10.1080/15287399109531559
7. Quiros-Alcala L, Pollack AZ, Tchangalova N, et al. Occupational exposures among hair and nail salon workers: a scoping review. *Curr Environ Health Rep*. 2019;6(4):269–285. Doi: https://doi.org/10.1007/s40572-019-00247-3
8. Pak VM, Powers M, Liu J. Occupational chemical exposures among cosmetologists: risk of reproductive disorders. *Workplace Health Saf*. 2013;61(12):522–528. Doi: https://doi.org/10.3928/21650799-20131206-04
9. Yazan, Y: Cosmetic Science: (2nd Edition). Istanbul: Nobel Medical Bookstores. 2010.
10. Shahi Z, Mehrizi MK, & Hadizadeh MA review of the natural resources used to hair color and hair care products. *J Pharm Sci Res.* 2017;9(7), 1026.
11. França SA, Dario MF, Esteves VB, et al. Types of hairdye and their mechanisms of action. *Cosmetics* 2015;2(2), 110-126. Doi: https://doi.org/10.3390/cosmetics2020110
12. Palisoc S, Causing AM, Natividad M. Gold nanoparticle / hexaammineruthenium / Nafion® modified glassy carbon electrodes for trace heavy metal detection in commercial hair dyes. *Analytical Methods*. 2017;9(29), 4240-4246. Doi: https://doi.org/10.1039/c7ay01114h
13. Galli CD, Bettin F, Metra P, et al. Novel analytical method to measure formaldehyde release from heated hair straightening cosmetic products: impact on risk assessment. *Regul Toxicol Pharmacol.* 2015;72.3: 562-568. Doi: https://doi.org/10.1016/j.yrtph.2015.05.010
14. Pierce JS, Abelmann A, Spicer LJ, et al. Characterization of formaldehyde exposure resulting from the use of four professional hair straightening products. *Journal of occupational and environmental hygiene.* 2011; 8(11); 686-699. Doi: https://doi.org/10.1080/15459624.2011.626259
15. Srinivas Durgam S, Page E. Formaldehyde Exposures During Brazilian Blowout Hair Smoothing Treatment at a Hair Salon – Ohio CDC Health Hazard Evaluation Report. 2011;0014-3147.
16. Leino T, Tammilehto L, Luukkonen R, Nordman H. Self reported respiratory symptoms and diseases among hairdressers. *Occup Environ*. 1997;54:452-455. Doi: https://doi.org/10.1136/oem.54.6.452
17. Moscato G, Pignatti P, Yacoub MR, et al. Occupational asthma and occupational rhinitis in hairdressers. *Chest.* 2005;128:3590-8.10. Doi: https://doi.org/10.1378/chest.128.5.3590
18. Hakim SA, and Abdel-Hamid MA. Occupational health risks of hairdressers: knowledge, practice and self-reported symptoms. *Egypt J Occup Med.* 43.1 2019; 161-174. Doi: https://doi.org/10.21608/ejom.2019.25131
19. Heibati B, Jaakkola MS, Lajunen TK, et al. Occupational exposures and respiratory symptoms and lung function among hairdressers in Iran: a cross-sectional study. *Int Arch Occup Environ Health.* 2021;94, 877-887. Doi: https://doi.org/10.1007/s00420-020-01645-z
20. Hendrick DJ. The world wide problem of occupational asthma. *Clin Exp Allergy*. 2001;31:1-4. Doi: https://doi.org/10.1111/j.1365-2222.2001.01028.x
21. Acar OÇ, Yenigün, A. Prevalence of occupational asthma among apprentices in Aydın province. *Turkish Clinics. J Pediatr.* 2005;14:113 -1.
22. Akpinar-Elci M, Cimrin AH, Elci OC. Prevalence and risk factors of occupational asthma among hairdressers in Turkey. *J Occup Environ Med.* 2002; 44(6): 585–590.
23. Peter G, Maciej S, Magdalena BK, et al. Dysregulation of markers of oxidative stress and DNA damage among nail technicians despite low exposure to volatile organic compounds. *Scand J Work Environ Health*. 2015;41 (6):579–93. Doi: https://doi.org/10.5271/sjweh.3523

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