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Original Article

The effects of occupational chemical exposure on respiratory health among hairdressers in Pakistan

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Abstract

The work environment in a hair saloon is a continuous threat to the respiratory health of hairdressers. Therefore, we assessed the status of respiratory symptoms and pulmonary functions of hairdressers in the present study. The subjects consisted of 90 female hairdressers and 90 matched controls. Symptoms were recorded through an adapted questionnaire. Anthropometric data such as age and BMI were noted. Pulmonary function tests were performed using a portable spirometer. Work-related risk factors such as exposure duration, work intensity, work area size, and ventilation, were recorded in hair saloons. Mann-Whitney test and Spearman's rank correlation were applied to find associations between pulmonary functions and work-related risk factors. The criterion for statistical significance was a two-tailed P-value ≤ 0.05. Among the hairdressers, shortness of breath was at 32%, pharynx irritation at 31%, rhinal irritation at 29%, cough at 28%, ocular irritation at 21%, wheezing at 12%, and phlegm production at 9% higher levels than in the control group. FEV1% (p =.000) and FVC% (p =.000) were reduced in hairdressers compared to controls. Work duration and work intensity degraded the pulmonary functions, while ventilation showed a positive correlation. Precautionary measures adopted by the hairdressers were insufficient. Implementation of safety improvements, including appropriate ventilation systems, are recommended.

Keywords: pulmonary function tests, hairdressers, spirometry, lung, risk factors, respiratory health

1. Introduction

Exposure to chemicals in saloons is responsible for degradation of pulmonary functions. Chemical hazards in a hairdressing environment carry the risk of losses in pulmonary functions. Among hairdressers this can be seen in indicators such as FEV1, FVC and FEV1/FVC (Gupta, Thapa, Gupta, & Sharma, 2022). Repeated chemical exposure brings various symptoms (Ameille *et al.*, 2003; Malo & Chan-Yeung, 2001). Respiratory symptoms are common among hairdressers at work (Hiller, Greiner, & Drexler, 2022). Hairdressers are exposed to work-related air pollutants, which are responsible for airway disorders like occupational asthma, bronchitis, rhinitis, cough, and phlegm (Brisman *et al.*, 2003; Larstad & Olin 2018; Moscato & Galdi, 2006; Nemer, Kristensen, Nijem, Bjertness, & Skogstad, 2013; Nemer *et al.*, 2015; Onowhakpor, Aigbovorhiuwa, & Okojie, 2018; Quiros-Alcala, Pollack, Tchangalova, DeSantiago, & Kavi, 2019; Skoufi *et al.*, 2013).

Different activities like hair spraying, hair straightening, hair dyeing, bleaching, and so on, release irritants and sensitizing chemicals, such as ammonium compounds, hydrogen peroxide, alcohol, formaldehyde, polyvinylpyrrolidone, p-benzenediamine, toluene, ether, and henna (Akpinar-Elci, Cimrin, & Elci, 2002; Hasan & Srivastava, 2019; Mendes *et al.*, 2011; Nilsson *et al.*, 2016; Tsigonia *et al.*, 2010). These chemicals impair the lungs and provoke respiratory symptoms (Hasan & Srivastava, 2019).

In Pakistan, there are many unregistered saloons even in small houses and flats. Therefore, no official data on their numerosity is available. However, according to rough estimates, about 27% of saloons (second largest by rank) are

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established in Lahore city (State Bank of Pakistan [SBP], 2019). Therefore, this study's primary objective was to evaluate the female hairdressers' self-reported respiratory symptoms and pulmonary functional status and compare these with a matched control population, such that was not exposed to the work conditions of hairdressing. The secondary objective was to assess the impacts of work-related risk factors on pulmonary functions of the hairdressers. In the present study, the alternative hypothesis was that there are effects from occupational chemical exposure on respiratory health among hairdresser.

2. Materials and Methods

A case-control study was designed, sampling in the city of Lahore 90 female hairdressers and 90 matched controls. Collection of the workers' data was discontinued after attaining the target counts (Guest, Namey, & Chen, 2020). Subjects with a previous diagnosis of asthma or other chronic respiratory conditions, smokers, and those with job duration less than three years were excluded from the study. The participants of the control group were office employees having no particular exposure to the hairdressing environment. Controls were matched with the hairdressers in age, gender, ethnicity and BMI. Written consent to participate was taken from all subjects.

In the present study, the dependent variables were all the self-reported respiratory symptoms, and the pulmonary function indicators tested. The independent variables included were all work-related risk factors, along with age and BMI.

A questionnaire was adopted from Skoufi *et al.* (2013) to collect data on self-reported respiratory symptoms and allergies, such as cough, phlegm, shortness of breath, wheezing, ocular irritation, rhinal irritation, and pharynx irritation. This is a relatively simple way to collect data on many people quickly and at a low cost. In addition, anthropometric characteristics such as age in years (yrs) and BMI (kg/m^2) were also recorded using the same questionnaire.

The pulmonary functional status of all the participants was assessed by using a portable spirometer (Spirotron MDX, USA). Maximum volume and flow range of the device are respectively 10L and 1-16L/s. The volume accuracy is ±3% or 0.05L (whichever is greater) and the flow accuracy is ±10% or 0.3L (whichever is greater). Three readings of pulmonary function tests (PFTs) were taken as per the British Thoracic Society guidelines (British Thoracic Society [BTS], 2005) and the highest value was adopted. Spirometry was performed in a sitting position with a nose clip to avoid any leakage. The PFTs included forced vital capacity (FVC), forced expiratory volume in one second (FEV1), and the ratio FEV1/FVC. The results from the device consisted of a flow rate- volume chart, volume time chart display, and trend chart display, while all these results were interpreted per the British Thoracic Society guidelines (British Thoracic Society [BTS], 2005). All values were logged as percentages.

Physical work-related risk factors such as exposure duration, work intensity, work area size (m^2), and ventilation were also examined at the workplaces. Exposure duration was calculated according to Hashemi, Boskabady, and Nazari (2010) and categorized into low exposure (<= 12889 days) or high exposure (>12889 days). Similarly, work intensity was calculated based on the application counts of hair dyes, bleaching and hair straightening per week (Skoufi *et al.*, 2013). Work intensity was also categorized into low work intensity (≤ 32 times per weeks) and high work intensity (>32 times per weeks). Finally, the work area size was calculated to area per person in m^2. Moreover, the presence of ventilation was also noted at all studied sites. The study was approved by the ethical board of Punjab University, Lahore, Pakistan (Serial# 1880).

All statistical analyses were performed using SPSS (version 25). Normality of distribution test was run for continuous variables before running other statistical tests. Anthropometric characteristics and pulmonary functions are reported as mean ± SD, and differences of mean values between hairdressers and controls were assessed using the Mann-Whitney test. This non-parametric test was adopted since the data were not normally distributed. Spearman's rank correlation test was run to find associations between pulmonary functions and work-related risk factors. The criterion for statistical significance was a two-tailed P value ≤ 0.05.

3. Results

There were ninety female hairdressers; and ninety female office workers as a control group in the present study. There were no significant differences in age and BMI (Table 1). The prevalences of respiratory symptoms and allergies were cough 28%, phlegm production 9%, shortness of breath 32%, wheezing 12%, ocular irritation 21%, rhinal irritation 29%, and pharynx irritation 31%, which were higher among hairdressers (after work) as compared to hairdressers (before work) or to controls (Figure 1). Among the hairdressers, 20% used mask only, 39% gloves, and 19% both mask and gloves.

Table 1. Anthropometric data of hairdressers and controls*

	Hairdressers	Controls
Subjects (All females, n)	90	90
Age (mean ± SD, yr)	36.44± 8	36.02± 7
BMI (mean ± SD, kg/m^2)	23.4± 2.33	23.8± 2.10

*Matched demographic data of hairdressers and controls

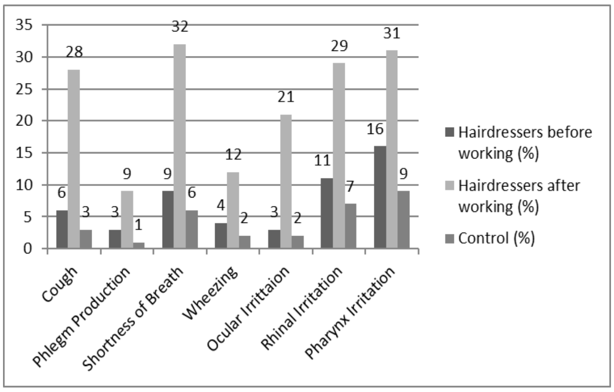

Figure 1. Prevalence comparison (%) of respiratory symptoms and allergies between hairdressers and controls

Pulmonary functions such as FEV1 (P =.000) and FVC (P =.000) were significantly lowered among hairdressers relative to the controls. However, FEV1/FVC (P =.051) did not show any significant mean difference between hairdressers and controls (Table 2).

Work-related risk factors of respiratory illnesses in hairdressers were analyzed (Table 3). Spearman's rank correlation test was conducted to investigate the associations between pulmonary functions and work-related risk factors (Table 4). It was found that there was a correlation between FEV1 or FVC, with work intensity, exposure duration, and work area size with statistical significance (P =.000). Ventilation was associated with pulmonary function performance. The presence of ventilation in hair saloons improves the spirometry measurements in hairdressers when compared to those without ventilation (Table 5).

Table 2. Tests of normality in distribution

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
BMI (kg/m^2)	.120	90	.003	.940	90	.000
FEV1	.100	140	.002	.967	140	.002
FVC	.160	140	.000	.923	140	.000
FEV1/FVC	.119	140	.000	.967	140	.016

a. Lilliefors significance correction

Table 3. Mean differences in pulmonary function indicators between hairdressers and control group

	Mean ± SD of percentage predicted		P*
	Hairdressers	Controls	
FEV1	82 ± 8	87 ± 6	.000
FVC	91 ± 8	96 ± 7	.000
FEV1/FVC	90 ± 4	92 ± 3	.051

* Determined using Mann-Whitney test, p-value = ≤ 0.05 is statistically significant.

Table 4. Work-related risk factors of respiratory illnesses in hairdressers

Risk factors		
Work Intensity	n	%
Low Intensity	47	52
High Intensity	43	48
Exposure Level		
Low Exposure	55	61
High Exposure	35	39
Work Area Size (m^2)		
≤ 23	40	44
> 23	50	56
Ventilation		
Yes	55	61
No	35	39

Table 5. Correlations between work-related risk factors and lung function indicators in hairdressers

Variable	Work intensity		Exposure level		Work area size	
	p	p-value	ρ	p-value	ρ	p-value
FEV1% pred	-.749**	.000	-.793**	.000	.467**	.000
FVC% pred	-.743**	.000	-.841**	.000	.512**	.000

**P= ≤0.05 Spearman rank correlation coefficient (p)

Table 6. Comparison of lung function indicators in hairdressers working with and without ventilation

Variables	Ventilation	Without ventilation	P-value
FEV1 %	87.07± 5.02	74.17± 4.14	.000
FVC %	95.73± 5.74	83.23± 3.29	.000

4. Discussion

In the present study, the impact of the hairdresser's occupation on their respiratory health was assessed. The complaints of respiratory symptoms were more frequent among hairdressers as compared to the controls. Hairdressers reported symptoms that stopped when away from work. A few workers had left the job because of respiratory problems. These findings are consistent with Hashemi, Boskabady, and Nazari (2010). They assessed the impacts of the work environment in hair saloons on the lung function performance of the hairdressers in the city of Mashhad, Iran. They concluded that hairdressers had more complaints just after the work exposure when compared to the controls. Other studies have also reported similar findings in hairdressers (Heibati *et al.*, 2021; Nemer *et al.*, 2015; Piapan, Baldo, & Filon, 2019). Macan *et al.* (2022) concluded after reviewing forty-two articles that there was a 20-fold higher risk of wheezing and breathlessness among hairdressers than in the control group.

Hairdressers showed lower spirometric values in their work environment as compared to the controls. FEV1 and FVC were significantly lowered in hairdressers, but not so for the ratio FEV1/FVC, when compared to the controls. These results may be attributed to the occupational exposures, which lead to a decline in the pulmonary functions of hairdressers. Similar findings have been reported among hairdressers by different researchers (Hasan & Srivastava, 2019; Muniyappanavar & Banner, 2017; Nemer, Kristensen, Nijem, Bjertness, & Skogstad, 2013) who have noted that pulmonary functions were declined in hairdressers as compared to controls even after adjusting for confounding factors.

Declined pulmonary functions of hairdressers were associated with the work-related risk factors. Work intensity and exposure duration showed negative correlations with FEV1 and FVC. Akpinar-Elci, Cimrin, and Elci (2002) reported that asthma increases with work intensity. Asthmatics have lung functions below those of non-asthmatics (Dijkstra *et al.*, 2006). Heibati *et al.* (2021) declared that the risk of reduced lung function was lesser with an exposure for fewer than six years, but after that it increased. Similarly, Nemer *et al.* (2015) declared that, in hairdressers, after four years of exposure, FEV1 had declined strongly as compared to cases with less than four years. The work area size and natural ventilation improve the spirometric results for hairdressers. Our findings agree with Skoufi *et al.* (2013), who reported that lung functions improve with the ventilation and size of the work area.

5. Conclusions

It is concluded that hairdressers show more frequent respiratory symptoms and lesser spirometric values than the controls not working in hair saloons. So, the alternative hypothesis was accepted. Different risk factors in this work environment include work intensity, exposure level, work area size, and ventilation, which may contribute to a decline in the pulmonary functions of the hairdressers. Proper ventilation, low exposure level, and reduced work intensity and work duration, are recommended to reduce the hazards at such work.

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References

AkPinar-Elci M, Cimrin AH, & Elci OC. (2002). Prevalence and risk factors of occuPational asthma among hairdressers in Turkey. *Journal of Occupational and Environmental Medicine, 44*, 585-590.

Ameille, J., Pauli, G., Calastreng-Crinquand, A., Vervloët, D., Iwatsubo, Y., Popin, E., . . . Kopferschmitt-Kubler, M. C. (2003). Reported incidence of occupational asthma in France, 1996-99: The ONAP programme. *Occupational and Environmental Medicine*, *60*(2), 136-141.

Brisman, J., Albin, M., Rylander, L., Mikoczy, Z., Lillienberg, L., Höglund, A. D., . . . Nielsen, J. (2003). The incidence of respiratory symptoms in female Swedish hairdressers. American *Journal of Industrial Medicine*, *44*, 673–678.

British Thoracic Society/COPD Consortium. (2005). Spirometry in practice: A practical guide to using spirometry in primary care. Retrieved from https://www.pennine-gp-training.co.uk/res/spirometry_in_practice%202005.pdf

Dijkstra, A., Vonk, J. M., Jongepier, H., Koppelman, G. H., Schouten, J. P., Ten Hacken, N. H., . . .Postma, D. S. (2006). Lung function decline in asthma: association with inhaled corticosteroids, smoking and sex. *Thorax*, *61*, 105-10.

Guest, G., Namey, E., & Chen, M. (2020). A simple method to assess and report thematic saturation in qualitative research. *PloS One*, *15*(5), 1-17.

Gupta, K., Thapa, B., Gupta, S., & Sharma, S. (2022). Lung function tests in hairdressers of Gangtok: A cross-sectional study. *Indian Journal of Occupational and Environmental Medicine*, *26*(2), 91.

Hasan, S. N., & Srivastava, T. R. (2019). Assessment of lung functions in hairdressers. *National Journal of Physiology, Pharmacy and Pharmacology*, *9*, 1159-1162.

Hashemi, N., Boskabady, M. H., & Nazari, A. (2010). Occupational exposures and obstructive lung disease: a case-control study in hairdressers. *Respiratory Care*, *55*, 895-900.

Heibati B, Jaakkola MS, Lajunen TK, Ducatman A, Bamshad Z, Eslamizad S, . . . Jaakkola, J. J. K. (2021). Occupational exposures and respiratory symptoms and lung function among hairdressers in Iran: a cross-sectional study. *International Archives of Occupational and Environmental Health*, 1-1.

Hiller, J., Greiner, A., & Drexler, H. (2022). Respiratory afflictions during hairdressing jobs: case history and clinical evaluation of a large symptomatic case series. *Journal of Occupational Medicine and Toxicology*, *17*(1), 1-11.

Larstad, M., & Olin, A. C. (2018). Work-related effects on lung function, small airways and inflammation in hairdressers with airway symptoms–a pilot study. *European Respiratory Journal*, *52*, 1-5.

Macan, J., Babić, Ž., Hallmann, S., Havmose, M. S., Johansen, J. D., John, S. M., . . . Turk, R. (2022). Respiratory toxicity of persulphate salts and their adverse effects on airways in hairdressers: a systematic review. *International Archives of Occupational and Environmental Health*, 1-24.

Malo, J. L., & Chan-Yeung, M. (2001). Occupational asthma. *Journal of Allergy and Clinical Immunology, 108*, 317-328.

Mendes, A., Madureira, J., Neves, P., Carvalhais, C., Laffon, B., & Teixeira, J. P. (2011). Chemical exposure and occupational symptoms among Portuguese hairdressers. *Journal of Toxicology and Environmental Health Part A, 74*, 993–1000.

Moscato, G., & Galdi, E. (2006). Asthma and hairdressers. *Current Opinion in Allergy and Clinical Immunology*, *6*, 91–95.

Muniyappanavar, N. S., & Banner, R. R. (2017). Pulmonary function tests in hairdressers. *Indian Journal of Clinical Anatomy and Physiology. 4*, 353-355.

Nemer, M., Kristensen, P., Nijem, K., Bjertness, E., Skare, Ø., & Skogstad, M. (2015). Lung function and respiratory symptoms among female hairdressers in Palestine: a 5-year prospective study. *BMJ Open*, *5*, 1-7.

Nemer, M., Kristensen, P., Nijem, K., Bjertness, E., & Skogstad, M. (2013). Respiratory function and chemical exposures among female hairdressers in Palestine. *Occupational Medicine*. *63*: 73-76.

Nilsson, P. T., Marini, S., Wierzbicka, A., Karedal, M., Blomgren, E., Nielsen, J., . . . Gudmundsson A. (2016). Characterization of hairdresser exposure to airborne particles during hair bleaching. *Annals of Occupational Hygiene*, *60*, 90–100.

Onowhakpor, A. O., Aigbovorhiuwa, D. I., & Okojie, O. H. (2018). Respiratory status of hairdressers in Edo

State, Nigeria. *Journal of Community Medicine and Primary Health Care*, *30*, 55-61.

Piapan, L., Baldo, J., & Filon, F. L. (2019). Occupation-related symptoms in hairdressers. *Dermatitis*, *30*, 142-149.

Quiros-Alcala, L., Pollack, A. Z., Tchangalova, N., DeSantiago, M., & Kavi, L. K. A. (2019). Occupational exposures among hair and nail salon workers: A scoping review. *Current Environmental Health Reports*, *6*, 269–285.

Skoufi, G. I., Nena, E., Kostikas, K., Lialios, G. A, Constantinidis, T. C., Daniil, Z., & Gourgoulianis, K. (2013). Work-related respiratory symptoms and airway disease in hairdressers. *The International Journal of Occupational and Environmental Medicine*, *4*, 224-253.

State Bank of Pakistan (2019). Beauty parlors and spas. Retrieved from https://www.sbp.org.pk/departments/ihfd/Sub-Segment%20Booklets/Beauty%20Parlors%20and%20Spas.pdf

Tsigonia, A., Lagoudi, A., Chandrinou, S., Linos, A., Evlogias, N., & Alexopoulos, E. C. (2010). Indoor air in beauty salons and occupational health exposure of cosmetologists to chemical substances. *International Journal of Environmental Research and Public Health*, *7*, 314–324.