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**Original Article**

# Occupational Respiratory and Cutaneous Allergic Diseases in Hairdressers: A Two-center Study

Nazan Beyhan[1], Gülden Paçacı Çetin[2], Bahar Arslan[2], Ebru Dumlupınar[3], Zeynep Çelebi Sözener[1], İnsu Yılmaz[2], Ömür Aydın[1], Dilşad Mungan[1]

[1]Division of Immunology and Allergy, Department of Pulmonary Diseases, Ankara University Faculty of Medicine, Ankara, Türkiye
[2]Division of Immunology and Allergy, Department of Pulmonary Diseases, Erciyes University Faculty of Medicine, Kayseri, Türkiye
[3]Department of Biostatistics, Ankara University Faculty of Medicine, Ankara, Türkiye

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## ABSTRACT

**OBJECTIVE:** Hairdressers are frequently exposed to various allergens in hair products, placing them at high-risk for occupational allergic diseases such as allergic contact dermatitis (ACD) and occupational asthma (OA). Despite the large number of hairdressers in Türkiye, data on occupational allergy risk are limited. This study aimed to investigate the occurrence of occupational allergic diseases in hairdressers presenting with skin or respiratory complaints and to identify common workplace allergens.

**MATERIAL AND METHODS:** We conducted a prospective, descriptive study of hairdressers aged 18 years or older with suspected occupational allergic disease who attended outpatient allergy clinics between 2020 and 2023. Participants underwent diagnostic tests, including skin prick tests, patch tests, pulmonary function tests, and specific inhalation challenges (SIC).

**RESULTS:** Thirty hairdressers (female/male: 18/12) were included. Although 93% of participants reported using personal protective equipment, allergic diseases remained prevalent. Participants had an average of 15.1 years of professional experience, worked nearly 11 hours per day, and spent the most time per day on hair dyeing (3.1 hours/day). Among the 21 participants (70%) with ACD symptoms, ammonium persulfate, potassium persulfate, cocamidopropyl betaine (CAPB), and nitro-p-phenylenediamine were the most common allergens. Ten participants (33%) were diagnosed with asthma, and SIC confirmed OA and/or occupational rhinitis in 3 cases (10%).

**CONCLUSION:** A considerable frequency of OA and ACD was observed among symptomatic hairdressers. Ammonium persulfate, CAPB, and nitro-p-phenylenediamine were identified as common triggers. The persistence of allergic diseases despite the use of protective equipment highlights the need for improved occupational health strategies, stronger regulations, and enhanced preventive measures in the hairdressing sector in Türkiye.

**KEYWORDS:** Hairdressers, allergic contact dermatitis, occupational allergic diseases, occupational asthma, occupational rhinitis

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**Corresponding author:** Prof. Ömür Aydın, MD, e-mail: mdomuraydin@gmail.com



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## INTRODUCTION

Occupational allergic diseases are a major concern in professions with frequent exposure to sensitizing agents. These include allergic contact dermatitis (ACD), occupational asthma (OA), occupational rhinitis (OR), and urticaria. Hairdressers are at particularly high-risk due to frequent and prolonged contact with shampoos, conditioners, hair dyes, and bleaching agents, both through skin contact and inhalation.[1] Previous studies indicate that work-related skin damage, especially hand eczema (HE), affects a large proportion of hairdressers and has a significant negative impact on career longevity.[2,3]

Routine exposure to these allergens damages the epidermal barrier and creates a pro-inflammatory environment, increasing the risk of occupational contact dermatitis. The transition from irritant contact dermatitis to allergic HE can occur rapidly as allergens penetrate the weakened skin barrier.[4,5] Repeated exposure to water, cleaning agents, and other chemical substances, exacerbates irritation and accelerates sensitization, further worsening the condition.[6] This process may lead to hypersensitivity reactions such as contact urticaria, protein contact dermatitis, and ACD.[7,8] These reactions are not limited to the skin: respiratory and ocular symptoms such as rhinitis, conjunctivitis, and asthma have also been observed, particularly following exposure to persulfate salts (PS) used in hairdressing and cosmetic products.[7,9] Although PS are water-soluble and unlikely to become airborne unless aerosolized, they have been identified as primary contributors to OR and asthma among hairdressers, representing a significant occupational respiratory hazard.[9,10]

There are limited studies on the prevalence of allergic skin and respiratory diseases among hairdressers in Türkiye; however, no data are available on specific sensitizing factors or on the adequacy of protective measures in this professional group.[11]

Hairdressing is a widespread profession in our country, employing a large workforce. According to the "Barbering and hairdressing occupational guide" published in 2021, there are 37,846 individuals employed in the hairdressing profession across Türkiye.[12] All procedures, including styling, waving or relaxing hair, and dyeing or bleaching, are carried out intensively during long working hours. Many salons are poorly ventilated, and personal protective measures are either not widely used or inadequate. Consequently, hairdressers are heavily exposed to hair cosmetic products in our country.

Because hairdressing is a common profession in our country, and because data are lacking and protection measures are inadequate, this study was required. We aimed to investigate the occurrence of occupational allergic diseases in hairdressers with skin and respiratory complaints and to identify the occupational allergens commonly encountered in the workplace. Additionally, we planned to assess the subjects' protective attitudes and the preventive measures implemented in the salons. We anticipate that this study will provide a snapshot of the occupational allergic conditions among hairdressers in our country.

**Main Points**

- This prospective study evaluated, in hairdressers who presented with work-related symptoms, occupational respiratory manifestations, including occupational asthma and occupational rhinitis, and occupational skin diseases.
- Respiratory symptoms were highly prevalent, with asthma symptoms reported by the majority of participants and objective confirmation of asthma and/or rhinitis obtained through pulmonary function testing, bronchial provocation, and specific inhalation challenge procedures.
- Persulfate salts were identified as the principal occupational agents responsible for both lower and upper airway diseases and as a leading cause of concomitant skin sensitization.
- Allergic contact dermatitis was frequently observed, with ammonium/potassium persulfate, cocamidopropyl betaine, and aromatic amines emerging as the most common sensitizing agents.
- The findings highlight the coexistence of occupational respiratory and cutaneous allergic diseases and underscore the need for integrated preventive strategies, including exposure reduction, adequate personal protective equipment, and improved workplace conditions among hairdressers.

## MATERIAL AND METHODS

### Study Design and Population

This prospective descriptive study, conducted at two allergy clinics of Erciyes University Medical Faculty and Ankara University Medical Faculty between 2020 and 2023, included hairdressers over 18 years old who presented to the clinics with respiratory and/or skin complaints suggestive of occupational allergic disease. Informed consent was obtained from all participants, and the study was approved by the Ethics Committee of Erciyes University Medical Faculty on October 7, 2020 (authorization no: CE 2020/499).

### Data Collection

The demographic and disease characteristics of the participants, the relationship between symptoms and professional procedures, workplace conditions, and the use of personal protective equipment were recorded using a detailed questionnaire. For participants with skin complaints, skin patch and skin prick tests (SPT) were performed. For those with respiratory complaints, SPT, pulmonary function testing (PFT), and methacholine challenge testing were conducted. Patients diagnosed with asthma underwent serial peak expiratory flow (PEF) monitoring and/or specific inhalation challenges (SIC) with the suspected agent to confirm the diagnosis of OA. The overall diagnostic workflow for the study participants, including evaluation pathways for skin, nasal, and respiratory complaints, is presented in Figure 1.

### Diagnostic Procedures

SPTs for common inhalant allergens *(Dermatophagoides pteronyssinus, Dermatophagoides farinae, tree pollens, weed pollens, mixtures of grass pollens, Alternaria, Aspergillus fumigatus, cat and dog epithelia,* and *latex*) were performed

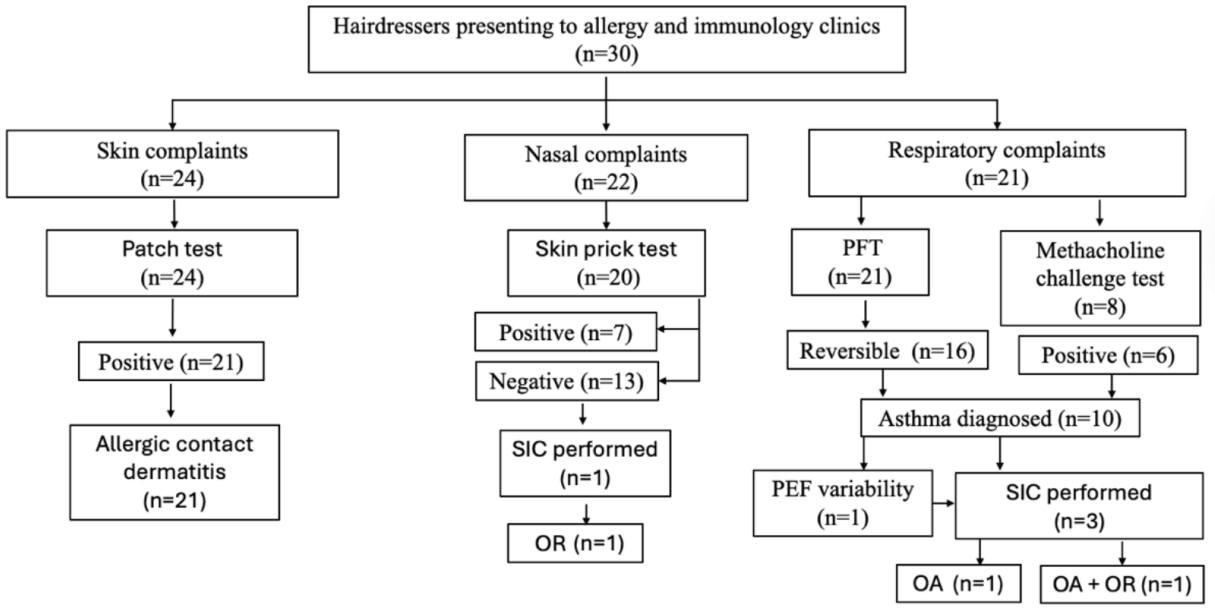



**Figure 1.** Flow diagram of the diagnostic assessment of hairdressers with occupational allergic disease symptoms

*SIC: specific inhalation challenge, OR: occupational rhinitis, PFT: pulmonary function test, PEF: peak expiratory flow, OA: occupational asthma*

using commercial extracts (ALK, Abello, Spain). Histamine and saline solution were used as positive and negative controls, respectively. After 20 minutes, a positive reaction was defined as a wheal diameter ≥3 mm with no reaction to the negative control and a positive reaction to histamine. Atopy was defined as at least one positive SPT response to allergens.

Patch tests were performed according to the European Society of Contact Dermatitis patch test guidelines.[13] Patch tests were conducted by placing allergen extracts from a set of 20 hairdresser series (ammonium persulfate/potassium persulfate, ammonium thioglycolate, captan 0.5%, cocamidopropyl betaine (CAPB), cysteamine HCl, disperse orange, disperse yellow, formaldehyde, glycerylthioglycolate, hydroquinone, hydroxyethyl methacrylate, m-aminophenol, methylchloroisothiazolinone, methylisothiazolinone, N,N-bis(2-hydroxyethyl)-p-phenylenediamine sulfate, nickel sulfate, nitro-p-phenylenediamine, quaternium-15, resorcinol thiuram mix, toluen-2,5-diamine sulfate) on the patient's back (ALK, Abello, Madrid, Spain). The test was evaluated at 48, 72, and 96 hours. Reaction intensity was recorded in four categories (negative, 1+, 2+, and 3+); doubtful reactions (?+) were considered negative. A positive patch test result in the presence of dermatitis was used to diagnose allergic occupational dermatitis.

Pulmonary function tests, reversibility tests, and methacholine challenge tests were performed in patients with respiratory symptoms. Reversibility was tested with 400 mcg salbutamol inhalation; an increase in forced expiratory volume in one second ($FEV_1$) ≥12% and ≥200 mL after 15 minutes was considered positive. Methacholine challenge tests were performed in individuals who had normal lung function but reported respiratory symptoms. Aerosolized methacholine was generated using a pressurized nebulizer, and inhalations were administered at 5-min intervals with increasing concentrations (0.25, 0.5, 1, 2, 4, 8, and 16 mg/mL) until a positive reaction occurred or the maximum dose was reached. A provocative concentration causing a 20% (PC20) fall in $FEV_1$ below 8 mg/mL was considered positive.

For OA diagnosis, 15-day PEF monitoring during at-work and off-work periods was planned; however, due to demanding working conditions in hairdressing salons, only one participant completed the monitoring. In addition, SIC with persulfate was conducted in selected participants. Four participants underwent SIC in a 7 $m^3$ cabinet. Participants were asked to simulate a workplace situation by inhaling persulfate powder while mixing it in a bowl. Subjects were closely monitored during the challenge procedure. Study participants were exposed to bleaching powder in a controlled manner for 5, 10, 15, 30, and 60 minutes. A ≥20% decrease in $FEV_1$ measurements after each exposure period was considered a positive test. At the same time points, the same physician assessed nasal symptoms (itching, congestion, sneezing, rhinorrhea) and recorded total nasal symptom scores. An increase in rhinitis symptom scores at posttest was also recorded.

### Statistical Analysis

Descriptive statistics were presented as mean ± standard deviation (SD) for the variables with normal distribution and as median (minimum, maximum, and interquartile range) for the variables without normal distribution, whereas they were presented as number and percentage (%) for nominal variables. Differences in median values between groups were analyzed using the Mann-Whitney U test. Categorical variables were evaluated using Fisher's exact test. A *P* value of less than 0.05 was considered statistically significant, and the analyses were conducted using the Statistical Package for Social Sciences (SPSS, Version 30.0, Chicago, IL).

## RESULTS

Thirty patients (female/male: 18/12) were included in the study with a mean age of 34.53±11.23 (mean ± SD) years. The average duration of employment as a hairdresser was 15.08±11.06 years. Patient demographics and disease characteristics are shown in Table 1.

Hairdressers reported that they work 6 days a week for 10 hours per day. They spent the most time performing hair

**Table 1.** The demographics and disease characteristics of the patients

| Variable | Category | Value |
|---|---|---|
| Sex | Female, n (%) | 18 (60.00) |
| | Male, n (%) | 12 (40.00) |
| Age (years), mean ± SD | | 34.53±11.23 |
| Age (years), median (min-max, IQR) | | 35 (18–57, 15.25) |
| Smoking history | Never, n (%) | 15 (50.00) |
| | Ex-smoker/active smoker, n (%) | 15 (50.00) |
| Occupational exposure (years), mean ± SD | | 15.08±11.06 |
| Occupational exposure (years), median (min-max, IQR) | | 14.5 (1–45, 18.5) |
| Allergic comorbidities | Drug allergy, n (%) | 4 (13.33) |
| | Urticaria, n (%) | 4 (13.33) |
| Increased work-related complaints | Skin symptoms, n (%) | 26 (86.66) |
| | Asthmatic symptoms, n (%) | 21 (70.00) |
| | Nasal symptoms, n (%) | 22 (73.33) |
| Skin prick test | Negative, n (%) | 19 (63.33) |
| | Positive, n (%) | 9 (30.00) |
| $FEV_1$ (L), mean ± SD | | 3.26±0.72 |
| $FEV_1$ (L), median (min-max, IQR) | | 3.08 (2.3–4.69, 1.06) |
| $FEV_1$ (%), mean ± SD | | 97.84±12.82 |
| $FEV_1$ (%), median (min-max, IQR) | | 96 (82–134, 17) |
| FVC (L), mean ± SD | | 4.03±0.87 |
| FVC (L) , median (min-max, IQR) | | 3.71 (2.55–5.82, 1.41) |
| FVC (%), mean ± SD | | 105.4±13.8 |
| FVC (%), median (min-max, IQR) | | 100 (88–137, 15) |
| $FEV_1$/FVC (%), mean ± SD | | 82.12±10.90 |
| $FEV_1$/FVC (%), median (min-max, IQR) | | 79 (65–105, 15.25) |
| Pulmonary function test | Reversible, n (%) | 5 (16.66) |
| | Normal, n (%) | 16 (53.33) |
| Methacholine challenge test | Negative, n (%) | 2 (6.66) |
| | Positive, n (%) | 6 (20.00) |
| Confirmed to have asthma, n (%) | | 10 (33.33) |
| PEF variability n (%) | | 1 (3.33) |
| SIC | Negative, n (%) | 1 (3.33) |
| | Positive, n (%) | 3 (10.00) |
| OA, n (%) | | 1 (3.33) |
| OR, n (%) | | 1 (3.33) |
| OA + OR, n (%) | | 1 (3.33) |
| Of the 26 patients with cutaneous symptoms, 24 underwent patch testing | Negative, n (%) | 3 (10.00) |
| | Positive, n (%) | 21 (70.00) |
| Confirmed to have ACD, n (%) | | 21 (70.00) |

SD: standard deviation, min-max: minimum-maximum, IQR: interquartile range, $FEV_1$: forced expiratory volume in one second, FVC: forced vital capacity, PEF: peak expiratory flow, SIC: specific inhalation challenge, OA: occupational asthma, OR: occupational rhinitis, ACD: allergic contact dermatitis

dyeing (3.10±1.17 hours/day), hair cutting (2.47±0.89 hours/day), and blow drying (2.45±1.09 hours/day). Most complaints were related to hair dyeing: 13 participants (38.2%) reported general dyeing complaints, and 17 (50%) reported complaints related to bleaching/lightening procedures. Most participants (93%) reported using personal protective equipment, including gloves and masks. In general, gloves were used during dyeing procedures and, less frequently, for other wet work.

Eighty-six percent (n = 24) of the patients reported skin symptoms, while 70% and 73% of them complained of asthma and nasal symptoms, respectively. Symptoms worsened at work in 93% of participants and improved on days off in 86% of participants.

Patch testing was performed in 24 patients presenting with dermatologic complaints. ACD was diagnosed in 21 participants based on sensitivity to one or more allergens. Among the 21 hairdressers diagnosed with ACD, the most frequently sensitizing allergens were ammonium persulfate/potassium persulfate (n = 11, 52%), CAPB (n = 6, 28%), and nitro-p-phenylenediamine (n = 6, 28%).The frequency of sensitization detected in the patch test is summarized in Figure 2.

Respiratory symptoms were reported by 21 participants (70%). Ten patients were diagnosed with asthma based on PFTs and/or methacholine challenge tests.

Pulmonary function test results were compared between female and male participants; no significant differences were observed in $FEV_1$ (%), forced vital capacity (FVC) (%), or the $FEV_1$/FVC ratio. Similarly, no significant sex-based differences were observed in SPT or patch-test positivity (Table 2).

SIC was performed in four subjects; one was diagnosed with OA, one with OR, and one with both OR and OA. No participants exhibited a delayed decrease in $FEV_1$ during the 24-hour follow-up after exposure to PS. The characteristics of patients who underwent SIC are listed in Table 3.

## DISCUSSION

This study investigated the occurrence and spectrum of occupational allergic diseases among hairdressers and identified the specific sensitizing agents responsible for both cutaneous and respiratory manifestations. In contrast to earlier Turkish studies, which were primarily limited to questionnaire-based or survey-derived prevalence data, our findings provide a detailed allergen-specific diagnostic assessment in a cohort of patients presenting with symptoms related to workplace exposure.[11] Consistent with international evidence, our results indicate that hairdressers remain highly vulnerable to occupational allergic risks, despite their reporting adequate implementation of personal protective measures.[14,15]

Hairdressers are among the occupational groups most affected by contact dermatitis due to repeated exposure to various chemicals.[16] The cohort's average professional experience was approximately 15 years, suggesting that prolonged exposure substantially increases health risks. These results are consistent with findings from a 24-year Turkish cohort in İstanbul, which also identified ammonium persulfate as the leading allergen among hairdressers.[15] Similarly, a recent systematic review by Havmose et al.[17] reported a lifetime prevalence of HE of 38.2%, with a 1-year prevalence of 20.3%. In our study, the majority of participants reported skin-related complaints, all of which were exacerbated in the workplace. This finding is consistent with the high prevalence reported in the literature and underscores the significance of occupational skin exposure in hairdressers.[18] Notably, hair-dyeing procedures, which account for, on average, more than three hours per day, represent a major source of such exposure. These results indicate that the high rate of self-reported protective measures

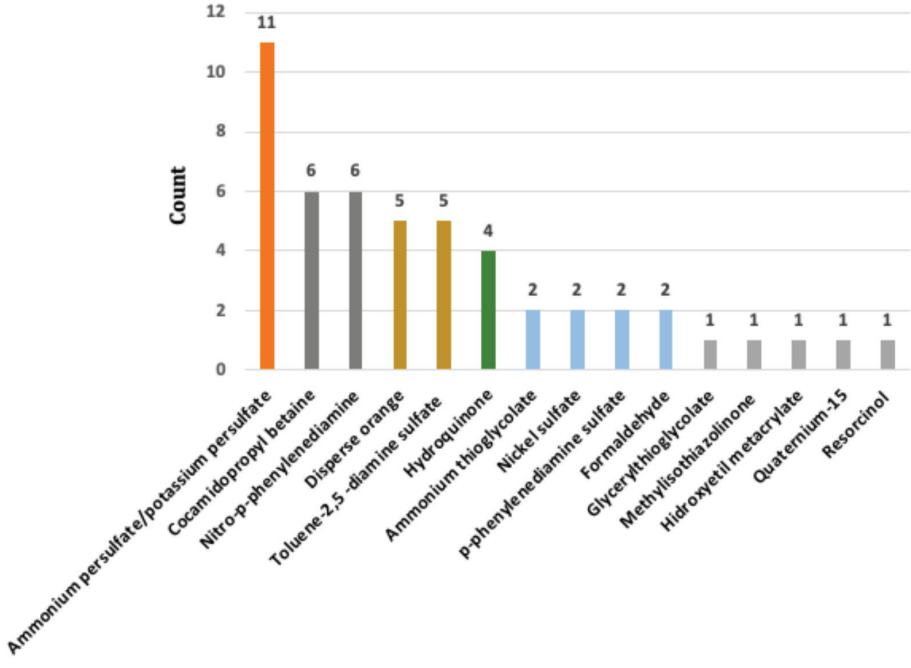





**Figure 2.** Frequency of sensitization to haptens in patch tests conducted on hairdressers

should be questioned, as such measures are insufficiently implemented in practice.

Patch testing remains essential for diagnosing ACD and should ideally incorporate hairdresser-specific test series.[19] In our cohort, ACD was diagnosed in 70% of hairdressers and in 87% of those presenting with dermatitis. Patch testing of hairdressers with dermatitis revealed a high frequency of sensitization to ammonium persulfate and potassium persulfate. Ammonium persulfate, potassium persulfate, and p-phenylenediamine (PPD) were the most frequent sensitizing agents, consistent with both international studies and previous Turkish retrospective data.[15,20] Our findings demonstrate that contact allergies to ammonium persulfate and potassium persulfate, which are widely used in hair-bleaching and lightening products, remain highly prevalent among hairdressers. The persistent and extensive occupational exposure to these agents likely contributes to the elevated sensitization rates, rendering ACD an ongoing occupational health concern within this profession.

Although other studies report lower rates, our analysis found that 28% of hairdressers with ACD were sensitised to CAPB.[20,21] CAPB, a surfactant derived from coconut oil, is widely used in personal care products and can cause skin irritation, eye irritation, and skin sensitization.[22] A meta-analysis found that hairdressers had a 1.7-fold higher risk of developing contact allergy to CAPB compared with non-hairdresser controls.[23] According to data from the North American Contact Dermatitis Group, CAPB was identified as a common allergen, accounting for 5.9% of positive patch-test reactions associated with hair-care products; notably, 71% of patients who developed ACD related to hair-care products were hairdressers or cosmetologists.[24]

**Table 2.** Comparison of clinical test results by sex

| Parameter | Female | Male | *P* value |
|---|---|---|---|
| **Pulmonary function tests*** | | | |
| $FEV_1$ (L) | 2.78 (2.30–3.17, 0.46) | 3.81 (2.76–4.69, 0.81) | **<0.001** |
| $FEV_1$ (%) | 96 (82–109, 16.75) | 96 (82–134, 21) | 0.968 |
| FVC (L) | 3.39 (2.55–4.27, 0.41) | 4.78 (3.63–5.82, 0.86) | **<0.001** |
| FVC (%) | 98 (88–128, 4) | 108 (93–137, 21) | 0.412 |
| $FEV_1$/FVC (%) | 80 (68–105, 23.5) | 78 (65–97, 13.5) | 0.73 |
| **Skin prick test positivity†, n (%)** | | | |
| Negative | 13 (68.4) | 6 (31.6) | 0.677 |
| Positive | 5 (55.6) | 4 (44.4) | |
| **Patch test positivity‡, n (%)** | | | |
| Negative | 2 (66.7) | 1 (33.3) | 0.999 |
| Positive | 12 (57.1) | 9 (42.9) | |

*Pulmonary function test data are presented as median (min-max, interquartile range) and were compared using the Mann-Whitney U test
†Skin prick test
‡Patch test data are presented as n (%) and were compared using Fisher's exact test
A *P* value <0.05 was considered statistically significant
$FEV_1$: forced expiratory volume in one second, FVC: forced vital capacity, min-max: minimum-maximum

**Table 3.** Characteristics of patients undergoing specific inhalation challenges

| Variable | Patient 1 | Patient 2 | Patient 3 | Patient 4 |
|---|---|---|---|---|
| Age | 39 | 32 | 38 | 35 |
| Gender | Male | Male | Female | Female |
| ACD | No | Yes | No | Yes |
| PFT | Normal | Normal | Normal | Normal |
| Eosinophil count cells/μL (%) | 280 (5.9) | 390 (4.6) | 120 (2.1) | 20 (0.3) |
| SPT | Negative | Positive | Positive | Negative |
| Methacholine challenge test (PC20 mg/mL) | Negative | Positive (4.38) | Positive (0.51) | Positive (4.09) |
| Asthma | No | Yes | Yes | Yes |
| PEF variability | Not performed | Yes | Not performed | Not performed |
| SIC | + (rhinitis) | + (asthma) | + (asthma and rhinitis) | - |
| OA | No | Yes | Yes | No |
| OR | Yes | No | Yes | No |

ACD: allergic contact dermatitis, PFT: pulmonary function test, SPT: skin prick test, PC20: provocative concentration causing a 20%, PEF: peak expiratory flow, SIC: specific inhalation challenge, OA: occupational asthma, OR: occupational rhinitis, +: indicates a positive test, -: indicates a negative test

Given the relatively high rate of CAPB sensitization observed in our cohort, we suggest including CAPB in routine patch testing panels for all hairdressers diagnosed with eczema.

In our study, PPD, a key intermediate used in oxidative hair dyes, was identified as another allergen through patch testing. An analysis of 271 allergic reactions diagnosed among 4,314 patients between 2008 and 2013 revealed that approximately 80% of those who tested positive for PPD had previously dyed their hair, of whom half developed scalp dermatitis.[25] Alongside PPD, toluene-2,5-diamine (TDA), another aromatic amine widely used in permanent hair dyes, was detected in 16% of our patients. In contrast to some reports in the literature, co-sensitization to TDA among PPD-positive individuals was relatively infrequent, suggesting that patterns of cross-reactivity may vary between populations.[26]

Despite the use of gloves and masks by 93% of participants, these measures appear to be insufficient to prevent allergic diseases. The fact that hairdressers in this study work for prolonged periods under intensive conditions, together with their perception of being adequately protected by using gloves only during selected wet work procedures, may partially explain this discordance. In addition to individual compliance, factors such as glove quality, replacement frequency, and workplace ventilation should be considered key preventive strategies. Enhanced occupational health training for hairdressers would also help increase awareness of chemical hazards and promote more effective and consistent use of protective measures.

Respiratory health is another critical issue in this profession. Hairdressers are frequently exposed to ammonia, volatile organic compounds, and persulfates, all of which are known to induce OA and OR.[7,27,28] In our study, 70% of participants reported asthma-related symptoms, and asthma was confirmed in 33% of participants. Among those who underwent SICs, two were diagnosed with OA; both were atopic, suggesting that atopic status may increase susceptibility to persulfate-induced asthma. Supporting our findings, a retrospective Italian cohort study reported that over half of hairdressers evaluated for OA were diagnosed with the condition, with persulfates responsible for nearly 90% of cases.[29] A meta-analysis showed that hairdressers have a 20-fold higher risk of respiratory symptoms from bleaching powders compared with controls.[7] In Spain, persulfates accounted for 12.1% of occupational respiratory diseases, making them the second most common cause of OA.[30] Provocation studies have further confirmed that persulfates can induce both lower and upper airway symptoms, including asthma and rhinitis.[31] Taken together, these data highlight persulfates as a major occupational respiratory hazard and underscore the urgent need for safer bleaching formulations, improved salon ventilation, and strict adherence to comprehensive protective measures. In our cohort, patch test results were comparable between female and male participants, and no significant sex-based differences were observed in $FEV_1$ (%), FVC (%), or $FEV_1$ /FVC ratio.

Serial PEF monitoring is a valuable method for demonstrating work-related variability in airway obstruction and is commonly used in the diagnostic evaluation of OA. In the present study, PEF monitoring could be performed on only one hairdresser. The demanding working conditions in hairdressing salons made it difficult for most participants to take approximately 15 days off work, which are typically required for reliable serial PEF measurements. As a result, PEF monitoring could not be applied to all asthmatic participants. Nevertheless, clinical evaluation together with PFT, methacholine challenge, and SIC testing provided important diagnostic information for identifying occupational respiratory disease in this cohort.

Nasal symptoms were observed in 73% of patients, with two patients diagnosed with OR through SIC. In one patient, a positive SIC despite a negative inhalant-allergen SPT highlights the importance of obtaining a detailed occupational history in patients presenting with rhinitis symptoms. Previous studies have reported that OR occurs in approximately half of OA cases caused by ammonium persulfate, and that exposure to persulfates is strongly associated with an increased risk of developing OR.[32,33] Provocation tests that simultaneously assess upper and lower airways are more time- and cost-efficient than separate airway tests and have high diagnostic specificity for detecting persulfate-induced asthma and rhinitis.[31]

The strengths of our study include the comprehensive identification of allergic sensitization and respiratory diseases in a high-risk occupational group such as hairdressers. A wide range of standardized diagnostic procedures was employed to identify specific allergens and respiratory conditions. This study provides valuable and clinically relevant insights into occupational allergic diseases and associated health risks among hairdressers, highlighting the importance of implementing more effective and targeted protective measures in our country. However, the relatively small sample size may limit the generalizability of the findings and restrict the ability to establish definitive causal relationships. Because the study population consisted of symptomatic hairdressers presenting to allergy clinics, the findings reflect a selected clinical sample rather than a representative occupational cohort of hairdressers and should therefore be interpreted with caution when generalizing to the broader population of hairdressers. Furthermore, serial PEF monitoring could only be performed in one participant due to the demanding working conditions that limited the ability of most hairdressers to take time away from work. An additional limitation of the study is the inability to perform SIC in all patients diagnosed with asthma. Nevertheless, these findings have important implications for occupational health practice and underscore the need for larger, multicenter studies to further clarify occupational risks in this profession.

## CONCLUSION

This study indicates a considerable frequency of ACD and OA among symptomatic hairdressers evaluated in allergy clinics for suspected occupational allergic diseases; ammonium persulfate/potassium persulfate, PPD, and CAPB are the predominant allergens. The high rates of occupational diseases among hairdressers indicate that protective measures are not always fully implemented. These findings underscore the need for stronger protective strategies, regulatory measures, and improved educational programs in the hairdressing sector in our country.

### Ethics

**Ethics Committee Approval:** The study was approved by the Ethics Committee of Erciyes University Medical Faculty on October 7, 2020 (authorization no: CE 2020/499).

**Informed Consent:** Informed consent was obtained from all participants.

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### Footnotes

### Authorship Contributions

Concept: N.B., Z.Ç.S., İ.Y., Ö.A., D.M., Design: N.B., Z.Ç.S., İ.Y., Ö.A., D.M., Data Collection or Processing: N.B., G.P.Ç., B.A., Ö.A., Analysis or Interpretation: N.B., E.D., Literature Search: N.B., G.P.Ç., B.A., Z.Ç.S., İ.Y., Ö.A., D.M., Writing: N.B., G.P.Ç., B.A., E.D., Z.Ç.S., İ.Y., Ö.A., D.M.

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