

RESEARCH ARTICLE

Demographic and clinical features and subsectoral differences in occupational contact allergens in clothing manufacturing workers

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Abstract

Background: Epidemiologic data on the occurrence of contact dermatitis (CD) and the contact allergens involved in clothing manufacturing and its subsectors are scarce. This study aimed to determine the extent of occupational contact allergy and differences between work subsectors in clothing employees with CD.

Methods: A cross-sectional study was conducted with 272 clothing employees, who complained of CD and were diagnosed with occupational allergic contact dermatitis (OACD). Participants worked in accessory, dyeing, sewing, cutting, knitting, packing, cleaning, and ironing subsectors. Data on demographics, working-subsector, working-duration, and lesion-duration were collected, and participants were examined and patch tested.

Results: Participants included 173 females and 99 males. Dyeing workers were most frequently diagnosed with OACD, whereas cutting workers were least. Lesions were mostly located on the hands only. The most frequently detected allergens were nickel sulfate in accessory work; disperse blue-106 in dyeing, sewing, cutting, and knitting; cobalt chloride in packing; p-phenylenediamine in cleaning; and budesonide in ironing.

Conclusions: Contact allergens show significant differences in frequency by work subsectors in clothing employees. Careful monitoring of workers for excessive exposures and for early signs of CD is warranted.

KEYWORDS

allergic contact dermatitis, antigenic diversity, clothing manufacturing employees, demographics, workplace

1 | INTRODUCTION

Contact dermatitis (CD) is the most frequently occurring chronic and recurrent occupational disorder worldwide. The disorder mostly affects the hands because the majority of manual and blue-collar workers work with their hands over long periods, and they are

frequently in contact with allergenic or irritant substances or tools, such as dyes, finishing agents, and metals.¹ The majority of occupational contact dermatitis (OCD) occurs in certain sectors such as hairdressing, healthcare, automotive work, and leather and shoe manufacturing industries. Although the prevalence of occupational dermatitis (OD) from contact with textiles in the clothing sector is not precisely known, it has been thought to be increasing.^{2,3} Occupational allergic contact dermatitis (OACD) in the textile industry frequently occurs from handling textile fibers, coloring

Abbreviations: ACD, allergic contact dermatitis; CD, contact dermatitis; OACD, occupational allergic contact dermatitis; OCD, occupational contact dermatitis; OD, occupational dermatitis.

materials, equipping materials, and accessories during certain stages of textile processing, including spinning, yarn processing, weaving, knitting, dyeing, finishing, cutting, and sewing. In the spinning process, yarn is made from fibers from natural sources (wool, silk, flax or linen, and cotton), from regenerated cellulose (viscose or rayon, acetate, and lyocell), or from synthetic polymers (polyester, polyamide, acrylic, and spandex). During yarn processing, yarn is smoothed using mechanical force or chemical polymers to increase durability and ruggedness. In the knitting mill, yarn is waxed with a lubricant before the meshing process. In the dyeing and finishing processes, the textile is exposed to numerous chemicals (of which there are approximately seven thousand in current use) for coloring and the improvement of fiber and fabric characteristics.³ Workers are thus usually exposed to a variety of harmful materials in these processes.¹⁻³ Likely exposures in stages¹⁻⁵ of textile processes are shown in Table 1. OACD in textile employees is most frequently attributed to sensitization to dyes and dye finishes, with the majority resulting from disperse dyes, which are generally used for the coloring of mixed fabrics and synthetic fibers.³ Additionally, epoxy resins, p-tert-butylphenol formaldehyde resin, and colophony which may be volatilized in textile processes, may cause airborne contact allergies at exposed sites of the body, especially in sewing and ironing workers.² Other sensitizer agents in sunscreens, waterproofing, water repellence, polishing, bleaching, preshrinking, glazing to improve the appearance, sizing to increase the body and texture, flameproofing and fireproofing may lead to OACD.¹⁻³ Inappropriate workplace conditions such as poorly ventilated or dusty indoor environments, humidity, heat, friction, sweating, prolonged immersion in water, and existing dermatoses accentuate the damaging effect of the sensitizer agents on the skin.^{1,2,6} Increased contact with water in many wet-work job tasks may also lead to occupational dermatitis (OD).⁷⁻⁹ Additionally, genetic factors and atopy may lead to a predisposition to develop OACD.⁶ The disorder may require both

long-term treatments, lead to long-standing functional disabilities, and loss of work capacity, along with high costs of treatment in addition to their disease burden.^{1,2} Although some studies have reported contact allergens in certain textile subsectors,^{1,2,4,6,10} they either lack detailed statistics^{2,4} and address few job tasks,^{1,6} or include few subjects.¹¹ Providing detailed information to the literature on the topic is important to ensure proper control of hazards specific to textile subsectors.^{1,6,12} Also, a better understanding of the allergic potential of workplace materials is needed to update safety regulations to protect employees.¹² Little is known about subsector allergen exposure differences in clothing manufacturing, which encouraged us to do this study.

2 | MATERIAL AND METHODS

2.1 | Study population

We designed a pilot cross-sectional study, which took place between September 2018 and February 2019. Subjects were randomly selected from attending dermatology and venereology outpatient clinics of Bagcilar Research and Training Hospital of the University of Health Sciences, and who complained of dermatitis. Patients were questioned about their occupation on presentation to the clinic. Only workers in clothing manufacture with CD who met our inclusion criteria were selected for this study. Because managers are less exposed to allergens than field workers, they were not included in the study. Randomized selection was performed with random numbers generated by a computer (STATA 16 output, 2019; Stata Corp LLC). Subjects were included in the study until the number reached a previously-determined sample size. Inclusion criteria were as follows: (a) Age over 18 years; (b) CD history for at least 4 weeks; (c) work at the same subsector in clothing manufacturing for at least 3 months;

TABLE 1 Likely exposures in certain stages of textile processes

Stages of textile processes	Likely exposures
Spinning and yarn processing	Esters, fatty acids, oxyethylates, antistatic agents, biocides (triclosan, zinc pyrithion, MCI/MI, dichlorooctylisothiazolinone, dimethyl fumarate, silver particles), mineral oils, polyvinyl alcohol, polyacrylate, and Kathon oil
Weaving	Lubricants
Knitting	Lubricants
Dyeing	Disperse blue-124, disperse blue-106, Red RC salt, Orange RC salt, Bordeaux GB salt, naphthol dyes, p-phenylenediamine, p-aminophenol and p-tolylenediamine, anthraquinone, or nitro chemistries
Finishing	Epoxy resins, formaldehyde resins, urea-formaldehyde resins, colophony, synthetic resins on the basis of urea, melamine or cyclic urea derivatives insecticides such as pyrethroids, acrylates, fluoridated hydrocarbons, antiseptics and fungicides, cresol or mercury salts
Cutting	Machine oil and iron
Sewing	Different textile constituents and accessories such as metal parts made of nickel sulfate, mercaptobenzothiazole, epoxy resins, potassium dichromate, cobalt dichloride, disperse blue-106, black rubber mix, p-tert-butylphenol formaldehyde resin
Accessory	Nickel, iron, chrome, and cobalt
Ironing	Potassium dichromate, nickel sulfate, colophony, cobalt dichloride, and disperse blue-106

(d) skin disorder clinically compatible with allergic contact dermatitis (ACD); and (e) no treatment for the lesions for at least the previous 2 weeks. Subjects who had florid eczema, who underwent systemic or local corticosteroid or immunosuppressive treatments, or who had autoimmune or any immunocompromising disease, that might affect the clinical condition of the lesions and patch-test results were not included in the study. Persons having active infection, infective or traumatic lesions, or UV exposure in the tested area that might affect test responses were also excluded from the study. After enrollment, participants were patch tested. Positive patch-test results were considered to be diagnostic of ACD and a diagnosis of OACD was made in conjunction with the history, clinical examination findings, and patch-test results. Additionally, the number of "MOAHLFAP" factors; (M [male], O [occupational disease], A [atopic dermatitis], H [hand dermatitis], L [leg dermatitis], F [face dermatitis], A [age 40+], P [at least one positive]), which influence patch-test reactions to allergens, were recorded for each participant.¹³

2.2 | Participant histories and determination of working subsectors

Subjects were questioned on demographics (age, gender, and marital status), occupational history (working subsector, working duration in the same subsector (3–6, 6–9, 9–12, 12–15, and >15 months), and examined for Fitzpatrick's skin phototypes (I, II, III, IV, V, and VI), and location(s) of the lesions. Occupational subsectors were classified into eight groups as follows: Accessory, dyeing, sewing, cutting, knitting, packing, cleaning, and ironing. Locations of the lesions were classified into five different regions based on intensity, which included only hands, hands/arms, hands/legs, hands/trunk, and hands/face.

2.3 | Dermatological examination and clinical diagnosis of OCD

CD was diagnosed by a dermatologist experienced with the disease. Dermatological examination included clinical signs such as erythema, papules, vesicles, scaling, fissuring, spread of lesions, and subjective symptoms. Atopic dermatitis findings were also recorded. OCD was confirmed clinically using the following criteria: (a) Occupational contact with materials or tools known to cause similar skin findings in other individuals; (b) the presence of similar dermatitis in colleagues in the same occupation; (c) temporal relationship between exposure and dermatitis; (d) types and sites of lesions consistent with occupational exposure; and (e) episodes of dermatitis followed by an improvement or resolution period postexposure.¹⁴

2.4 | Patch-testing and confirmation of OACD

Patch test was performed in all subjects using the "Thin-layer Rapid-Use Epicutaneous" (TRUE test; Smartpractice ApS). Plasters for

provocation testing included three different allergen panels and were applied to the skin of the back for 2 days. The initial reading was done on day 2 (at 48 h), whereas delayed readings were taken on day 4 (96 h) based on the guidelines of the International Contact Dermatitis Research Group (ICDRG). Reactions were evaluated as negative (–): no reaction; doubtful (?): erythema only, no infiltration; weak positive (+): erythema, infiltration, possible discrete papules; strong positive (++) : erythema, infiltration, papules, vesicles; and extreme positive or irritant: different types of reactions (soap effect, vesicles, blister, and necrosis).^{2,15,16} Diagnosis of OACD was made based on the following criteria^{14,17,18}: (a) Clinical confirmation of lesion as OCD, as noted above; (b) history of exposure to relevant occupational allergens; (c) confirmation of a positive reaction (+ or ++) to at least one of the relevant occupational patch-test allergens; and (d) confirmation of exposure as a cause or as an important aggravating factor in the development of the lesion.

2.5 | Statistical analysis

Statistical analysis was performed with the NCSS (Number Cruncher Statistical System) software package program. Standard descriptive statistics were expressed as mean ± standard deviation and frequency distributions. Categorical variables were expressed as percentages (%). Continuous variables were age, and work and disease durations, whereas gender, marital status, phototype, workplaces, location of the lesions, allergens, and allergic responses were considered as categorical. The normality assumption of the groups was checked using the Shapiro–Wilk test. Continuous data were compared with independent-samples *t* tests whose distributions were normal. For comparison of more than two groups, such as means of different subsectors by disease duration, the Kruskal–Wallis test was used because distributions were asymmetric. Categorical variables were compared using χ^2 tests. In the multiple comparisons of subsectors by disease duration, Dunn's multiple comparison test was used. The significance of differences in means was determined using 95% confidence intervals. A $p < .05$ was considered statistically significant.

2.6 | Ethical procedures

The study was approved by the Local Ethics Committee of the University of Health Sciences (approval number: 029-02). Written informed consent was obtained from each subject at the dermatology clinic before starting the work.

3 | RESULTS

A total of 272 (173 female, 99 male) clothing employees from 14 different textile factories located in our district were diagnosed with OACD and reported here. Descriptive statistics of subjects by

TABLE 2 Descriptive statistics of subjects by MOAHLFAP factors, demographics, working duration, phototype, subsector, and location of the lesions

Variables	n	%
Male	99	36.4
Occupational dermatitis	272	100.0
Atopic dermatitis	34	12.5
Hand dermatitis	272	71.3
Leg dermatitis	2	0.7
Face dermatitis	17	6.3
Age 40+	103	37.9
P (at least one positive)	272	100.0
Age (years)		
18–28	91	33.5
29–39	78	28.7
40–50	58	21.3
>51	45	16.5
Marital status		
Married	145	53.3
Working duration (months)		
3–6	67	24.6
6–9	58	21.3
9–12	52	19.1
12–15	43	15.8
>15	52	19.1
Phototype		
I	53	19.5
II	99	36.4
III	92	33.8
IV	15	5.5
V	12	4.4
VI	1	0.4
Subsectors		
Accessory	69	25.4
Dyeing	113	41.5
Sewing	17	6.3
Cutting	7	2.6
Knitting	16	5.9
Packing	21	7.8
Cleaning	19	7.0
Ironing	10	3.7
Distribution of lesions by most concentrated locations		
Total	272	100.0
Only hands	194	71.3
Hands/arms	45	16.5
Hands/legs	2	0.7
Hands/trunk	14	5.2
Hands/face	17	6.3

MOAHLFAP factors, demographics, working-durations, phototypes, work subsectors, and location of lesions are shown in Table 2. Comparison of subsectors by age, gender, and disease duration are seen in Table 3. The mean age was 35.8 ± 2.1 years. The mean working duration was 12.1 ± 7.2 months. The minimum and maximum mean duration of work were in packing and knitting subsectors. Positive patch-test reactions to allergens are shown in Table 4. A total of 760 positive reactions were detected. One doubtful reaction to neomycin sulfate and four irritant reactions to potassium dichromate, p-tert-butylphenol formaldehyde resin, epoxy resin, and carba mix were seen. In both accessory and dyeing groups, one positive response to a blank patch was obtained. These reactions were excluded from the analyses. The most frequently detected positive test was obtained for disperse blue-106 ($n = 138$, 50.7%), whereas the least frequent were obtained for hydrocortisone-17-butyrate and mercaptobenzothiazole ($n = 4$, 1.5% for each one). A comparison of allergen responses that showed significant differences according to subsectors is shown in Table 5. Significant differences were seen for only 18 antigens. Positive patch tests for nickel sulfate were significantly higher in accessory and packing groups than in others ($p = .001$). Caine mix positivity was significantly more common in cutting and packing groups ($p = .001$). In ironing and packing groups, significantly higher positives were seen for neomycin sulfate ($p = .011$), fragrance mix ($p = .016$), p-tert-butylphenol formaldehyde resin ($p = .018$), mercapto mix ($p = .002$), and formaldehyde ($p = .011$). Positive responses for ethylenediamine dihydrochloride ($p = .004$), epoxy resin ($p = .002$), cobalt chloride ($p = .001$), and thiuram mix and bacitracin ($p = .006$ for the last two) were seen significantly more in packing. p-Phenylenediamine positivity was seen significantly more in the cleaning group ($p = .028$), whereas methyldibromo glutaronitrile ($p = .034$) and budesonide ($p = .001$) positives were much higher in the ironing group. Positivity for gold sodium thiosulfate was more common in accessory and cutting groups, whereas disperse blue-106 positivity was seen more in dyeing and cutting groups ($p = .001$ for each allergen). The relevance of subjects' work-places to their obtained allergen-positive tests was usually compatible with antigens common in certain textile processes.

4 | DISCUSSION

Approximately 30% of all dermatoses may be considered occupational, of which 90% are CD, a disease that leads to a significant economic burden and reduced quality of life.¹⁹ Mathias^{20,21} described useful diagnostic criteria for establishing occupational causation and aggravation of OCD in 1989 to determine and modify workers' health-risk factors and provide appropriate employment. Studies of OCD caused by textile work are not recent, and the majority of them are not comparable, due to differences in subject selection, description of OCD, data collection, work sectors and working conditions, different screening periods, and healthy

TABLE 3 Comparison of subsectors by age, gender, and disease duration

Variables	Accessory		Dyeing		Sewing		Cutting		Knitting		Packing		Cleaning		Ironing		p Value
	N: 69		N: 113		N: 17		N: 7		N: 16		N: 21		N: 19		N: 10		
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	
Age (years) ^a																	
18–28	17	24.6	37	32.7	5	29.4	2	28.6	8	50.0	5	23.8	10	52.6	7	70.0	.106
29–39	24	34.8	29	25.7	4	23.5	2	28.6	6	37.5	9	42.9	2	10.5	2	20.0	
40–50	17	24.6	24	21.2	6	35.3	3	42.9	2	12.5	2	9.5	3	15.8	1	10.0	
> 51	11	15.9	23	20.4	2	11.8	0	0.0	0	0.0	5	23.8	4	21.1	0	0.0	
Gender ^b																	
Male	22	31.9	46	40.7	6	35.3	3	42.9	6	37.5	7	33.3	6	31.6	3	30.0	.953
Female	47	68.1	67	59.3	11	64.7	4	57.1	10	62.5	14	66.7	13	68.4	7	70.0	
Disease duration (month) ^c																	
Mean (Min–max)	69	18.9 ± 9.7 (1.2–35.3)	113	16.8 ± 10.4 (2.2–33.7)	17	12.1 ± 12.6 (2.3–33)	7	22.5 ± 11.4 (6.9–35)	16	23.9 ± 6.5 (7.9–33.7)	21	12.0 ± 7.6 (2.1–22.5)	19	17.9 ± 9.1 (2.3–29)	10	16.7 ± 10.3 (5.9–33.2)	.003

^aIndependent-samples t test.^b χ^2 test.^cKruskal–Wallis Test.

worker-survivor effects. Moreover, employees who experience OD are more likely to quit high-exposure jobs or change their workplaces in the same manufactory.^{1,6} Kurpiewska et al.²² noted an OCD prevalence of 24% among textile workers. It is usually more common in women than in men, and increases with age, with greater rates in those older than 70. This increase with age is likely to represent longer-term exposure to potential contact allergens.²³ By contrast, textile ACD was mostly reported in men, and in those 30–40 years old in several other studies.^{1,4,6} Differing from these reports, our subjects consisted mostly of women (63.6%), similar to Lisi et al's¹⁰ study (67.5%), with the majority in the age range of 18–39. However, our mean age was lower (35.8 ± 2.1), than generally reported for ACD.^{3,18,24} We believe this reflects patterns of employment in the textile and clothing sectors in Turkey, with 63.4% of females, mainly young, in the manufacturing industry working in this sector.²⁴ There was no significant difference between textile subsectors according to age or gender. The mean working-duration of our subjects was 12.1 months, and only 35% of them had worked in their factories for more than 1 year, durations which were considerably less than those in Chen et al's¹ study. The longest and shortest mean disease durations were found in workers in the knitting and packing subsectors, with significant differences between the subsectors. In the knitting subsector, the mean disease duration was significantly higher than the sewing and packing groups. We could find no comparable information on these job risks in the current literature. However, this finding suggests that allergic sensitization in the knitting subgroup occurs earlier than in other jobs. We considered that this finding may arise from greater exposure to airborne contact allergens in this group because the knitting subsector has a dustier environment than the others. Mathur et al.⁴ reported that ACD was seen in 14 of 26 dermatitis patients (53%), and only in dyeing, rinsing, and washing workgroups, whereas wrapping workers did not have dermatitis. Singhi et al.⁶ categorized their textile employees as tie, dye, dry, and rinse workers, and indicated that the most of the lesions were in the dyeing subsector (25%), whereas the fewest cases (2%) were seen in rinsing work. Chen et al.^{1,2} surveyed sewing and ironing workers, as well as managers, and found that OACD prevalence among the workers (10.8%) was higher than seen in managers (3.2%). However, managers were not included in our study due to the fact that they are less exposed to allergens than field workers.¹ Similar to these studies, most of our employees were working in the dyeing subsector (41.5%), whereas only a few (2.6%) were in the cutting group. Occupational allergens can be detected with a sensitivity of approximately 80% with standard patch tests.²⁵ Moreover, ACD in textile industry employees is mostly attributable to dye and dye-finishing products.⁴ In Chen et al.'s¹ study, the most frequently detected allergens were nickel sulfate and cobalt dichloride overall and also in sewing and ironing workers. In their study, the main sensitizers were nickel sulfate, cobalt dichloride, and potassium dichromate in descending order both in sewing and ironing workers, whereas equal proportions of colophony and p-tert-butylphenol formaldehyde resin in managers. However, differences between the subsectors were not significant. Mathur et al.⁴ mostly detected Red RC salt

TABLE 4 Positive patch-test reactions to allergens

Allergens	Positive patch-test reactions		Allergens	Positive patch-test reactions	
	<i>n</i>	%		<i>n</i>	%
Nickel sulfate	85	31.3	Methyldibromo glutaronitrile	7	2.6
Wool alcohols	17	6.3	p-phenylenediamine	26	9.6
Neomycin sulfate	18	6.6	Formaldehyde	8	2.9
Potassium dichromate	26	9.6	Mercapto mix	10	3.7
Caine mix	12	4.4	Thiomersal	30	11.0
Fragrance mix	25	9.2	Thiuram mix	13	4.8
Colophony	9	3.3	Diazolidinyl urea	10	3.7
Paraben mix	8	2.9	Quinoline mix	7	2.6
Blank patch	2	0.7	Tixocortol-21-pivalate	8	2.9
Balsam of Peru	13	4.8	Gold sodium thiosulfate	41	15.1
Ethylenediamine dihydrochloride	13	4.8	Imidazolidinyl urea	11	4.0
Cobalt chloride	29	10.7	Budesonide	17	6.3
p-Tert-butylphenol formaldehyde resin	26	9.6	Hydrocortisone-17-butyrate	4	1.5
Epoxy resin	29	10.7	Mercapto-benzothiazole	4	1.5
Carba mix	24	8.9	Bacitracin	5	1.8
Black rubber mix	22	8.1	Parthenolide	6	2.2
Cl ⁺ Me ⁻ isothiazoline	25	9.2	Disperse blue-106	138	50.7
Quarternium-15	16	5.9	2-Bromo-2-nitropropane-1,3-diol	16	5.9

(5-chloro-O-anisidinehydrochloride) in their 14 OACD patients from all sub-sectors; their allergens nearly always belonged to dyes, and no statistical analysis was performed in their study. Similarly, in our present study, the majority of positive responses were seen in the dyeing group. Besides the other test allergens, positive responses to some antibacterials such as neomycin sulfate may appear unlikely to be work-related. However, numerous antibacterial or fungicidal substances or biocides are used in many textile processes.^{3,26,27} Wool fabric, in particular, is a suitable medium for bacteria to grow under favorable temperature and humidity conditions.^{28,29} Textiles are antimicrobially treated and are usually finished with insecticides such as pyrethroids. Fluoridated hydrocarbons in stain removers, antiseptics, and fungicides likewise can be sensitizing substances.^{3,28,29} As a consequence, observed allergic reactions to medicines such as neomycin, budesonide, or bacitracin may not be so surprising, and we considered that these positives should be accepted as OACD, both because these reactions developed across subjects' working time in textile factories, and they were diagnosed according to the OACD criteria. When assessing textile workers and occupationally related dermatitis, another logical concern may be to distinguish whether detected positives are due to workplace allergens or to workers' uniforms. This latter is a neglected source of CD and may be difficult to distinguish from work

in textiles. However, some practical clues have been proposed to diagnose clothing dermatitis: Lesions found on only on skin areas having direct contact with fabric; involvement of certain areas in which the garment contacts skin surface (e.g., the inner thigh), where the fabric is wetted during wearing (the periaxillary area, axillae, groin, antecubital and popliteal fossae and waistline), or where the skin moves repeatedly over the fabric (such as the back of the hand). In men, it can arise from stiff collars, and in women, may involve anterior and posterior axillary folds, while in both, it involves inner and anterior thighs and popliteal fossae. Sparing areas covered by underwear, dermatitis around the waist, and brassiere straps can be seen due to rubber additives. The hands, soles, and scalp are usually not involved.³⁰ Because these suggestive findings were not seen in our subjects, workers' uniform-induced dermatitis was not considered. However, we should note that clothing dermatitis cannot be completely excluded for textile workers. Among Mathias²¹ criteria for occupational causation of acquired skin disease is whether there are workplace exposures to potential cutaneous allergens. Indeed, workers' uniforms are themselves work-related exposures. Thus, uniform-induced dermatitis may be considered occupationally causative in the textile employee, independent of materials used in work tasks. Moreover, determining occupational relevance is not always a simple task even

TABLE 5 Comparison of certain allergen responses that showed significant differences by subsectors (χ^2 test)

Positive patch-test reactions																		
Allergens	Accessory		Dyeing		Sewing		Cutting		Knitting		Packing		Cleaning		Cutting		Knitting	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Nickel sulfate	58	84.1	19	16.8	0	0.0	0	0.0	2	12.5	6	28.6	0	0.0	0	0.0	0.0	.001
Neomycin sulphate	4	5.8	4	3.6	0	0.0	0	0.0	1	6.3	4	19.1	2	10.5	3	30.0	30.0	.011
Caine mix	2	2.9	3	2.7	0	0.0	1	14.3	0	0.0	5	23.8	1	5.3	0	0.0	0.0	.001
Fragrance mix	3	4.4	12	10.6	0	0.0	0	0.0	0	0.0	6	28.6	2	10.5	2	20.0	20.0	.016
Ethylenediamine dihydrochloride	1	1.5	6	5.3	0	0.0	0	0.0	0	0.0	5	23.8	1	5.3	0	0.0	0.0	.004
Cobalt chloride	5	7.3	10	8.9	0	0.0	0	0.0	1	6.3	11	52.4	1	5.3	1	10.0	10.0	.001
p-Tert-formaldehyde resin	5	7.3	8	7.1	0	0.0	1	14.3	1	6.3	6	28.6	2	10.5	3	30.0	30.0	.018
Epoxy resin	8	11.6	8	7.1	0	0.0	0	0.0	2	12.5	8	38.1	3	15.8	0	0.0	0.0	.002
Carba mix	3	4.4	7	6.3	0	0.0	0	0.0	4	25.0	7	33.3	3	15.8	0	0.0	0.0	.001
Methyldibromo glutaronitrile	1	1.5	2	1.8	0	0.0	0	0.0	1	6.3	1	4.8	0	0.0	2	20.0	20.0	.034
p-Phenylenediamine	0	0.0	16	14.2	1	5.9	0	0.0	2	12.5	3	14.3	4	21.1	0	0.0	0.0	.028
Formaldehyde	0	0.0	1	0.9	1	5.9	0	0.0	0	0.0	3	14.3	1	5.3	2	20.0	20.0	.001
Mercapto mix	1	1.5	1	0.9	1	5.9	0	0.0	2	12.5	3	14.3	0	0.0	2	20.0	20.0	.002
Thiuram mix	3	4.4	4	3.5	0	0.0	0	0.0	1	6.25	5	23.81	0	0.0	0	0.0	0.0	.006
Gold sodium thiosulfate	28	40.7	9	8.0	0	0.0	1	14.3	0	0.0	2	9.5	1	5.3	0	0.0	0.0	.001
Budesonide	4	5.8	6	5.3	0	0.0	0	0.0	1	6.3	0	0.0	1	5.26	5	50.0	50.0	.001
Bacitracin	1	1.5	1	0.9	0	0.0	0	0.0	0	0.0	3	14.3	0	0.0	0	0.0	0.0	.006
Disperse blue-106	12	17.4	105	92.9	3	17.7	6	85.7	6	37.5	4	19.1	1	5.3	1	10.0	10.0	.001

with careful history taking. Textbooks on contact dermatitis are inadequate resources in this regard. A simple and pragmatic method has been proposed to associate positive reactions with the lesion. When the patient is exposed to known or suspected allergens during the current episode of dermatitis and improves when the exposure ceases, practically it is accepted as OCD.³¹ Indeed, considering the aforementioned likely allergens in certain stages of textile processes and patients' histories, there was a general and meaningful compatibility between the detected allergens and their current workplaces. Furthermore, in accordance with the diagnostic criteria for OACD, such as workers' histories, clinical confirmation of lesion as OCD, presence of exposure to likely relevant occupational allergens, and confirmation of a positive reaction to at least one of the relevant patch-test allergens,^{14,17,18,21} we considered that the lesions we saw deserved to be considered as OACD.

4.1 | Study limitations

The present study is not without limitations. First, a relatively low number of subjects from a single dermatology clinic, and employees from only 14 factories, can raise concerns regarding the validity of our findings. Additionally, performing examinations and patch tests of subjects in only one dermatology clinic may lead to possible bias. However, there is no similar and comprehensive study comparing textile workplace allergens in Turkey, and also in the related literature. Indeed, this study was performed as a pilot study on this topic. Moreover, our hospital is located in the major manufacturing center of clothing in Turkey.²⁴ Thus, we believe that our results are noteworthy, and provide an overall picture of the characteristics of OACD seen by work task or sector in clothing workers. A second limitation is the inequality in the number of subjects employed in different work sectors. However, we believe that this inequality is not a disadvantage, and may in some sense be valuable in indicating the real distributions of exposure and of OACD subjects. It is still important epidemiologically because no similar study has been conducted on this subject in our country. Lastly, perhaps, the most important shortcoming was the inability to study our subjects with textile-specific allergens, because we did not have them. Nevertheless, the results we obtained, support that, not only exposures specific to the work but also common contact allergens play an important role in the development of textile OACD. Conducting broad-based studies with large sample sizes can be difficult, due to the differences in exposures, work conditions, changes in working time, short-term employment, or workplace rotations of the workers. Therefore, long-term, broad-based, and comparative studies are needed to better understand the topic.

5 | CONCLUSIONS

Although improvements in industrial safety and occupational health have been increasing in recent years, a better understanding of workplace-mediated causes of OACD is necessary to take targeted measures. Certain contact allergens may play specific roles in different subsectors

of textile employment. Careful monitoring of workers for excessive exposures and for early signs of contact dermatitis is warranted.

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CONFLICT OF INTEREST

The author declares that there is no conflict of interest.

DISCLOSURE BY AJIM EDITOR OF RECORD

John Meyer declares that he has no conflict of interest in the review and publication decision regarding this article.

AUTHOR CONTRIBUTIONS

Betul Tas conceptualized and designed the study, collected data, conducted data analysis and interpretation, and wrote the manuscript. The author approved the final version to be published and agreed to be accountable for all aspects of the study in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

ETHICS APPROVAL AND INFORMED CONSENT

The study was approved by the Ethics Committee at the University of Health Sciences, Istanbul Bagcilar Research and Training Hospital. Required written informed consent was obtained from each participant for inclusion in this study and this manuscript.

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