

Occupational contact dermatitis in a gender perspective: North East Italian data 1996-2016

MARCELLA MAURO¹, MASSIMO BOVENZI¹, FRANCESCA LARESE FILON¹

¹Clinical Unit of Occupational Medicine, Department of Medical Sciences, University of Trieste

KEY WORDS: Occupational contact dermatitis; patch test; sex

SUMMARY

Background: Occupational contact dermatitis (OCD) ranks high among occupational diseases in Europe, but little is known as regards OCD and jobs in a gender perspective. **Objectives:** To evaluate sex prevalence of OCD according to occupational sectors and agents involved. 27381 patients (1996–2016) with suspected irritant/allergic contact dermatitis (ICD-ACD) were evaluated in North-Eastern Italy. Each patient underwent: a standardized questionnaire, a dermatologist/occupational physician evaluation and a patch test. **Results:** Females were younger at diagnosis (35.2 ± 11.6 years vs 37.7 ± 12.6 in males, $p < 0.001$) and had a lower ICD prevalence (OR 0.58, C.I. 95% 0.51 – 0.66, $p < 0.001$). Job categories most involved differed between sexes, with highest rank for health-care professionals in females and machinery mechanics and filters for males. In females ACD percentage was higher in all job categories. **Conclusions:** OCD characteristics differ between sexes, according to intrinsic and extrinsic factors. Use of personal care products, housekeeping products and outdoor work activities may account for different sensitization profiles.

INTRODUCTION

Occupational contact dermatitis ranks among the occupational diseases most recognized in European countries (6, 7). Epidemiological studies have extensively focused on individual and environmental/occupational risk factors but little knowledge exist up to date as regards sex prevalence of contact dermatitis according to occupational sectors. Human skin biophysical properties are influenced by steroid hormones and so may vary according to sex (21).

Moreover, in some professional activities there is still a gender predominance (12), due to different characteristic between sexes, such as manual dexterity (11), biomechanic overload, and stress resistance (27) - to cite some - which can result in a different gender exposure to specific irritant and sensitizing agents. Experimental studies have been conducted to investigate skin differences between sexes, but results are controversial (3-5, 8-9, 13-14, 17, 20, 22, 26, 30-33). One study found that female skin thickness is thinner at all ages compared to men, due to a lower col-

Received 13.5.2020 - Accepted 25.9.2020

Corresponding author: Marcella Mauro, Clinical Unit of Occupational Medicine, Department of Medical Sciences, University of Trieste, Via della Pietà 2/2, 34100 Trieste, Italy - Tel +39 040 3992451 - E-mail: marcella.mauro82@gmail.com

Financial support: this study was supported by a grant from UNIFARCO S.p.A. - Santa Giustina (BL) - Via Cal Longa, 62 - Belluno Companies Register no. 58982

 open access www.lamedicinadellavoro.it

lagen content (30), while studies on the stratum corneum (SC) - the most important skin barrier layer - showed no clear relationship between SC thickness and gender (31, 33, 26, 34). One study analyzed tape stripping in both sexes and showed a significantly different protein composition of SC between gender (17) and another one showed a significantly thicker cellular epidermis in males compared to females (26), but the consequences of these findings in terms of skin permeability are still unclear.

The aim of our study was to investigate the characteristics of occupational contact dermatitis according to occupational sector and sex in our region. Clinical population consisted of consecutive patients, which succeed to dermatological/occupational medicine departments for suspected contact dermatitis in the period 1996-2016 and were patch tested.

METHODS

Study population

A total of 27381 consecutive patients were included in the analysis, as they had symptoms and/or signs of allergic or irritant contact dermatitis and came to the attention to one of the five departments of dermatology or occupational medicine in North-east Italy - Trieste, Padua, Pordenone, Rovigo and Trento-Bolzano - in the period between 1st January 1996 and 31st December 2016. All of them were administered a standardized questionnaire (25), were patch tested (18) and information was inserted in a single database. The questionnaire was designed to get information on their individual characteristics, personal and familial atopy tendency (asthma and/or allergic rhino-conjunctivitis with at least one positive prick test reaction to relevant aeroallergens) and occupational history. Job categories were defined according to ISCO 1988 codes (16). Specific body sites (e.g. fingers, palms and dorsa of hands) were aggregated into larger categories (e.g. "hands"). Occupational sectors such as constructions workers and cleaners, which showed an almost complete gender segregation (100% men in the first case and 100% women in the second), were excluded from the comparative analysis between sexes. Clerks were

used as internal control group, as they have comparable age range and sex distribution compared to other job categories but do not have significant job exposure to irritant agents or allergens. Nevertheless, this involves a possible bias due to different attention to dermatological problems and different expected result from a dermatological/allergological examination, as in this case the visit did not result in a recommendation for a removal from an exposure or in a job change.

Patch testing

Patch testing was performed with the European baseline series (Finn Chambers® on Scanpor® tape - Epitest Ltd, Tuusula, Finland), and a selection of haptens from FIRMA (Firenze, Italy) were applied to the upper back (25). The occlusion time was 48 hrs (D2), and readings were carried out at 72(D3)/96(D4) hours, according to the recommendations of the International Contact Dermatitis Research Group (25). Homogeneous redness and infiltration in the entire test area were the minimum requirement for a positive reaction. Reactions of strength +, ++ and +++ in the second examination were interpreted as positive responses. Irritant, doubtful and negative reactions were considered as negative responses.

Statistical methods

Data analysis was performed with the software STATA™ v. 12.0 (Stata Corp., LP, College Station, TX, USA). Categorical data were cross-tabulated into $k \times k$ contingency tables and compared using the chi-square test. Occupational contact dermatitis has been analyzed according to sex. Risk associated with gender was analyzed using Mantel-Haenszel Odds Ratios and 95% Confidence Intervals and men as reference category. Patch test positive results were analyzed by multivariate logistic regression analysis considering patient occupation (clerks as reference work category). Odds ratios (ORs) and 95% confidence intervals (CIs) were estimated from the coefficients and the standard errors of logistic regression output. Patients with missing data for relevant variables were excluded from analysis. A p-

value of <0.05 was established as the limit of statistical significance.

Diagnosis

For each case, a final diagnosis was made by the treating physician and entered in the database, together with the relationship between the current dermatitis and occupation. Allergic contact dermatitis was diagnosed if patch test results showed one or more positive reactions, while diagnosis of irritant contact dermatitis was made if patch test showed negative reactions. Occupational contact dermatitis was defined by the dermatologist or occupational physician when clinically associated with relevant allergen exposure in the workplace (n. 1962 in occupied workers and n. 137 in retired, unemployed, housewives). Hand dermatitis defined of “unknown origin” in hairdressers (n. 75), mechanics (n. 349), construction workers (n. 319), housekeeping and restaurant service workers (n. 431) and health care workers – HCWs (n. 724) were subsequently re-coded as “professional” if the hapten/s which gave a positive reaction was/were commonly present in the relative occupational scenario, as in those specific settings the occupational origin is highly probable and the technical or safety data sheets of the products used are hardly available in the daily outpatient practice (n. 2035).

RESULTS

Demographics

The study population comprised 27381 patients (18531 females and 8850 males) among which 3997 (15%) received a final diagnosis of occupational contact dermatitis (OCD). Females had a slightly lower rate of OCD compared to males (13% vs 17%). The mean age at diagnosis was significantly lower in females (35.2 ± 11.6 years in women vs 37.7 ± 12.6 in men, $p < 0.001$), who also had a significantly lower prevalence of irritant contact dermatitis (ICD) (OR 0.58, C.I. 95% 0.51 - 0.66, $p < 0.001$). Face dermatitis was significantly more prevalent in females ($p = 0.002$), where ACD represent 34.7% of the cases. Nickel, cobalt, chrome, thimerosal and perfumes rank higher among sensitizing agents, with positive reactions in 85.5%, 32.7%, 31%, 29.1% and 23.6% cases, respectively, of face dermatitis in women. In 2 cases we found a sensitization to epoxy resin causing an airborne dermatitis. No difference between sexes was found according to atopic dermatitis history (6.1 % in females and 5.1 % in males) (Table 1).

Occupational dermatitis according to job category and gender

For males ACD and ICD distribution was similar in most employment sectors (Figure 1), while

Table 1 - Demographic of occupational dermatitis features according to sex. Odds ratios (OR) and 95% Confidence Intervals (CI) are calculated considering males as reference category. Significant results are reported in bold

	Males	Females	Total	OR (C.I. 95%)
Number	1548	2449	3997	1.4 (1.3-1.5)
Mean age \pm SD	37.7 \pm 12.4*	35.2 \pm 11.6	36.2 \pm 12.0	
Age at 1 st symptoms age \pm SD	35.0 \pm 13.0*	31.8 \pm 12.0	33.0 \pm 12.6	
Age > 40 years n. (%)	623 (40.2)	827 (33.8)	1450 (36.3)	0.8 (0.7-0.9)
Atopic dermatitis n. (%)	69 (5.1)	130 (6.1)	169 (5.7)	1.2 (0.9-1.6)
ICD n. (%)	771 (49.8)	897 (36.6)	1668 (41.7)	0.6 (0.5-0.7)
Hand n. (%)	1325 (85.6)	2083 (85.1)	3408 (85.3)	0.9 (0.8-1.1)
Leg n. (%)	33 (2.1)	43 (1.8)	76 (1.9)	0.8 (0.5-1.3)
Face n. (%)	55 (3.6)	141 (5.8)	196 (4.9)	1.6 (1.2-2.3)

* $p < 0.05$

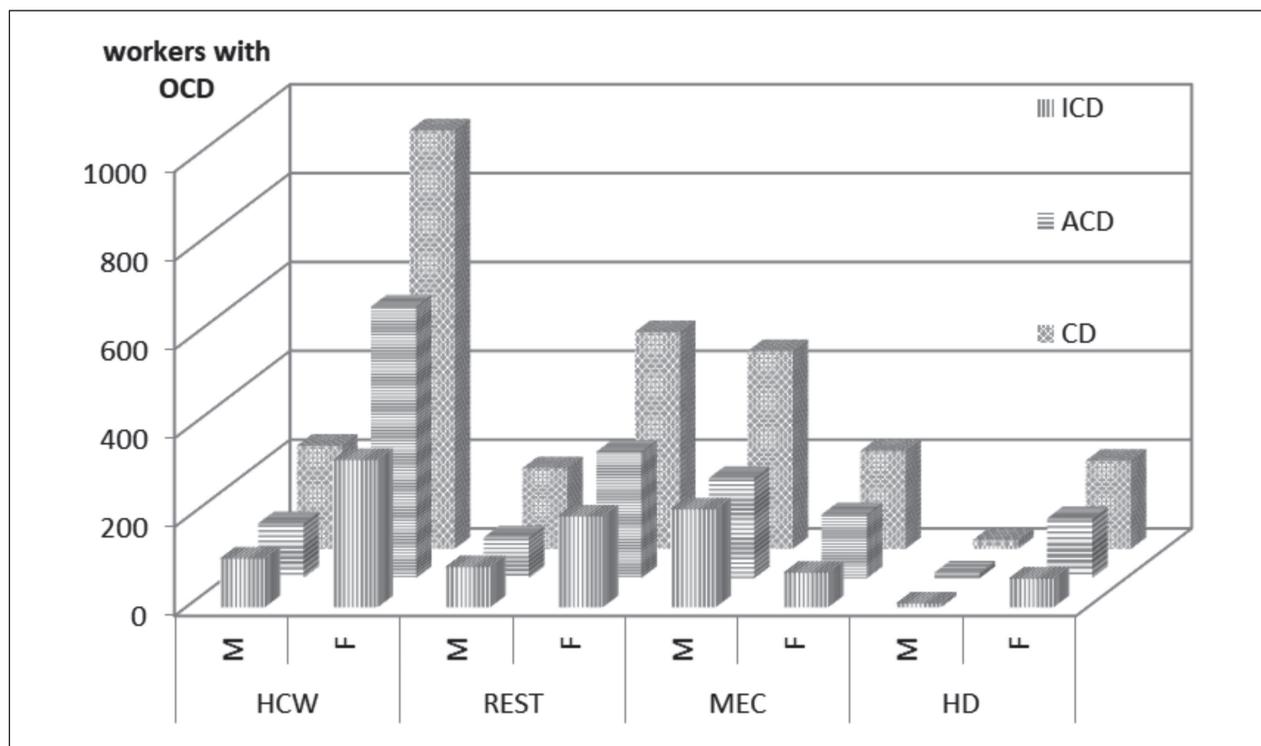


Figure 1 - Sex distribution of occupational contact dermatitis (OCD) - and subclassification in irritant (ICD) and allergic forms (ACD) - according to working categories. Job legend: HC= healthcare, REST= housekeeping and restaurant service, HD= hairdressers, MEC= machinery mechanics and filters

for females ACD forms were higher in almost all job categories, reaching 65% of the total OCD in healthcare sector, significantly higher compared to males (OR 2.2, C.I. 1.65-2.97). The job categories with higher prevalence of OCD were different between sexes. Female top four jobs most involved in OCD were 1st healthcare professionals, 2nd housekeeping and restaurant services workers, 3rd machinery mechanics and filters and 4th hairdressers, while for males were 1st machinery mechanics and filters, 2nd building frame and related trades workers (only men), 3rd healthcare professionals and 4th housekeeping and restaurant services workers (Figure 2). Comparing genders, female hairdressers and healthcare professionals have an increased risk to develop OCD compared to males, while OCD in female mechanics, chemical workers and drivers are significantly lower, compared to males (Table 2).

The four most frequent sensitizing agents in the healthcare sector were the same for both sexes, but specific prevalence changed a lot for each hapten:

1st nickel (40.3%), 2nd cobalt chloride (11.3%), 3rd thimerosal (10.6%) and 4th potassium dichromate (8.2%) for women, and 1st nickel (12.1%), 2nd potassium dichromate (11.9%), 3rd cobalt chloride (11.2%) and 4th thimerosal (10.8%), for men. Nickel, thimerosal, potassium dichromate and formaldehyde resulted significantly associated with occupational ACD in females HCWs compared to female clerks, even if not clinically relevant from an occupational-exposure management point of view. Thimerosal, cobalt chloride, potassium dichromate, carba mix and thiuram mix were the significant ones in male HCWs compared to male clerks (Table 3).

The three most frequent sensitizing agents in hairdressers were also similar for both sexes, with different prevalence and ranking between sexes. For women: 1st nickel (41.1%), 2nd p-phenyldiamine (23.7%), 3rd cobalt chloride (10.1%); for men: 1st nickel (12.1%), 2nd potassium dichromate (11.9%), 3rd cobalt chloride (10.0%). Between them only p-phenyldiamine sensitization resulted significantly



Figure 2 - Percentages of occupational contact dermatitis (OCD) by occupational sector according to sex

Table 2. Association between occupational dermatitis and gender in different occupational sectors. Reference category males. Results are reported as Odds ratios (OR) and 95% Confidence Intervals (95% CI). Significant differences are reported in bold

Occupational dermatitis in different sectors total n. (% female)	OR (CI 95%)
Hairdressers n. 218 (90.8)	4.70 (2.65 - 8.35)
Healthcare professionals n. 1174 (80.2)	1.93 (1.33 - 2.80)
Housekeeping and restaurant services workers n. 669 (72.9)	0.92 (0.7 - 1.2)
Machinery mechanics and filters n. 665 (33.1)	0.2 (0.16 - 0.34)
Chemical workers n. 49 (40.8)	0.3 (0.17 - 0.64)
Drivers n. 22 (22.7)	0.14 (0.05 - 0.40)
Others n. 1217 (47.6)	0.4 (0.35 - 0.45)

Table 3 - Top sensitizers in health care workers (HCW) with occupational dermatitis compared to clerks. Odds ratios (OR) and 95% Confidence Intervals (CI) are adjusted for age using multivariate logistic regression

	Females			Males		
	HCW	Clerks	OR (IC95%)	HCW	Clerks	OR (IC95%)
No. of subjects	2184	4834		563	2099	
Nickel sulphate 5% No. (%)	883 (40.3)	1844 (38.1)	1.1 (1-1.2)	71 (12.1)	237 (11.3)	1.1 (0.8-1.5)
Thimerosal 0.1% No. (%)	231 (10.6)	344 (7.1)	1.6 (1.3-1.9)	61 (10.8)	129 (6.1)	1.9 (1.4-2.7)
Cobalt chloride 1% No. (%)	247 (11.3)	560 (11.6)	0.98 (0.8-1.1)	63 (11.2)	166 (7.9)	1.5 (1.1-2.0)
Potassium dichromate 0.1% No. (%)	179 (8.2)	271 (5.6)	1.5 (1.2-1.8)	67 (11.9)	155 (7.4)	1.6 (1.2-2.2)
Fragrance mix-1 No. (%)	146 (6.7)	376 (7.8)	0.84 (0.7-1.0)	376 (7.8)	120 (5.7)	1.2 (0.8-1.7)
Balsam of Peru 25% No. (%)	207 (4.3)	207 (4.3)	1.2 (0.98-1.6)	51 (9.6)	105 (5)	1.7 (1.2-2.5)
Formaldehyde 1% No. (%)	75 (3.4)	115 (2.4)	1.47 (1.1-2.0)	21 (3.1)	54 (2.6)	1.4 (0.9-2.4)
Carba mix No. (%)	71 (3.2)	140 (2.9)	1.1 (0.8-1.5)	43 (7.6)	107 (5.1)	1.5 (1.0-2.2)
Thiuram mix No. (%)	38 (1.7)	58 (1.2)	1.4 (0.96-2.2)	11 (1.9)	17 (0.8)	2.2 (1.0-4.7)

associated to work as hairdressers and barbers compared to clerks, while thiuram mix sensitization resulted significantly higher only in women. For the other happens the sensitization prevalence was similar to the reference category (clerks) (Table 4).

The three most frequent sensitizing agents in machinery mechanics and filters were the same for both sexes, with prevalence as follows between sexes: 1st nickel (46.4% for women and 11.1% for men), 2nd cobalt chloride (13.6% for women and 9.0% for men), 3rd thimerosal for women (7.7%) and potassium dichromate for men (8.5%). ACD due to nickel in women and thiuram mix in both sexes were sig-

nificantly associated to machinery mechanics compared to clerks (Table 5).

As regards the housekeeping and restaurant sector, the most frequent sensitizing agents were nickel (37.9% for women and 14.9% for men), followed by fragrance mix (7.6%) and cobalt chloride (7%) for women and carba mix (7.2%) and thimerosal for men (6.6%). Occupational ACD due to thiuram mix in both sexes was significantly associated to housekeeping and restaurant workers compared to clerks, while occupational ACD due to cobalt chloride in female housekeepers was significantly lower compare to female clerks (Table 6).

Table 4 - Top 6 sensitizers in hairdressers with occupational dermatitis compared to clerks. Odds ratios (OR) and 95% Confidence Intervals (CI) are adjusted for age using multivariate logistic regression

	Females			Males		
	Hairdressers	Clerks	OR (IC95%)	Hairdressers	Clerks	OR (IC95%)
No. of subjects	128	4834		20	2099	
Nickel sulphate 5% No. (%)	81 (41.1)	1844 (38.1)	1.1 (0.8-1.5)	4 (20.0)	237 (11.3)	2.0 (0.6-5.9)
p-phenylendiamine 1% No. (%)	47 (23.7)	159 (3.3)	9.1 (6.4-13.2)	6 (30.0)	27 (1.3)	32.9 (11.7-92)
Cobalt chloride 1% No. (%)	20 (10.1)	560 (11.6)	0.8 (0.5-1.4)	2 (10.0)	166 (7.9)	1.3 (0.3-5.7)
Thiurams mix No. (%)	9 (4.6)	58 (1.2)	3.9 (1.8-8.0)	0	17 (0.8)	-
Fragrance mix-1 No. (%)	16 (8.1)	376 (7.8)	1.0 (0.6-1.9)	0	120 (5.7)	-
Balsam of Peru 25% No. (%)	9 (4.5)	207 (4.3)	1.1 (0.6-2.2)	1 (5)	105 (5)	1.2 (0.2-8.9)

Table 5 - Top sensitizers in Machinery mechanics and filters with occupational dermatitis compared to clerks. Odds ratios (OR) and 95% Confidence Intervals (CI) are adjusted for age using multivariate logistic regression

	Females			Males		
	Mechanics	Clerks	OR (IC95%)	Mechanics	Clerks	OR (IC95%)
No. of subjects	220	4834		445	2099	
Nickel sulfate 5% No. (%)	102 (46.4)	1844 (38.1)	1.4 (1.1-1.8)	49 (11.1)	237 (11.3)	0.97 (0.7-1.3)
Cobalt chloride 1% No. (%)	30 (13.6)	560 (11.6)	1.2 (0.8-1.8)	40 (9.0)	166 (7.9)	1.15 (0.8-1.6)
Thimerosal 0.1% No. (%)	17 (7.7)	344 (7.1)	1.1 (0.6-1.8)	31 (7.0)	129 (6.1)	1.2 (0.8-1.7)
Fragrance mix-1 No. (%)	13 (5.9)	376 (7.8)	0.76 (0.4-1.6)	24 (5.4)	120 (5.7)	0.91 (0.6-1.4)
Potassium dichromate 0.1% No. (%)	11 (5.0)	271 (5.6)	0.89 (0.48-1.7)	38 (8.5)	155 (7.4)	1.2 (0.8-1.7)
Kathon GC No. (%)	9 (4.1)	203 (4.2)	0.96 (0.48-1.9)	23 (5.2)	83 (3.4)	1.3 (0.8-2.1)
Formaldehyde 1% No. (%)	7 (3.2)	115 (2.4)	1.3 (0.8-1.9)	15 (3.4)	54 (2.6)	1.3 (0.7-2.4)
Carba mix No. (%)	7 (3.2)	140 (2.9)	1.1 (0.5-2.4)	26 (5.8)	107 (5.1)	1.1 (0.7-1.8)
Balsam of Peru 25% No. (%)	6 (2.7)	207 (4.3)	0.63 (0.3-1.4)	21 (4.7)	105 (5)	0.9 (0.6-1.5)
Thiuram mix No. (%)	8 (3.6)	58 (1.2)	3.1 (1.5-6.6)	16 (3.6)	17 (0.8)	4.5 (2.3-9.0)

Table 6 - Top sensitizers in Housekeeping and Restaurant Services (Hotel) with occupational dermatitis compared to clerks. Odds ratios (OR) and 95% Confidence Intervals (CI) are adjusted for age using multivariate logistic regression

	Females			Males		
	Hotel	Clerks	OR (IC95%)	Hotel	Clerks	OR (IC95%)
No. of subjects	488	4834		181	2099	
Nickel sulfate 5% No. (%)	165 (37.9)	1844 (38.1)	0.99 (0.8-1.2)	27 (14.9)	237 (11.3)	1.4 (0.9-2.1)
Cobalt chloride 1% No. (%)	34 (7.0)	560 (11.6)	0.57 (0.4-8.2)	9 (5.0)	166 (7.9)	0.61 (0.3-1.2)
Thimerosal 0.1% No. (%)	31 (6.3)	344 (7.1)	0.89 (0.6-1.3)	12 (6.6)	129 (6.1)	1.0 (0.54-1.8)
Fragrance mix-1 No. (%)	37 (7.6)	376 (7.8)	1.0 (0.68-1.4)	11 (6.1)	120 (5.7)	1.1 (0.6-2.2)
Potassium dichromate 0.1% No. (%)	28 (5.7)	271 (5.6)	1.0 (0.67-1.5)	11 (6.1)	155 (7.4)	0.84 (0.4-1.6)
Carba mix No. (%)	13 (2.7)	140 (2.9)	0.9 (0.5-1.6)	13 (7.2)	107 (5.1)	1.5 (0.8-2.7)
Balsam of Peru 25% No. (%)	27 (5.5)	207 (4.3)	1.3 (0.0-2.0)	10 (5.5)	105 (5)	1.22 (0.6-2.4)
Thiuram mix No. (%)	16 (3.3)	58 (1.2)	2.8 (1.6-4.9)	6 (3.3)	17 (0.8)	4.6 (1.8-11.9)

DISCUSSION AND CONCLUSIONS

To date there are not many studies that investigated OCD prevalence according to gender and job categories. It is conceivable that a different gender prevalence of dermatitis may exist due to: 1. a possible difference in skin structure between sexes, and 2. the gender segregation which is still present in some occupations, that, in turn, may vary the types of irritant and sensitizing agents that come in contact with female and male skin.

Our observational and retrospective study on 27381 patients found that the age at diagnosis for OCD in women was younger compared to men. This is in line with results of a Danish patient-based register study conducted by Schwensen and colleagues who investigated 1000 cases of severe OCD diagnosed at Gentofte University Hospital and could be explained in different ways (28). It is possible that a higher hapten penetration through female skin does take place, since there is evidence of a thinner thickness of female skin due to either lower testosterone levels (3, 8), lower epidermal cellular density (26) and lower collagen content in female skin at all ages compared with men (30). Moreover, it has been demonstrated a higher female skin permeability to some organic compounds (i.e. benzoic acid, cortisone, urea and trichloroethylene) in animal studies (3, 21).

Furthermore, we found that while in men the proportion of ICD and ACD is well balanced and

almost equal, in women the proportion of ACD is higher in almost all job categories, reaching highest values in the healthcare sector (65%). This is partially in line with results of a French study conducted by Bensefa and colleagues (1), investigating 3738 cases of occupational ACD recorded in the period 2001-2010 in the national network of occupational diseases vigilance and prevention (RNV3P). They found that young females (aged 20-29 years) had a higher prevalence of ACD compared to men, while with aging the prevalence between the sexes is reversed with a higher value in men (aged 30-60 years).

Our study showed also that occupations with higher prevalence of OCD differ between sexes, a finding that is in line with all the epidemiological studies available and which reflects the phenomenon of gender segregation, that has always been present in the labor market and whose characteristics varied during decades. In fact women with OCD were 90.8% of the hairdressers and 80.2% of the healthcare workers (HCW) tested, as resulted in other European data (23). Instead, among machinery mechanics, chemical workers and drivers of the working population tested, women represent only 33%, 40% and 22% respectively. This could explain the lower risk of OCD compared to men in these three last sectors. Cleaners and building workers were excluded from the analysis since in the first category almost all workers were females and in the

second almost all males, so comparisons could not be done.

The higher prevalence of OCD in females was found in these sectors in decreasing order: healthcare workers, restaurateurs, mechanics and hairdressers, findings which are partially in line with French and Danish data (1, 28). In both the cited studies healthcare workers and hairdressers are in the top three professions involved, even if with a different order (for the French: 1st hairdressers, 2nd nursing and associate professions and 3rd cleaners, while for the Danish: 1st nursing and nursing assistant, 2nd hairdressers and 3rd cleaners). Women in the restaurant sector rank at the 2nd place only in our clinical population, even if in a time trend analysis Bensefa and colleagues report this sector among the ones with a significant increase in OCD onset. In our study the 3rd place is occupied by mechanics, while in both the French and Danish studies at 3rd place stand cleaners, an interesting difference.

As regards OCD in men, we found a high prevalence in these sectors in decreasing order: mechanics, construction builders and healthcare workers. While mechanics rank at the top three occupations in French and Danish data too, masons appear only in the French data. Healthcare workers reach the podium at the 3rd position only in our clinical population, while in the Danish and French study, cooks and bakers are professions, respectively, at 1st and 3rd place in OCD prevalence. A higher prevalence of hand eczema in men is reported also in a survey on 3181 healthcare workers conducted by Ibler and colleagues (15), but in that case the diagnosis was not specified, nor the occupational correlation.

To understand the role of occupational exposure in the diagnosis of ACD in each working sector we compared the positive reactions to single haptens between specific working groups and clerks, divided by sex. Results showed that haptens more relevant in causing occupational ACD not always were the most prevalent and changed between sexes.

In HCWs with OCD we found relevant sensitization to thimerosal in both sexes, formaldehyde in females, carba mix and thiurams mix in males, which is in line with other studies on ACD in HCWs (19, 24), even if no gender data exist to make a comparison. Moreover, we found a relevant association with

potassium dichromate in both sexes, data that may be explained by the use of working shoes, which usually have a leather plantar in hospital supplies in Italy.

Sensitization to p-phenylenediamine in hairdressers is well known (29), and in our data is significantly associated with occupational exposure too. What is new is that this association is more higher in men compared to women (OR 23.9; CI95% 11.7-93 vs OR 9.1; CI95% 6.5-13.2, respectively).

In machinery mechanics, housekeeping and restaurant workers with OCD we found a relevant sensitization to thiuram mix in both sexes – which can be explained by the use of protective equipment – while nickel was significant only in women mechanics. The above discussed findings partially reflect the already cited gender segregation phenomenon, which is partially country-specific and may involve the local labor market, culture, and broader institutional context. Studies conducted to investigate the root cause analysis delineates multifactorial elements, which can weigh differently. Physical differences – i.e. muscular power, resilience or dexterity – have been almost completely evened out by the technological progress in most of the primary sectors, so other factors have been implicated such as neurobehavioral abilities, gender-related preferences for some occupations, economical and sociological factors, entry barriers and organizational practices (2, 10).

We found that OCD characteristics between sexes are different in terms of job involved and haptens more relevant. Behavioral aspects have to be considered, such as the use of personal care products and housekeeping products or outdoor work activities, which may partially account for different sensitization profiles between sexes. Some data are new, as the high relevance of PPD sensitization in male hairdressers and deserve more attention in future epidemiological studies.

REFERENCES

1. Bensefa-Colas L, Telle-Lamberton M, Paris C, et al: French National Network of Occupational Disease Vigilance Prevention (RNV3P), Momas I. Occupational allergic contact dermatitis and major allergens in France: temporal trends for the period 2001-2010. *Br J Derma-*

- tol 2014; 171:1375–85. doi: 10.1111/bjd.13133
2. Bettio F: The Pros and Cons of Occupational Gender Segregation in Europe. Source: Canadian Public Policy / Analyse de Politiques, Occupational Gender Segregation: Public Policies and Economic Forces 2002; 28Suppl: S65–S84. Published by: University of Toronto Press on behalf of Canadian Public Policy, Stable URL: <https://www.jstor.org/stable/3552344> Accessed 10.01.2019
 3. Bronaugh RL, Stewart RF, Congdon ER: Differences in permeability of rat skin related to sex and body site. *J Soc Cosmet Chem* 1983; 34: 127–135
 4. Cotterill JA, Cunliffe WJ, Williamson B, Bulusu L: Age and sex variation in skin surface lipid composition and sebum excretion rate. *Br J Dermatol* 1972; 87: 333–340
 5. Dąbrowska AK, Spano F, Derler S, et al: The relationship between skin function, barrier properties, and body-dependent factors. *Skin Res Technol* 2018; 24: 165–174. doi: 10.1111/srt.12424
 6. Deutsche Gesetzliche Unfallversicherung e.V. (DGUV). DGUV statistics 2013. Figures and long-term trends. Available at: <http://www.dguv.de/medien/inhalt/zahlen/documents/schueler/dguvstatistiken2013e.pdf> Accessed 20.11.2019
 7. Diepgen TL, Coenraads PJ: The epidemiology of occupational contact dermatitis. *Int Arch Occup Environ Health* 1999; 72: 496–506. <https://doi.org/10.1007/s0042000504073>.
 8. Earty H, Grad B, LeBlond CP: The antagonistic relationship between testosterone and thyroxine in maintaining the epidermis of the male rat. *Endocrinology* 1951; 49: 677–686
 9. Ehlers C, Ivens UI, Møller ML, et al: Females have lower skin surface pH than men. A study on the surface of gender, forearm site variation, right/left difference and time of the day on the skin surface pH. *Skin Res Technol* 2001; 7: 90–94
 10. Emerek R: Gender segregation in the labour market: roots, implications and policy responses in Denmark: Report to European Commission, Directorate-General for Employment, Social Affairs and Equal Opportunities, Unit G. 1. Publications Office (2008) <https://vbn.aau.dk/en/publications/gender-segregation-in-the-labour-market-roots-implications-and-po>. Accessed 28.01.2020
 11. Epting LK, Overman WH: Sex-sensitive tasks in men and women: a search for performance fluctuations across the menstrual cycle. *Behav Neurosci* 1998; 112: 1304–1317
 12. European Foundation for the Improvement of Living and Working Conditions, 03/12/2007. Available at: https://www.eurofound.europa.eu/sites/default/files/ef_publication/field_ef_document/ef0698en.pdf Accessed 10.11.2019
 13. Firooz A, Sadr B, Babakoohi S, et al: Variation of biophysical parameters of the skin with age, gender, and body region. *Scientific World Journal* 2012;386936. doi: 10.1100/2012/386936
 14. Giacomoni PU, Mammone T, Teri M: Gender-linked differences in human skin. *J Dermatol Sci* 2009; 55: 144–149. doi: 10.1016/j.jdermsci.2009.06.001. Epub 2009 Jul 1
 15. Ibler KS, Jemec GB, Flyvholm MA, et al: Hand eczema: prevalence and risk factors of hand eczema in a population of 2274 healthcare workers. *Contact Dermatitis* 2012; 67: 200–207. doi: 10.1111/j.1600-0536.2012.02105
 16. International Standard Classification of Occupations, available at: <https://www.ilo.org/public/english/bureau/stat/isco/isco88/index.htm>. Accessed 12.01.2019
 17. Jacobi U, Gautier J, Sterry W, Lademann J: Gender-related differences in the physiology of the stratum corneum. *Dermatology* 2005; 211: 312–317
 18. Johansen JD, Aalto-Korte K, Agner T, et al: European Society of Contact Dermatitis guideline for diagnostic patch testing - recommendations on best practice. *Contact Dermatitis* 2015; 73: 195–221. doi: 10.1111/cod.12432.
 19. Kadivar S, Belsito DV: Occupational Dermatitis in Health Care Workers Evaluated for Suspected Allergic Contact Dermatitis. *Dermatitis* 2015; 26: 177–183
 20. Man MQ, Xin SJ, Song SP, et al: Variation of skin surface pH, sebum content and stratum corneum hydration with age and gender in a large Chinese population. *Skin Pharmacol Physiol* 2009; 22: 190–199. doi: 10.1159/000231524. Epub 2009 Jul 31
 21. McCormick K, Abdel-Rahman MS: The role of testosterone in trichloroethylene penetration in vitro. *Environ Res* 1991; 54: 82–92
 22. Mizukoshi K, Akamatsu H: The investigation of the skin characteristics of males focusing on gender differences, skin perception, and skin care habits. *Skin Res Technol* 2013; 19: 91–99. doi: 10.1111/srt.12012
 23. Pesonen M, Jolanki R, Larese Filon F, et al: Patch test results of the European baseline series among patients with occupational contact dermatitis across Europe - analyses of the European Surveillance System on Contact Allergy network, 2002–2010. *Contact Dermatitis* 2015; 72: 154–163. doi: 10.1111/cod.12333.
 24. Prodi A, Rui F, Belloni Fortina A, et al: Sensitization to Formaldehyde in Northeastern Italy, 1996 to 2012. *Dermatitis* 2015; 26:177–183.
 25. Rui F, Bovenzi M, Prodi A, et al: Nickel, cobalt and chromate sensitization and occupation. *Contact Dermatitis* 2010; 62: 225–231
 26. Sandby-Møller J, Poulsen T, Wulf HC: Epidermal thickness at different body sites: relationship to age, gender, pigmentation, blood content, skin type and smoking habits. *Acta Derm Venereol* 2003; 83: 410–413

27. Schondorf R, Low PA: Gender related differences in the cardiovascular responses to upright tilt in normal subjects. *Clin Auton Res* 1992; 2: 183-187
28. Schwensen JF, Friis UF, Menné T, Johansen JD: One thousand cases of severe occupational contact dermatitis. *Contact Dermatitis* 2013; 68: 259-68. doi: 10.1111/cod.12045
29. Schwensen JF, Johansen JD, Veien NK, et al: Occupational Contact Dermatitis in Hairdressers: An Analysis of Patch Test Data From the Danish Contact Dermatitis Group, 2002-2011. *Contact Dermatitis* 2014; 70: 233-237
30. Shuster S, Black MM, McVitie E: The influence of age and sex on skin thickness, skin collagen and density. *Br J Dermatol* 1975; 93: 639-643
31. Whitton JT, Everall JD: The thickness of the epidermis. *Br J Dermatol* 1973; 89: 467-476
32. Wilhelm KP, Cua AB, Maibach HI: Skin aging. Effect on transepidermal water loss, stratum corneum hydration, skin surface pH, and casual sebum content. *Arch Dermatol* 1991; 127: 1806-1809
33. Ya-Xian Z, Suetake T, Tagami H: Number of cell layers of the stratum corneum in normal skin - relationship to the anatomical location on the body, age, sex and physical parameters. *Arch Dermatol Res* 1999; 291: 555-559
34. Zhen YX, Suetake T, Tagami H: Number of cell layers of the stratum corneum in normal skin—relationship to the anatomical location on the body, age, sex and physical parameters. *Arch Dermatol Res* 1999; 291:555-559

NO POTENTIAL CONFLICT OF INTEREST RELEVANT TO THIS ARTICLE WAS REPORTED BY THE AUTHORS

ACKNOWLEDGEMENTS: *This study was supported by a grant from UNIFARCO S.p.A. - Santa Giustina (BL) - Via Cal Longa, 62 - Belluno Companies Register no. 58982.*

We acknowledge all centers members of the North – East Italy Contact Dermatitis Group (NEICDG): Dermatologic Unit, S. Chiara Hospital, Trento, Italy; Clinical Dermatology, University of Padua, Italy (Prof. Anna Belloni Fortina); Dermatologic Unit, S. Maria degli Angeli Hospital, Pordenone, Italy (Dr. Teresa Corradin); Dermatologic Unit, Hospital of Rovigo, Italy; Dermatologic Unit, S. Martino Hospital, Belluno, Italy; Dermatologic Unit, Poliambulatorio Euganea Medica, Padua, Italy.