One thousand cases of severe occupational contact dermatitis

Jakob Ferløv Schwensen[1], Ulrik Fischer Friis[1], Torkil Menné[2] and Jeanne Duus Johansen[1]

[1]*Department of Dermato-Allergology, National Allergy Research Centre, Copenhagen University Hospital Gentofte, 2900 Hellerup, Denmark and*
[2]*Department of Dermato-Allergology, Copenhagen University Hospital Gentofte, 2900 Hellerup, Denmark*

doi:10.1111/cod.12045

Summary

Background. Occupational contact dermatitis is frequent, and further understanding of the epidemiology will improve the basis of its prevention.
Objectives. To identify occupations at risk for severe occupational contact dermatitis.
Methods. The last 1000 cases of severe occupational contact dermatitis seen at our department were identified.
Results. The study population comprised 618 females and 382 males. The mean age at onset of irritant contact dermatitis was significantly lower than the mean age at onset of allergic contact dermatitis for both sexes, irrespective of the presence of atopic dermatitis. Females at high riskwere cooks, butchers, beauticians, bakers, and hairdressers, ranging from 23.3 to 96.8 cases per 10 000 workers per year. Males at high risk were painters, cooks, mechanics, locksmiths, and bakers, ranging from 16.5 to 32.3 cases per 10 000 workers per year.
Conclusions. Occupational contact dermatitis remains frequent, even if only severe cases are considered. It is a concern that no effective, systematic interventions and prevention schemes have been launched in Europe, despite documentation of a significant problem overmany years, and knowledge of risk occupations and risk factors. This study suggests new approaches for general and specific prevention of occupational contact dermatitis.

Key words: allergic contact dermatitis; atopic dermatitis; incidence rate; irritant contact dermatitis; mean age; occupational contact dermatitis; prevention.

Occupational contact dermatitis is the most frequently recognized occupational disease in many countries, including Denmark (1). Ninety-five per cent of all notified cases of occupational contact dermatitis involve the hands (1). The socio-economic burden for society and the individual is high, owing to sick leave, potential job loss, and negative impact on quality of life (2, 3). Epidemiological studies have identified individual risk factors as atopic dermatitis, contact allergy, age, and sex (4). High-risk occupations have been studied, and specific occupational preventive measures have been suggested (5–10). The impact of these preventive measures has, for example in Denmark, already paid dividends as a reduction in nickel allergy is evident owing to the Danish nickel legislation (11).

The aim of the present study was to contribute to the epidemiological basis for further prevention of occupational contact dermatitis, using data for a cohort of 1000 new patients diagnosed with severe occupational contact dermatitis tested at the Department of Dermato-Allergology at Gentofte University Hospital, Denmark.

Correspondence: Jakob Ferløv Schwensen, Department of Dermato-Allergology, National Allergy Research Centre, Copenhagen University Hospital Gentofte, Niels Andersens Vej 65, 2900 Hellerup, Denmark. Tel.: +45 30237085; Fax: +45 39777118. E-mail: jakobschwensen@gmail.com

Conflicts of interest: The authors declare no conflicts of interests.

Accepted for publication 28 November 2012

Materials and Methods

Study population

Initially, a total of 1045 patients were included in the analysis, as they had severe occupational contact

© 2013 John Wiley & Sons A/S

dermatitis diagnosed at the Department of Dermato-Allergology at Gentofte University Hospital, Denmark between 1 September 2003 and 31 December 2010. According to their medical charts, 23 cases were not occupational, 16 were duplicates in the database, and 6 were patients with atopic dermatitis as the main diagnosis. A total of 45 were excluded.

The study population comprised 1000 new consecutive cases of severe occupational contact dermatitis. Gentofte University Hospital has, for many years, been a specialist centre for occupational contact dermatitis in the capital region of Denmark. By definition, all cases seen at the department suffer from severe contact dermatitis, as patients are referred from other specialists when complex exposure assessment, extended allergy testing and intensified treatment are needed.

Less severe cases are seen, treated and notified by dermatologists in private practice or departments of occupational medicine.

Information available from the database included test results of patch testing with the European baseline and extended Series, diagnosis and information concerning the MOAHLFA index.

In Denmark, physicians are obliged by law to notify all suspected or known occupational diseases.

Patch testing

Specially trained dermatologists examined all cases according to uniform guidelines (12).

Patch testing was performed with the European baseline series (Finn Chambers®, Scanpor® tape, and Trolab® patch test allergens) applied to the upper back. The occlusion time was 48 hr, and readings were carried out on D2, D3/D4 and D7, according to the recommendations of the International Contact Dermatitis Research Group (13). Homogeneous redness and infiltration in the entire test area was the minimum requirement for a positive reaction. Reactions of strength 1+, 2+ and 3+ were interpreted as positive responses. Irritant reactions, doubtful reactions and negative reactions were interpreted as negative responses. Not all study subjects were tested with the complete set of allergens, either because of known sensitivity based on previous testing, registered as 'Not Tested: Sensitized', or for unknown reasons, registered as 'Not Tested'. Readings of 'Not Tested: Sensitized' were categorized as positive responses, and readings of 'Not Tested' as missing data (14).

Statistical methods

The data were processed with SPSS (SPSS™ Statistics, Chicago, IL, USA; IBM PASW Statistics) for Windows™, edition 19.0. Analyses comprised prevalence and asymptotic chi-square tests for mean age, equal distribution of diagnosis, sex, atopic dermatitis, and hand, leg, and face involvement. Asymptotic confidence intervals (CIs) for the incidence rates were calculated according to standard theory. The Mantel–Haenszel chi-square test was used to examine trends in the proportion of atopic dermatitis among cases of allergic contact dermatitis and irritant contact dermatitis within two different age groups. All p-values are two-sided, and 0.05 was chosen for statistical significance.

Occupation and incidence rates

The occupation of cases in the database was coded according to the Danish International Standard Classification of Occupations (DISCO88), which is analogous to the International Standard Classification of Occupations, at the time of patch testing. A more detailed occupational classification was made on the basis of well-known subgroups, for example 'machine operators' or 'nurse and nurse assistants', and used in the analyses.

The incidence rates of severe occupational contact dermatitis according to occupation were calculated on the basis of all employees in each occupation in the capital region of Denmark, as of 1 January 2010. The data were provided by Statistics Denmark. Incidence rates were adjusted for 7 years and 4 month in accordance with observation period.

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.

This means that the diagnosis of irritant contact dermatitis was made if there was significant exposure at the workplace to irritants that partly or fully explained the dermatitis (12). The diagnosis of allergic contact dermatitis was made if there was a positive patch test reaction to an allergen that was also found in the work environment in such a way that it partly or fully explained the dermatitis (12).

For the purpose of this analysis, patients were grouped as having either allergic contact dermatitis or irritant contact dermatitis. This means that individuals with both diagnoses were only grouped as having allergic contact dermatitis. The assignment of the diagnosis irritant contact dermatitis is based on knowledge of risk factors, and quantitative criteria are given only for wet work (12). In cases, for example glove use, where an allergy is

© 2013 John Wiley & Sons A/S

detected, assignment or not of the diagnosis of irritant contact dermatitis may be random, introducing random errors. Among our patients, only 64 had diagnoses of both allergic contact dermatitis and irritant contact dermatitis.

The diagnosis of atopic dermatitis was based upon the MOALHFA index, and included past and present atopic dermatitis.

Results

Demographics

The complete study population comprised 1000 patients (618 females and 382 males), aged 15–72 years. The distribution for the total study population diagnosed with severe occupational contact dermatitis within the MOAHLFA index is given in Table 1. The findings of the MOALHFA index for the patients with severe occupational contact dermatitis could be summarized as female predominance, young age, hand dermatitis, and a higher prevalence of atopic dermatitis among females than among males.

The mean age at onset of irritant contact dermatitis was lower than the mean age at onset of allergic contact dermatitis for both sexes (Table 2). The mean age for females diagnosed with irritant contact dermatitis (35.9 years; 95% CI 34.4–37.4) was significantly lower than the mean age for males diagnosed with irritant contact dermatitis (39.4 years; 95% CI 37.6–41.2).

Table 1. The distribution of the MOAHLFA index for total cases of severe contact dermatitis and the distribution within sexes

	Total	Male	Female	*p*-value
Male	38.2	100	0	< 0.001
Occupational	100	100	100	
Atopic dermatitis	19.1	13.6	22.5	0.001
Hand dermatitis	88.3	89.3	87.7	0.454
Leg dermatitis	1.5	2.9	0.6	0.005
Face dermatitis	10.9	9.4	11.8	0.239
Age > 40 years	50.9	59.4	45.6	< 0.001

The Pearson chi-square test was used to test the level of significance among sexes; $p < 0.05$ is considered to be significant.

Table 2. Mean age for males and females diagnosed with allergic contact dermatitits and irritant contact dermatitis

	Mean age in years (95% confidence interval)	
	Males (n = 382)	Females (n = 618)
Allergic contact dermatitis	44.4 (42.5–46.3)	39.8 (38.3–41.2)
Irritant contact dermatitis	39.4 (37.6–41.2)	35.9 (34.4–37.4)

To review the influence of sex, age and atopic dermatitis on the development of irritant or allergic contact dermatitis, age was merged into two subgroups, and prevalence rates of atopic dermatitis among patients with irritant contact dermatitis and allergic contact dermatitis were determined for both sexes (Table 3). The prevalence of atopic dermatitis among young females with irritant contact dermatitis was 37.7%, and that among older females was 15.0% ($p < 0.0001$). Young females had an earlier disease onset of irritant contact dermatitis if they were diagnosed with former or actual atopic dermatitis than other sex, age and diagnosis groups.

Occupation and incidence rates

The most frequent occupations of females who developed severe occupational contact dermatitis were, in decreasing order, nurse and nursing assistants, hairdressers, cleaners, cooks, and office workers (Table 4). For males, the most frequent occupations were, in decreasing, order cooks, mechanics, machine operators, painters, and cleaners (Table 5).

The incidence rates of severe occupational contact dermatitis according to occupation were calculated on the basis of all employees in each occupation in the capital region of Denmark, as of 1 January 2010 (Tables 4 and 5).

The probabilities of developing severe occupational contact dermatitis in the capital region of Denmark were 1.1 per 10 000 workers per year for males and 1.9 per 10 000 workers per year for females. Females at high risk were identified as cooks, butchers, beauticians, bakers, and hairdressers, ranging from 23.3 to 96.8 cases per 10 000 workers per year. Males at high risk were identified as painters, cooks, mechanics, locksmiths, and bakers, ranging from 16.5 to 32.3 cases per 10 000 workers per year. Occupations that carried a risk of the development of severe occupational contact dermatitis, irritant contact dermatitis and allergic contact dermatitis are listed with their calculated incidence rates, in descending order, for females and males in Fig. 1a,b.

Allergic contact dermatitis as the main diagnosis was only assigned when a positive patch test result had occupational relevance. Investigation of individual allergens is outside the scope of this article.

Among the 1000 cases of occupational hand dermatitis, 491 patients (326 females and 165 males) had allergic contact dermatitis as the main diagnosis (Tables 4 and 5). On the basis of the prevalence, females more often had allergic contact dermatitis as their main diagnosis than males ($p < 0.01$). In Fig. 2a,b, the relative frequencies of allergic contact dermatitis and

© 2013 John Wiley & Sons A/S

Table 3. The distribution of atopic dermatitis within two different age groups among males and females diagnosed with irritant contact dermatititis or allergic contact dermatitis

	Age (years)	n (%)	ICD+/AD+	ICD+/AD-	ACD+/AD+	ACD+/AD-
Female	< 35	281 (45.5)	60 (37.7)	99 (62.3)	30 (24.6)	92 (75.4)
	≥ 35	337 (54.5)	20 (15.0)	113 (85.0)	29 (14.2)	175 (85.8)
			$p < 0.0001$		$p = 0.028$	
Male	< 35	126 (33.0)	17 (20.0)	68 (80.0)	10 (24.4)	31 (75.6)
	≥ 35	256 (77.0)	12 (9.1)	120 (90.9)	13 (10.5)	111 (89.5)
			$p = 0.036$		$p = 0.050$	

ACD, allergic contact dermatitis; AD, atopic dermatitis; ICD, irritant contact dermatitis.
+: Positive diagnosis, e.g. 'ICD+/AD+', diagnosed with irritant contact dermatitis and present or former atopic dermatitis.
p-Values were calculated with the Mantel–Haenszel chi-square test stratified for age < 35 years within specific diagnosis and sex groups. A *p*-value of < 0.05 is considered to be significant.

Table 4. The distribution of occupation according to diagnosis for females. The incidence rates for severe occupational contact dermatitis according to occupation were calculated

	n (%)	ICD (%)	ACD (%)	No. of employees in capital region of Denmark	Incidence rate per 10 000 workers per year (95% CI)
Nurses and nursing assistants	108 (17.5)	57 (19.5)	51 (15.6)	42 833	3.4 (2.9–4.0)
Hairdressers	99 (16.0)	44 (15.1)	55 (16.9)	1395	96.8 (79.3–114.3)
Cleaners	67 (10.8)	31 (10.6)	36 (11.0)	10 694	8.5 (6.6–10.5)
Cooks	61 (9.9)	33 (11.3)	28 (8.6)	3567	23.3 (17.8–28.9)
Office workers	44 (7.1)	17 (5.8)	27 (8.3)	30 305	2.0 (1.9–17.0)
Dental surgery assistants	28 (4.5)	9 (3.1)	19 (5.8)	2150	17.8 (11.3–24.2)
Nursery school teachers	21 (3.4)	13 (4.5)	8 (2.5)	19 708	1.5 (0.8–2.1)
Bakers	15 (2.4)	7 (2.4)	8 (2.5)	231	88.6 (44.3–132.9)
Physicians	14 (2.3)	7 (2.4)	7 (2.1)	2854	6.7 (3.2–10.2)
Laboratory technicians	10 (1.6)	3 (1.0)	7 (2.1)	5651	2.4 (0.9–3.9)
Beauticians	7 (1.1)	6 (2.1)	1 (0.3)	163	58.6 (15.4–101.7)
Dentists	7 (1.1)	5 (1.7)	2 (0.6)	695	13.7 (3.6–23.9)
Shop assistants	7 (1.1)	3 (1.0)	4 (1.2)	20 690	0.5 (0.1–0.8)
Machine operators	6 (1.0)	3 (1.0)	3 (0.9)	865	9.5 (4.6–40.8)
Painters	6 (1.0)	1 (0.3)	5 (1.5)	360	22.7 (4.6–40.8)
Butchers	4 (0.6)	2 (0.7)	2 (0.6)	174	31.4 (0.7–62.0)
Kitchen workers	4 (0.6)	4 (1.4)	0 (0.0)	3376	1.6 (0.0–3.2)
Others	110 (17.8)	47 (16.1)	63 (19.3)	2 95 672*	0.5 (0.4–0.6)
Total	618 (100.0)	292 (100.0)	326 (100.0)	4 41 383†	1.9

ACD, allergic contact dermatitis; CI, confidence interval; ICD, irritant contact dermatitis.
*Others are summed by occupations with < 4 subjects.
†Total employees in the capital region of Denmark.

irritant contact dermatitis are listed in descending order according to occupation for both sexes.

Discussion

The present study is based on 1000 patients with severe occupational contact dermatitis diagnosed at the Department of Dermato-Allergology at Gentofte University Hospital, Denmark, between September 2003 and December 2010, in the capital region of Denmark. The study population made it possible to calculate the incidence rates of severe occupational contact dermatitis, allergic contact dermatitis and irritant contact dermatitis in various occupational groups.

The labour market of the capital region of Denmark is characterized by occupations involving service and administration, healthcare, and pharmaceuticals, and a lack of heavy industry and mining.

As we expected, the findings of the MOALHFA index for patients with occupational contact dermatitis could be summarized as female predominance, young age, and hand dermatitis (1, 5, 6). Female predominance correlates with previous studies (6, 15). However, female predominance has not always been found.

© 2013 John Wiley & Sons A/S

Table 5. The distrubution of occupation according to diagnosis for males. The incidence rates for severe occupational contact dermatitis according to occupation were calculated

	n (%)	ICD (%)	ACD (%)	No. of employees in capital region of Denmark	Incidence rate per 10 000 workers per year (95% CI)
Cooks	37 (9.7)	24 (11.1)	13 (7.9)	2892	17.5 (12.1–22.8)
Mechanics	34 (8.9)	22 (10.1)	12 (7.3)	2442	19.0 (12.9–25.1)
Machine operators	26 (6.8)	17 (7.8)	9 (5.5)	2921	12.1 (7.6–16.6)
Painters	20 (5.2)	8 (3.7)	12 (7.3)	1655	16.5 (9.5–23.5)
Cleaners	18 (4.7)	8 (3.7)	10 (6.1)	5784	4.2 (2.3–6.2)
Blacksmiths	17 (4.5)	9 (4.1)	8 (4.8)	3611	6.4 (3.4–9.4)
Electricians	16 (4.2)	8 (3.7)	8 (4.8)	6277	3.5 (1.8–5.1)
Bakers	16 (4.2)	10 (4.6)	6 (3.6)	676	32.3 (16.8–47.8)
Manual workers	15 (3.9)	10 (4.6)	5 (3.0)	13 091	1.6 (0.8–2.3)
Carpenters	11 (2.9)	6 (2.8)	5 (3.0)	3736	4.0 (1.7–6.4)
Office workers	11 (2.9)	5 (2.3)	6 (3.6)	7996	1.9 (0.8–3.0)
Bricklayers	10 (2.6)	6 (2.8)	4 (2.4)	1943	7.0 (2.7–11.3)
Plumbers	10 (2.6)	7 (3.2)	3 (1.8)	3567	3.8 (1.5–6.2)
Physicians	9 (2.4)	6 (2.8)	3 (1.8)	2730	4.5 (1.6–7.4)
Locksmiths	7 (1.8)	4 (1.8)	3 (1.8)	441	21.7 (5.8–37.5)
Hairdressers	6 (1.6)	2 (0.9)	4 (2.4)	–	–
Kitchen workers	5 (1.3)	2 (0.9)	3 (1.8)	2385	2.9 (0.4–5.4)
Butchers	4 (1.0)	3 (1.4)	1 (0.6)	803	6.8 (0.2–13.4)
Nurses and nursing assistants	4 (1.0)	4 (1.8)	0 (0.0)	4941	1.1 (0.0–2.2)
Nursery school teachers	4 (1.0)	1 (0.5)	3 (1.8)	5279	1.0 (0.0–2.0)
Dentists	3 (0.8)	0 (0.0)	3 (1.8)	353	11.6 (- 1.5 to 24.7)
Laboratory technicians	1 (0.3)	1 (0.5)	0 (0.0)	–	–
Dental surgery assistants	0 (0.0)	0 (0.0)	0 (0.0)	–	–
Others	98 (25.7)	54 (24.9)	44 (26.7)	395 475*	0.3 (0.3–0.4)
Total	382 (100.0)	217 (100.0)	165 (100.0)	468 998†	1.1

ACD, allergic contact dermatitis; CI, confidence interval; ICD, irritant contact dermatitis.
*Others are summed by occupations with < 4 subjects, except for dentists, laboratory assistants, shop assistants, and dental surgery assistants.
†Total employees in the capital region of Denmark.

A study conducted by Fregert (10) in the years 1960–1969 showed male predominance among patients with occupational contact dermatitis. This reflects the male predominance in the labour market at that time, with heavy industry and mining (10). Furthermore, the prevention of chromium dermatitis in the construction industry because of the reduction in the amount of hexavalent chromium in cement has reduced the risk of the development of dermatitis (16–18).

As a new finding, it was shown that patients with irritant contact dermatitis were younger than those with allergic contact dermatitis, indicating that the one may precede the other, that repeated allergen exposure and a longer induction period may be needed for the development of severe allergic contact dermatitis, or that the diagnosis of allergic contact dermatitis is more complex and therefore delayed. Females are especially affected at the beginning of their careers, owing to wet work, whereas males are affected later on, owing to skin contact with oils (19). Several other studies have found that occupational contact dermatitis occurs after a short induction period (7–9).

The direct correlation between exposure time and irritant contact dermatitis points to an unexploited opportunity for prevention.

The overall proportion of atopic dermatitis is similar to previous findings in the background population (20). Atopic dermatitis is a predisposing factor for the development of irritant contact dermatitis (21, 22).

Recent studies have identified subgroups of individuals with atopic dermatitis with a particular risk of developing hand eczema. Filaggrin gene mutation carriers, who experienced hand eczema in their childhood, owing to minor irritant traumas, makes them avoid wet work later on in their work life (23). Approximately 62.5% of individuals with atopic dermatitis and filaggrin gene mutations develop chronic hand eczema during their lifetime in north European countries (24). It is therefore tempting to speculate that individuals with atopic dermatitis with early onset of occupational contact dermatitis resulting from exposure to irritants represent a

© 2013 John Wiley & Sons A/S

certain subgroup that might be identified at an early stage by combining the phenotype (atopic dermatitis) with the genotype (filaggrin gene mutations and others) so that early preventive measures can be started.

Among young females and males with irritant contact dermatitis, the prevalence rates of atopic dermatitis were 37.7% ($p < 0.0001$) and 20.0% ($p = 0.036$), respectively, as compared with older females and males. Among hairdressing apprentices, atopic dermatitis was found to be a risk factor for the development of hand eczema, irrespective of interventions such as glove use (25). On the other hand, a recent intervention study by Wilke et al. showed the long-term effects of the combined effects of systemic planned guidance and treatment on occupational hand eczema (26).

In this patient-based register study, the calculated overall incidence rates for severe occupational contact dermatitis among males and females were lower than in previous studies (1, 5, 15, 27). A study from the United Kingdom by Cherry et al. (19) also showed an overall low incidence rate, as only patients notified by dermatologists and occupational physicians were included. The low incidence rates in this study may be explained by the fact that only severe cases were included, either from dermatologists in private practice or from departments of occupational medicine. Furthermore, it may be that not all severe cases are referred according to the guidelines, and also that patients may be seen in the other dermatological department of our region, resulting in an underestimation of the incidence rate. Despite low overall incidence rates, high incidence rates were observed for specific occupations, including hairdressing and beauty, food-related occupations, and male-dominated occupations related to metal processing and construction. These findings correlate with previous epidemiological studies (5, 6). The studies mentioned above are not entirely comparable, owing to differences in sample size, definitions of diagnoses, and medical examination methods (1), and the fact that national case definitions differ (28).

Overall, the frequent occupations were similar to those previously found, with hairdressing, healthcare work, food-related occupations and occupations related to metal processing at the top of the ranking (5, 6).

Female hairdressers had the highest incidence rate, at 96.8 cases of severe occupational contact dermatitis per 10 000 full-time workers per year, and hairdressing is considered to be a high-risk occupation for the development of occupational contact dermatitis (5, 8). Previous epidemiological studies based upon reported cases of occupational contact dermatitis have found incidence rates for hairdressers ranging from 56.1 to 97.4 cases per 10 000 workers per year (5, 6). Hairdressers are mainly affected at the beginning of their careers (8), and allergic contact dermatitis is the predominant diagnosis (5). These assumptions correlate with our data (Table 4 and Fig. 2a).

High incidence rates among food-related occupations were found. Male bakers had the highest incidence rate among the male occupations, with an incidence rate of 32.3 cases of severe occupational contact dermatitis per 10 000 full-time workers per year, dominated by the diagnosis of irritant contact dermatitis. Tacke et al. (9) have previously found high incidence rates for food-related occupations, with irritant contact dermatitis as the main diagnosis. On the other hand, female bakers had an almost three-fold greater incidence rate, of 88.6 cases of severe occupational contact dermatitis per 10 000 full-time workers per year, with a slight overrepresentation of allergic contact dermatitis. A higher incidence rate among female bakers than among male bakers has been reported before (9). Those in food-related occupations have a tendency to have prolonged sick leave as compared with other occupations (29). Protein contact dermatitis, which is a frequent diagnosis among people handling food, has not been included in the analysis (30).

In the male-dominated construction industry, high incidence rates were observed, resulting from both irritants and allergens (Table 5 and Fig. 2b). Our incidence rates correlate and are in accordance with the findings of a study by Bock et al. (31) based on the prospective BKH-N register from Northern Bavaria in Germany. Cement dermatitis caused by potassium dichromate dominated the allergic contact dermatitis group (31). Cement dermatitis caused by potassium dichromate also used to be a common occupational disease in Denmark (16), but the introduction of preventive measures against the high concentration of potassium dichromate in cement in 1981 led to a significant decrease in potassium dichromate sensitization (16). EU legislation was introduced later on, and this likewise led to a decrease in the rate of cement dermatitis (17, 18). Epoxy resin systems are widely used in the industrial sector, and are still common occupationally relevant allergens (31, 32). Males, in particular, are sensitized to epoxy, and it is often found in glue and paint (17, 32).

In Denmark, it is a legal requirement to participate in an educational programme before commencing work with epoxy resin (32). In a study by Bangsgaard et al. (32), it was concluded, on the basis of an unselected, occupational and non-occupational, group of dermatitis patients, that only half had participated in the programme. This leaves some need for surveillance of the implementation of the epoxy directive, and one-quarter of the patients had to change occupation.

© 2013 John Wiley & Sons A/S

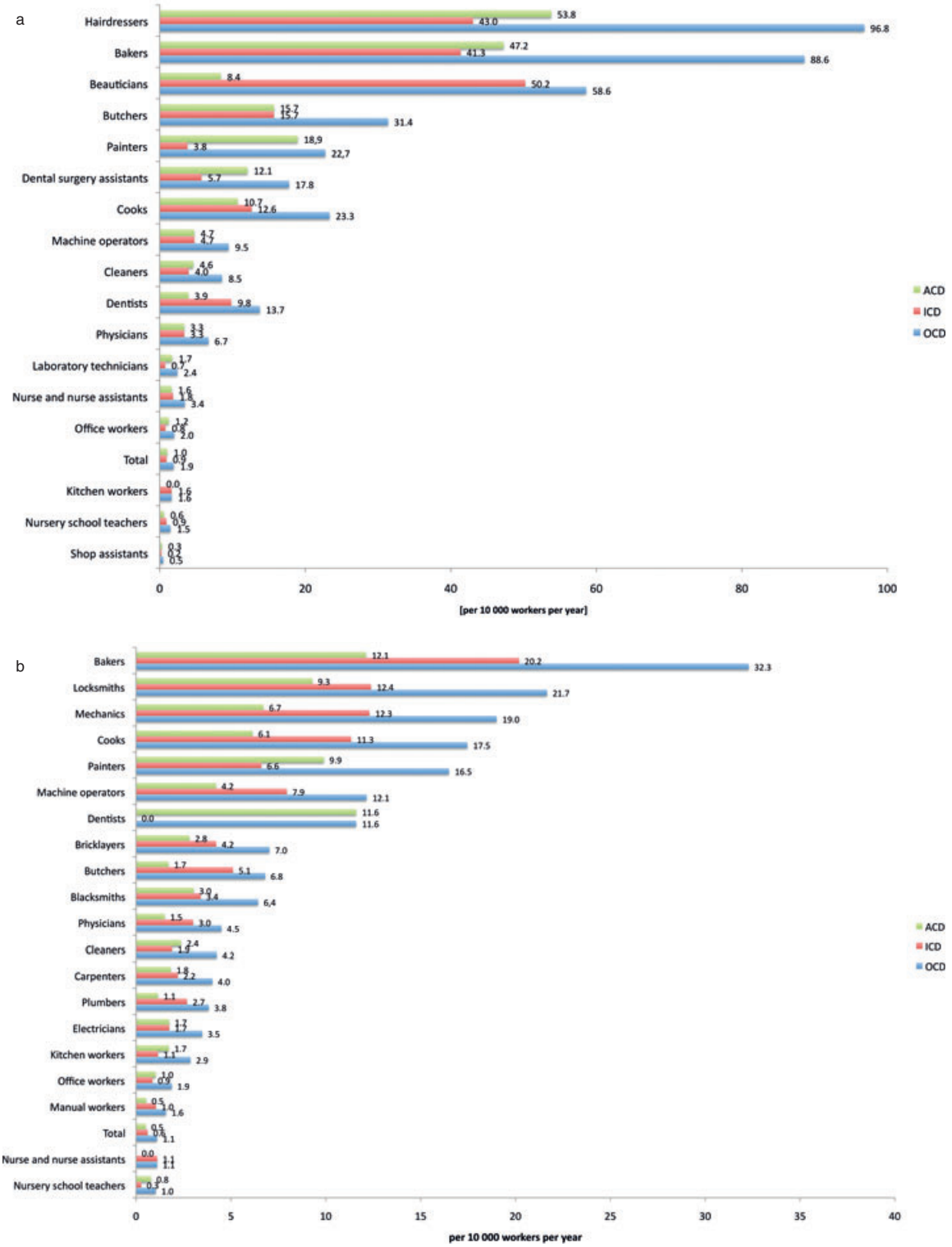

Fig. 1. (a) Incidence rates for the cases with severe occupational contact dermatitis (OCD) and those further specified as having either allergic contact dermatitis (ACD) or irritant contact dermatitis (ICD) within specified occupational groups for females. (b) Incidence rates for the cases with severe OCD and those further specified as having either ACD or ICD within specified occupational groups for males.

© 2013 John Wiley & Sons A/S

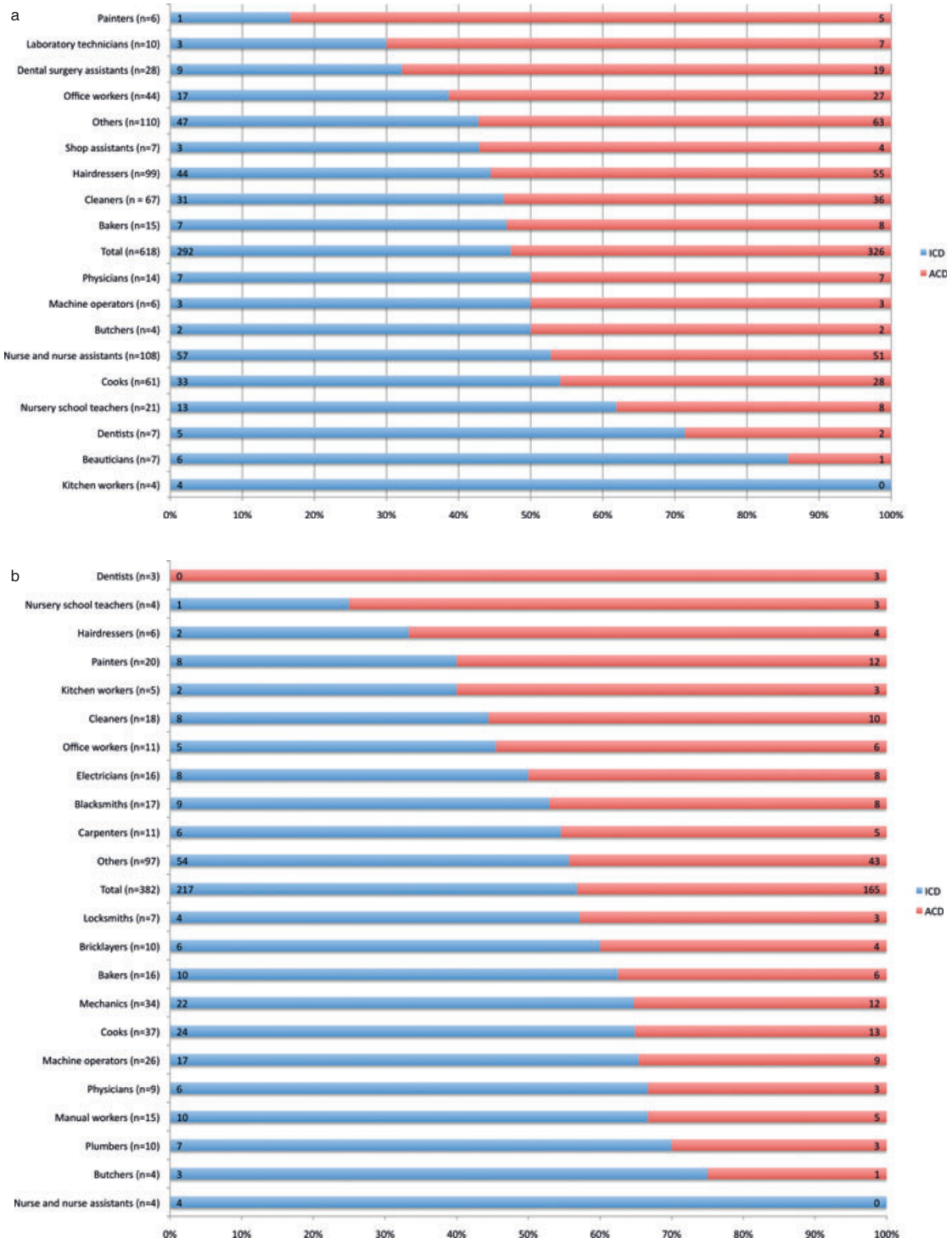

Fig. 2. (a) Relative frequencies of allergic contact dermatitis (ACD) and irritant contact dermatitis (ICD) within occupational groups for females. (b) Relative frequencies of ACD and ICD within occupational groups for males. The groups 'Total' and 'Others' are included as references.

© 2013 John Wiley & Sons A/S

In conclusion, the incidence of occupational contact dermatitis is still high in our region, even when only severe cases are considered. High incidence rates were found among female cooks, butchers, beauticians, bakers, and hairdressers, ranging from 23.3 to 96.8 cases per 10 000 workers per year. Among males, high incidence rates were shown for painters, cooks, mechanics, locksmiths, and bakers, ranging from 16.5 to 32.3 cases per 10 000 workers per year. Allergic contact dermatitis was predominant among hairdressers, painters, dental surgery assistants, and female bakers. Although evidence-based prevention programmes have been developed, there has been no effective implementation in Denmark or at the European level, as shown by the continuing problems highlighted in the current investigation. Furthermore, there is a need to focus attention on the prevention of early onset of occupational hand eczema in individuals with atopic dermatitis and specific occupational allergies by legislation at a multinational level. Such interventions have previously proven successful.

In order to follow the trends in occupational contact dermatitis and document the effects of intervention, it is important to have national and international surveillance systems.

References

1 Halkier-Sorensen L. Occupational skin diseases. *Contact Dermatitis* 1996: **35**: 1–120.

2 Rosen R H, Freeman S. Prognosis of occupational contact dermatitis in New South Wales, Australia. *Contact Dermatitis* 1993: **29**: 88–93.

3 Apfelbacher C J, Radulescu M, Diepgen T L, Funke U. Occurrence and prognosis of hand eczema in the car industry: results from the PACO follow-up study (PACO II). *Contact Dermatitis* 2008: **58**: 322–329.

4 Bryld L E, Hindsberger C, Kyvik K O, Agner T, Menné T. Risk factors influencing the development of hand eczema in a population-based twin sample. *Br J Dermatol* 2003: **149**: 1214–1220.

5 Dickel H, Kuss O, Blesius C R, Schmidt A, Diepgen T L. Occupational skin diseases in Northern Bavaria between 1990 and 1999: a population-based study. *Br J Dermatol* 2001: **145**: 453–462.

6 Skoet R, Olsen J, Mathiesen B, Iversen L, Johansen J D, Agner T. A survey of occupational hand eczema in Denmark. *Contact Dermatitis* 2004: **51**: 159–166.

7 Funke U, Fartasch M, Diepgen T L. Incidence of work-related hand eczema during apprenticeship: first results of a prospective cohort study in the car industry. *Contact Dermatitis* 2001: **44**: 166–172.

8 Uter W, Pfahlberg A, Gefeller O, Schwanitz H J. Prevalence and incidence of hand dermatitis in hairdressing apprentices: results of the POSH study. Prevention of occupational skin disease in hairdressers. *Int Arch Occup Environ Health* 1998: **71**: 487–492.

9 Tacke J, Schmidt A, Fartasch M, Diepgen T L. Occupational contact dermatitis in bakers, confectioners and cooks. A population-based study. *Contact Dermatitis* 1995: **33**: 112–117.

10 Fregert S. Occupational dermatitis in a 10-year material. *Contact Dermatitis* 1975: **1**: 96–107.

11 Nielsen N H, Linneberg A, Menné T et al. Incidence of allergic contact sensitization in Danish adults between 1990 and 1998; the Copenhagen Allergy Study, Denmark. *Br J Dermatol* 2002: **147**: 487–492.

12 Menné T, Johansen J D, Sommerlund M, Veien N K. Hand eczema guidelines based on the Danish guidelines for the diagnosis and treatment of hand eczema. *Contact Dermatitis* 2011: **65**: 3–12.

13 Wilkinson D S, Fregert S, Magnusson B et al. Terminology of contact dermatitis. *Acta Dermato-Venereologica* 1970: **50**: 287–292.

14 Carlsen B C, Fischer L A, Søsted H, Volund A, Menné T, Johansen J D. Patch test dose–response study: polysensitized individuals do not express lower elicitation thresholds than single/double-sensitized individuals. *Br J Dermatol* 2009: **160**: 103–106.

15 Dickel H, Bruckner T, Bernhard-Klimt C, Koch T, Scheidt R, Diepgen T L. Surveillance scheme for occupational skin disease in the Saarland, FRG. First report from BKH-S. *Contact Dermatitis* 2002: **46**: 197–206.

16 Zachariae C O, Agner T, Menné T. Chromium allergy in consecutive patients in a country where ferrous sulfate has been added to cement since 1981. *Contact Dermatitis* 1996: **35**: 83–85.

17 Geier J, Krautheim A, Uter W, Lessmann H, Schnuch A. Occupational contact allergy in the building trade in Germany: influence of preventive measures and changing exposure. *Int Arch Occup Environ Health* 2011: **84**: 403–411.

18 Schnuch A, Geier J, Lessmann H, Arnold R, Uter W. Surveillance of contact allergies: methods and results of the Information Network of Departments of Dermatology (IVDK). *Allergy* 2012: **67**: 847–857.

19 Cherry N, Meyer J D, Adisesh A et al. Surveillance of occupational skin disease: EPIDERM and OPRA. *Br J Dermatol* 2000: **142**: 1128–1134.

20 Nielsen N H, Linneberg A, Menné T et al. The association between contact allergy and hand eczema in 2 cross-sectional surveys 8 years apart. *Contact Dermatitis* 2002: **47**: 71–77.

21 Dickel H, Bruckner T M, Schmidt A, Diepgen T L. Impact of atopic skin diathesis on occupational skin disease incidence in a working population. *J Invest Dermatol* 2003: **121**: 37–40.

22 Coenraads P J, Diepgen T L. Risk for hand eczema in employees with past or present atopic dermatitis. *Int Arch Occup Environ Health* 1998: **71**: 7–13.

23 Ross-Hansen K, Bandier J, Carlsen B et al. Filaggrin mutations and hand eczema: more pieces to the puzzle. *Contact Dermatitis* 2012: **66**: 58.

24 Thyssen J P, Carlsen B C, Menné T et al. Filaggrin null mutations increase the risk and persistence of hand eczema in subjects with atopic dermatitis: results from a general population study. *Br J Dermatol* 2010: **163**: 115–120.

25 Bregnhoj A, Menné T, Johansen J D, Søsted H. Prevention of hand eczema among Danish hairdressing apprentices: an intervention study. *Occup Environ Med* 2012: **69**: 310–316.

26 Wilke A, Gediga G, Schlesinger T, John SM, Wulfhorst B. Sustainability of interdisciplinary secondary prevention in patients with occupational hand eczema: a 5-year follow-up survey. *Contact Dermatitis* 2012: **67**: 208–216.

27 Kaufman J D, Cohen M A, Sama S R, Shields J W, Kalat J. Occupational skin

© 2013 John Wiley & Sons A/S

diseases in Washington State, 1989 through 1993: using workers' compensation data to identify cutaneous hazards. *Am J Public Health* 1998: **88**: 1047–1051.

28 Frosch P J, Werner A, Agner T et al. *International Comparison of Legal Aspects of Workers' Compensation for Occupational Contact Dermatitis*, 5th edition, Berlin, Heidelberg, Springer-Verlag, 2011: 1029–1051.

29 Cvetkovski R S, Rothman K J, Olsen J et al. Relation between diagnoses on severity, sick leave and loss of job among patients with occupational hand eczema. *Br J Dermatol* 2005: **152**: 93–98.

30 Vester L, Thyssen J P, Menné T, Johansen J D. Occupational food-related hand dermatoses seen over a 10-year period. *Contact Dermatitis* 2012: **66**: 264–270.

31 Bock M, Schmidt A, Bruckner T, Diepgen T L. Occupational skin disease in the construction industry. *Br J Dermatol* 2003: **149**: 1165–1171.

32 Bangsgaard N, Thyssen J P, Menné T et al. Contact allergy to epoxy resin: risk occupations and consequences. *Contact Dermatitis* 2012: **67**: 73–77.

© 2013 John Wiley & Sons A/S