

A survey of exposures related to recognized occupational contact dermatitis in Denmark in 2010

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Summary

Background. Skin diseases are the most commonly recognized occupational diseases in Denmark, and occupational contact dermatitis (OCD) comprises ~95% of all cases.

Objectives. To prevent occupational contact dermatitis, it is important to specifically identify exposures and work routines related to outbreak of the disease. The aim of this study was to give an overview of exposures for patients with occupational contact dermatitis in Denmark in 2010, and relate this to line of work and disease severity.

Material and methods. The study was a descriptive, register-based study including patients with recognized occupational contact dermatitis in Denmark in 2010. Data were obtained from the *National Board of Industrial Injuries in Denmark*, and comprised information about the skin disease as well as the occupation/industry of employment and exposures.

Results. One thousand five hundred and four patients, 1020 women and 484 men, were included in the study. Irritant contact dermatitis accounted for 70% of all cases; 68% of these were caused by wet work. Forty-six per cent of all patients were employed either in the healthcare sector, in cleaning, or as kitchen workers. Among contact allergies, the most common were to rubber additives from gloves and epoxy in patients employed in the windmill industry.

Conclusion. The data are important for planning preventive efforts in the future. The workers in the healthcare sector, kitchen workers and cleaners constitute almost half of all cases, and future preventive efforts should be directed at these occupations.

Key words: contact allergies; occupational contact dermatitis; wet work.

Skin diseases are the most commonly recognized occupational diseases in Denmark (1), and occupational contact dermatitis (OCD) comprises ~95% of all cases. It often has an early onset, the average age being 36 years (2, 3), and therefore has a significant influence on working life and quality of life for the individual (4), while also causing a significant financial burden to society (5).

Over the years, many preventive initiatives have been taken to avoid the development of OCD. These initiatives include skin care programmes for primary or secondary prevention of occupational irritant contact dermatitis (OICD) (6–9), and legislation on concentrations of allergens to prevent occupational allergic contact dermatitis (OACD) (10, 11). In spite of this, we have no data indicating a reduction in the numbers of notified cases of OCD. In contrast, a slight increase has been found in Denmark during the last few years (1). Precise identification of the circumstances related to the outbreak of the disease, that is, job situation and chemical exposures, as well as individual factors, such as atopy and previous contact allergies, is important. In a modern industrial society, exposures will change

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over time, and updated exposure assessment for OCD is therefore necessary.

The aim of this study was to give an overview of occupational exposures for patients with recognized OCD in Denmark in 2010, and relate this to line of work, disease severity, and individual factors. Detailed knowledge of exposures may help to focus preventive measures directed at OCD.

Materials and Methods

The study is a descriptive, register-based study including all patients with recognized OCD in Denmark in the period 1 January 2010 to 31 December 2010. All data were obtained from the National Board of Industrial Injuries in Denmark (DNBII). Data in the patient files in the DNBII were based on either medical specialist certificates or patient files from dermatological departments, which were all available. The data included demographic information, including sex and age at onset, and information on diagnoses and sub-diagnoses, including current or pre-existing atopic eczema and pre-existing non-occupational contact allergy, and localization of eczema. The data also included occupation/industry of employment and exposure/suspected product. Data on the degree of permanent disability and financial compensation were also available.

Classification of industry was based on the Danish Industry Code year 2007. Specific irritants were coded according to www.armoni.dk. In the files, there was no clear distinction between wet work including and not including the use of soap, and both are therefore listed as wet work. With respect to sub-diagnoses, the following criteria were applied: OICD was used whenever a relevant occupational irritant exposure was found, OACD was used whenever a relevant contact allergy to a substance that the patient had been in contact with at work was found, and occupational contact urticaria (OCU) was used when a specific substance at the workplace had caused a type 1 reaction, and the patient subsequently tested positive to the suspected substance in a prick test, or had a positive specific IgE test result. To avoid subgroups with very

low numbers of patients, all patients who had OCU were registered as such, although some of them also had OICD and/or OACD. Atopic eczema was defined as personal previous or current atopic eczema, and non-occupational contact allergy was defined as a contact allergy not related to occupation.

Results

The study comprised 1504 patients: 1020 women and 484 men (female/male ratio 2:1). The median age was 36 years (quartiles 26–48); 35 years for women (quartiles 26–47), and 39 years for men (quartiles 26–50). The distribution of sub-diagnoses in relation to age, sex, atopic eczema and non-occupational contact allergy is shown in Table 1. OICD counted for 70% of all cases, OACD for 15%, and combined OICD and OACD for 10%. A total of 67 patients (4.5%) had OCU: 25 had OCU as the only diagnosis, 27 had OCU and OICD, 13 had OCU and OACD, and 2 had OCU as well as OICD and OACD.

Of those with OICD, 70% were women; of those with OACD, 55% were women. Twenty-two per cent of the patients had atopic dermatitis: 24% of those with OICD, 13% of those with OACD, and 20% of those with OCU, respectively. All patients had been patch tested with the European baseline series, supplemented with special series whenever relevant, except for 6 patients who were not tested, owing to pregnancy. For these 6 patients, the sub-diagnosis was made according to the clinical judgement of the specialist who had examined the patient.

The distribution of occupation in relation to sub-diagnosis is shown in Table 2. Overall, the most frequent occupation was healthcare [nurses, auxiliary nurses, biotechnicians, physicians, physiotherapists, and very few (fewer than 2 of each) veterinarians, radiographers, midwives, dentists, and occupational therapists], which accounted for 26% of all cases. Kitchen workers accounted for 12%, cleaning personnel for 8%, craftsmen for 8%, and hairdressers for 7%. OICD was the most frequent diagnosis in all occupations except for factory work and gardening, where OACD was the most frequent diagnosis.

Table 1. Distribution of sex, age and atopic eczema in relation to sub-diagnosis; n = 1504

Sub-diagnosis	Sex		Total	Atopic eczema
	Women	Men		
Occupational irritant contact dermatitis (OICD)	741	31	1054	249
Occupational allergic contact dermatitis (OACD)	125	103	228	31
OICD + OACD	108	47	155	42
Occupational contact urticaria	46	21	67	14
Total	1020	484	1504	336
Atopic dermatitis (past or present)	258	78	336	–

Table 2. Distribution of diagnoses in relation to occupation; n = 1504

	Total	OICD (%)	OACD (%)	OICD + OACD (%)	OCU (%)
Healthcare workers	388	303 (78)	38 (10)	31 (8.0)	16 (4.1)
Kitchen personnel	178	138 (77)	8 (5)	10 (5.6)	2 (1.1)
Cleaning personnel	118	100 (85)	7 (5.9)	8 (68)	3 (2.5)
Craftsmen ^a	113	74 (66)	32 (28.3)	7 (6.2)	0 (0.0)
Hairdressers	101	54 (54)	17 (16.8)	27 (26.7)	3 (3.0)
Factory workers	89	37 (42)	43 (48.3)	8 (9.0)	1 (1.1)
Mechanics/fitters/technicians	70	47 (68)	11 (15.7)	10 (14.3)	2 (2.9)
Nursery teachers	68	60 (88)	1 (1.5)	5 (7.4)	2 (2.9)
Machine operators/metalworkers	56	33 (59)	13 (23.2)	10 (17.9)	0 (0.0)
Sales assistants	41	30 (73)	6 (14.6)	5 (12.2)	0 (0.0)
Bakers/confectioners	41	23 (56)	1 (2.4)	4 (10.0)	13 (31.7)
Dental assistants	39	24 (62)	4 (10.3)	9 (23.1)	2 (5.1)
Laboratory personnel	25	20 (80)	3 (12.0)	1 (4.0)	1 (4.0)
Butchers/slaughterhouse workers	23	16 (70)	2 (8.7)	4 (17.4)	1 (4.3)
Agricultural workers/farmers	21	18 (86)	3 (14.3)	0 (0.0)	0 (0.0)
Office workers	20	11 (55)	8 (4.0)	0 (0.0)	1 (5.0)
Postal workers	20	10 (50)	5 (25.0)	5 (25.0)	0 (0.0)
Gardeners	16	4 (25)	8 (50.0)	4 (25.0)	0 (0.0)
Other occupations	77	52 (68)	17 (22.1)	7 (9.1)	1 (1.3)
Total	1504	1054 (70)	227 (15.1)	155 (10.3)	68 (4.5)

OACD, occupational allergic contact dermatitis; OCU, occupational contact urticaria; OICD, occupational irritant contact dermatitis.

^aIncluding workers in the building industry.

Table 3. Irritant exposures in relation to occupation; the number of exposures exceeds the number of patients

Occupation	Wet work	Foods	Oil	Gloves	Mechanical irritation	Paper and cardboard	Dust	Cement/concrete/mortar	Cold/warm	Disinfection	Solvents	Soap	Metal	Total
Healthcare workers	320	1	1	13	2	0	0	0	0	3	0	2	0	339
Kitchen personnel	147	85	0	1	2	0	0	0	1	0	0	1	0	237
Cleaning personnel	97	2	0	11	1	0	0	0	0	0	0	2	3	116
Craftsmen	23	0	24	4	8	0	5	11	1	1	2	0	0	78
Hairdressers	80	0	0	0	0	0	0	0	0	0	0	0	0	80
Nursery teachers	63	1	0	1	0	0	0	0	0	1	0	1	0	66
Mechanics/fitters/technicians	10	0	39	4	2	0	0	0	0	0	4	2	2	63
Factory workers	17	4	6	4	4	0	3	0	4	0	1	1	0	44
Machine operators/metalworkers	12	0	30	1	2	0	1	2	2	1	2	0	2	54
Dental assistants	31	0	0	1	0	0	0	0	0	1	0	0	0	32
Sales assistants	22	6	1	1	4	4	0	0	1	0	0	0	0	39
Bakers/confectioners	25	21	0	0	0	0	0	0	0	0	0	0	0	46
Laboratory personnel	14	0	0	6	0	0	0	0	0	2	0	0	0	20
Butchers/slaughterhouse workers	12	7	0	5	1	0	0	0	0	1	0	0	0	25
Agricultural workers/farmers	12	0	0	2	1	0	2	0	1	0	0	0	0	18
Postal workers	1	0	0	0	7	2	1	0	0	0	0	0	0	11
Office workers	1	0	0	0	4	7	0	0	0	0	0	0	0	12
Gardeners	4	0	0	0	0	0	0	0	0	0	0	0	0	4
Total	909	128	109	62	44	18	17	13	11	11	10	10	10	1341

Irritant exposures in relation to occupation are shown in Table 3. One patient could have more than one irritant exposure, and the number of exposures exceeds the number of patients. Oil exposure included refrigerants and lubricants. Wet work included frequent hand washing, and the use of water and soap and/or gloves.

The use of gloves, disinfection and soap is only described when it occurred unaccompanied by wet work. Wet work and exposure to foods and oils were the dominant irritant exposures, and the dominant professions exposed to these irritants were healthcare workers, kitchen workers, and cleaners.

Table 4. Allergic exposures in relation to occupation; the number of exposures exceeds the number of patients

Occupation	Rubber additives	Biocides	Epoxy resin	Nickel/cobalt	Hairdressing chemicals	Perfumes	Chromium	Colophonium	Plants	Black rubber	Other allergens	Total number of occupational allergies
Healthcare workers	50	13	1	3	0	6	0	1	0	0	11	85
Hairdressers	4	7	0	5	37	4	1	0	0	0	5	63
Factory workers	7	7	24	4	0	2	4	1	0	1	10	60
Craftsmen	4	9	14	5	0	1	6	1	0	0	4	44
Kitchen personnel	19	3	0	0	0	3	0	0	0	0	4	29
Machine operators/metalworkers	4	4	4	5	0	0	4	1	0	1	6	29
Mechanics/fitters/technicians	2	5	0	2	0	1	2	1	0	2	10	25
Cleaning personnel	7	2	0	1	0	5	0	0	0	1	2	18
Dental assistants	4	1	1	1	0	0	0	1	0	0	7	15
Sales assistants	2	0	0	2	0	3	0	0	3	0	4	14
Gardeners	2	0	0	0	0	0	1	1	9	0	1	14
Postal workers	4	2	0	1	0	0	0	2	0	0	1	10
Office workers	3	0	0	1	0	0	1	1	0	0	3	9
Nursery teachers	3	2	0	2	0	1	0	0	0	0	0	8
Butchers/slaughterhouse workers	5	0	0	0	0	0	0	0	0	1	1	7
Laboratory personnel	1	1	0	0	0	0	0	0	0	0	4	6
Bakers/confectioners	0	0	0	1	0	0	0	0	0	0	4	5
Agricultural workers/farmers	3	1	0	0	0	0	0	0	0	1	0	5
Other occupations	4	2	0	5	0	4	0	2	0	0	7	24
Total	128	59	44	38	37	30	19	12	12	7	84	464

Relevant contact allergies in relation to occupation are shown in Table 4. The most frequent occupational contact allergens were rubber additives, biocides, epoxy, and nickel/cobalt.

Rubber additives

Occupational contact allergy to various rubber additives in various occupations is shown in Table 5. Thiuram was the most frequently reported rubber chemical, followed by carbamate and mercaptobenzothiazole, and 44 patients were sensitized to more than one rubber chemical. No significant difference in the frequency of occupational

contact allergy to rubber additives was found between men and women. The eczema was most often localized to the hands (98%); however, in 13 cases, the eczema was localized to the face as well, and in 2 cases the eczema was found on the face only. Gloves were the most predominant exposure relevant to rubber contact allergy, and accounted for 87% of all exposures.

Biocides

The workers with the highest frequency of OACD caused by biocides were healthcare workers, craftsmen, factory workers, and hairdressers (Table 4). Some patients had

Table 5. Occupational contact allergy to various rubber additives in various occupations; 1 person can have more than one relevant contact allergy

Occupation	Rubber additive				Total number of allergies
	Thiuram/thiuram mix	Carbamate/carbamate mix	Mercaptobenzothiazole/mercapto mix	Other	
Healthcare workers	39	20	7	11	77
Kitchen workers	15	6	2	4	27
Cleaning personnel	3	3	2	0	8
Factory workers	6	2	0	0	8
Other occupations	33	13	10	4	60
Total	96	44	21	19	180

Table 6. List of biocides causing occupational allergic contact dermatitis; $n = 62$; 1 person can have more than one relevant contact allergy

Biocides	Total
Isothiazolinones	20 (total)
Isothiazolinone, unspecified	1
Benzisothiazolinone	4
Methylchloroisothiazolinone/methylisothiazolinone	13
Octylisothiazolinone	2
Formaldehyde and formaldehyde-releasers	40 (total)
Formaldehyde	25
2-Bromo-2-nitropropane-1,3-diol	3
Imidazolidinyl urea	3
Quaternium-15	9
Others	18 (total)
Chloroacetamide	1
Chlorocresol	1
Iodopropynyl butylcarbamate	1
Paraben/paraben mix	3
Methyldibromo glutaronitrile	12
Total	76

more than one relevant contact allergy, and the number of allergens exceeds the number of patients. The most common exposures were to soaps (9 cases), paints (7 cases), and cutting oils (6 cases). No significant difference in the frequency of occupational contact allergy to biocides was found between men and women. The frequency of various biocides causing contact allergy is shown in Table 6. The eczema was seen on the hands in all cases, and in 2 cases additionally on the face/neck.

Epoxy

OACD caused by epoxy was found in 38 men and 6 women ($p < 0.01$), mostly in factory workers and craftsmen (Table 4). The eczema was localized to the hands in 89% of all cases, additional eczema on the face/neck was found in 15 patients, and in 3 patients the eczema was found on the face/neck only. Half of the patients with OACD caused by epoxy were employed in the windmill

industry, and 7 patients were exposed to glue either in floor material or elsewhere.

Nickel/cobalt

No significant difference in the frequency of occupational contact allergy to nickel/cobalt was found between men and women. The workers most commonly affected were machine operators and metalworkers, craftsmen, and hairdressers. In all cases, the eczema was localized to the hands.

OCU

The most frequent allergens found to cause contact urticaria were natural rubber latex and foods (Table 7).

Degree of injury

The concept 'injury' is, in insurance medicine, defined as the medical assessment of the daily disadvantage in personal life that the occupational disease has caused, and the degree of injury (percentage of injury) is assessed on the basis of this. The injury may be bone injuries, cancer, psychological diseases, etc., as well as skin diseases. The percentage injury will be assessed when the condition is considered in a stationary state. The maximum of injury that can be achieved (except in special cases) is 100% (corresponding to totally handicapped), and the financial compensation for 100% injury is fixed by law and regulated each year. Examples of injuries are given in a table from the Danish National Board of Industrial Injuries (an example from this table is: Moderate hand eczema with frequent eruptions, 15%). The economic compensation corresponding to a certain percentage of injury is calculated from the 100%, but is also regulated with respect to age (decreasing with age, as older people are expected to live for a shorter time with their injury). The median value for degree of injury for the population was 8% (quartiles 0–10), with no difference in degree of injury being found with respect to sex (p not significant). The degree of injury was, however, assessed as being significantly

Table 7. Exposures causing occupational contact urticaria in relation to occupation

Occupation	Natural rubber latex	Food	Others ^a	Total number of allergies	Total number of patients
Kitchen workers	6	18	0	24	22
Healthcare workers	14	0	1	15	15
Bakers, confectioners	0	13	1	14	13
Other occupations	14	1	4	19	18
Total	34	32	6	72	68

^aOthers: ethanol; ammonium persulfate in flour; ammonium persulfate and potassium persulfate in hair bleach.

Table 8. Degree of injury related to different sub-diagnoses; median values (and 25th–75th percentiles)

Sub-diagnosis	Degree of injury
Occupational irritant contact dermatitis (OICD)	8 (0–10)
Occupational allergic contact dermatitis (OACD)	5 (0–10)
Rubber additives	10 (5–15)
Biocides	10 (5–15)
Epoxy	5 (0–10)
Nickel/cobalt	10 (8–15)
OICD + OACD	10 (8–15)
Contact urticaria	6.5 (5–15)

higher for patients aged >40 years than for patients aged <40 years, indicating that the occupational eczema was more severe in the older group [median values and quartiles of 8% (0–10) for <40 years, and 10% (5–10) for >40 years, respectively; $p < 0.001$]. Degree of injury related to different sub-diagnoses is shown in Table 8.

Discussion

In spite of preventive efforts, OCD was, in 2010, as in previous years, the most commonly recognized occupational disease in Denmark. The fact that OCD does not seem to be in decline, as assessed by the number of recognized cases, does not necessarily mean that the preventive measures have not been effective; it may also reflect the fact that attention has been drawn to the area, so attracting an increasing number of notifications. However, in spite of the high and slightly increasing number of OCD cases, recent data from the healthcare sector show that only 12% of cases with current hand eczema were notified to the authorities, indicating that it is still only the tip of the iceberg that is being reported (12).

The patients in the present study population are similar to those in previous studies of OCD with respect to overweight, female sex, and onset at a young age (3, 13). The occupations most often involved were healthcare, kitchen work, and cleaning, which together constituted 46% of all cases. The fact that these three occupations include almost half of the recognized cases indicates that preventive efforts should be focused here.

The distribution of sub-diagnoses (OICD, AICD, and OCU) shows an increase in irritant contact dermatitis as compared with previous studies (3, 13). OICD is particularly frequent in women, which has also been previously reported (13). The increased frequency of OICD in women, as opposed to the more equal sex distribution for OACD, probably reflects the fact that women more often work in wet occupations, and are probably also more involved in wet tasks at home, which counteracts

the healing process of the skin barrier that should take place during leisure hours. Wet work was found to be the most frequently reported irritant exposure, accounting for 68% of all registered irritant exposures. The data indicate that a preventive focus on wet work could significantly reduce the number of annually recognized OCD cases.

With respect to OACD, the majority of cases are related to rubber additives and to epoxy. Contact allergy to rubber additives, mainly thiuram, is related mainly to the healthcare sector and glove exposure (87%). This shows that, although contact allergy from gloves is a well-known problem, it still needs further attention to reduce the high number of cases. Glove exposure as an occupational risk factor for hand eczema is further underlined by the fact that 34 cases of natural rubber latex allergy – the majority being caused by glove exposure – were recognized in 2010. This figure has remained unchanged over the last decade, and shows that, although regulation for latex exposure has been introduced, the problem is not yet solved. The majority of skin problems caused by gloves are still irritant skin reactions (Table 4), a fact that could be addressed by the introduction of skin care programmes in wet occupations (9).

Epoxy was the second most frequent contact allergen to cause OACD, and half of the cases were exposed in the windmill industry. A preventive effort in these specific industries, ensuring that national regulations on epoxy courses are being observed, should be able to reduce the numbers of OCD cases in this industry.

An interesting clinical observation is that, in some workers with OACD caused by rubber additives and epoxy, eczema is localized to the face and hands, and in some workers it is localized only to the face. It is important to note that facial eczema may sometimes be an occupational disease.

In our study, we had access to the patient files, and the relevance of contact allergies with respect to occupation was, in almost all cases, based on the conclusions drawn by specialists in dermatology in the medical certificates. Relevance was considered to be present either if the allergen was identified at the workplace, or if the allergen was generally accepted/described in the literature as occurring in the specific types of workplace.

The severity of OCD, as assessed by degree of injury, was significantly higher among patients aged >40 years. More severe eczema in the older group has previously been reported (3), and probably reflects the fact that younger people more easily change jobs (and exposures), whereas older people more often stay in their jobs and maintain occupational exposures. The slightly higher degree of severity in OICD cases than in OACD cases has previously been reported (3). The degree of injury is, in most cases,

not assessed until 6–12 months after notification of the particular case, and the lower degree of injury in OACD cases than in OICD cases probably reflects the fact that, in some OACD cases, avoidance of the allergen has led to total clearance of the eczema.

A limitation of the present survey is that, as previously mentioned, it is probably only the tip of the iceberg that is being notified, and there may still be numerous cases of OCD that are not being reported. There may also be a tendency for recognition of OCD within specific areas (e.g. wet work) to attract more notification in this area than in other areas. Because of this, it is still very important to be alert, and not to dismiss exposures not reported here as possible causes of OCD. The present data give information on recognized cases only, and the data are directly related to the financial burden of OCD for society.

Conclusion

From the present data, it seems obvious that there is still a great need for preventive measures within the area of OCD. The data are useful for planning preventive efforts in the future. From the data, it can be concluded that healthcare workers, kitchen workers and cleaners are at increased risk of OCD, and preventive efforts should be directed at these occupations. The facts that OICD accounts for 70% of all cases of OCD and that wet work is the cause in 68% of OICD cases make it clear that prevention should be directed at wet work occupations. Solid evidence for the efficacy of 'skin care programmes' to prevent OCD resulting from wet work is available, establishing the basis for reducing the numbers of OCD cases.

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