

**Allergic contact dermatitis and other occupational skin disorders in health care workers in the
Finnish Register of Occupational Diseases in 2005–2016**

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Abstract

Background: Health care workers are an important risk group for occupational skin disease (OSD).

Aims: To study diagnoses and causes of health care workers' OSDs in the Finnish Register of Occupational Diseases (FROD) in 2005-2016.

Methods: We searched the FROD for dermatological cases (1) in health care-related occupations defined by ISCO-08 and (2) in the industrial branch of health care defined by European industry standard classification system (NACE rev. 2).

Results: Health care workers comprised 19% of all OSD cases in the FROD, and irritant contact dermatitis dominated the diagnoses. Nurses and assistant nurses were the largest occupational groups with incidence rates of 3.3 and 2.7/10 000 person years, respectively. Rubber chemicals were by far the most common causative agents of allergic contact dermatitis (ACD) followed by preservatives. The latter mainly comprised isothiazolinones and formaldehyde. Acrylates were important allergens in dental professions. Metals and coconut fatty acid derivatives were the next largest causative groups for ACD. Drugs caused only 1% of the ACD cases.

Conclusions: Workers in different health care occupations don't have a uniform risk for OSD, but they share the risk for ACD due to rubber chemicals and various preservatives.

Keywords: rubber chemicals, incidence rate, preservatives, formaldehyde, fragrances, drugs, isothiazolinones,

1. Background

Health care workers constitute a major risk group for occupational skin disease (OSD) ¹⁻³. Studies on incidences and causes of various OSD diagnoses in healthcare workers are not abundant.

We have already published some data on health care workers in our recent analyses on OSDs in a 12-year material (2005–2016) of the Finnish Register of Occupational Disease (FROD) ⁴⁻⁶. In the present study, we wanted to analyse in detail all health care occupations for incidences of different OSD diagnoses and causes of allergic contact dermatitis (ACD).

2. Methods

We have recently described the main characteristics of the FROD and the present 12-year data ^{4,5}. In brief, the Finnish Institute of Occupational Health (FIOH) maintains the FROD. The data are provided by a coordinator of Finnish insurance institutions, Finnish Workers' Compensation Center, that collects data from private insurance companies and Farmers Social Insurance Institution. The register contains both recognized and suspected cases of occupational diseases determined by private insurance institutions. The register comprises data on for example occupation, branch of industry, up to three causes of occupational disease and the respective diagnoses. One case can have several different skin diagnoses [for example ACD, and irritant contact dermatitis (ICD)]. We restricted the present study to the recognised cases.

To search and identify cases of occupational contact dermatitis within health care, our first approach to the FROD data was based on the registered branches of industry. They were coded according to the Standard Industrial Classification TOL 2008 ⁷ since 2009. This national classification is equal to European industry standard classification system, NACE (Nomenclature des Activités Économiques dans la Communauté Européenne) revision 2. The preceding 2002 version of the national classification ⁸ was used in 2005–2008. We searched cases in 'Health care activities' (code 86 in the present classification; code 851 in the earlier classification) and studied numbers of different diagnoses and causes of ACD.

Our second approach to the FROD data was to analyse the registered occupations. They were coded according to the Finnish Classification of Occupations 2010 (3) (based on ISCO-08) since 2011. The preceding 2001 version of the national classification (4) (based on ISCO-88) was used until 2010. In ISCO-08, there are two sub-major groups (2-digit codes) dedicated for health care workers: 'Health professionals' (code 22; e.g. medical doctors) and 'Health associate professionals' (code 32; e.g. nurses). Health care workers can also be found under 'Personal care workers in health services' [code 532; e.g. health care assistants (practical nurses; assistant nurses)]. In addition, we have a national extension at the 5-digit level for 'Hospital and institutional helpers' (code 91123). They can be distinguished from other cleaners working in offices and hotels. Several ISCO-08 codes in the above-mentioned groups are not used in our national version: 'Traditional and complementary medicine professionals' (223), 'Paramedical practitioners' (224), 'Physiotherapists' (2264; note the major group 2), 'Optometrists and ophthalmic opticians' (2267), 'Medical records and health information technicians' (3252), 'Community health workers' (3253), and 'Medical assistants' (3256). We decided to exclude professions related to veterinary medicine [i.e. veterinarians (code 2250) and 'Veterinary technicians and assistants' (code 3240)].

We searched the 12-year data for cases in health care occupations and corresponding occupations in the earlier classification. Statistics Finland provides conversion tables between the two classifications [in Finnish; ^{9 10}]. We used them to combine cases from the earlier and the later period. In many

occupations, the conversion was straightforward and involved just two interconvertible codes. In two occupations, however, we chose to present data from the later 6-year period only, because conversion was not possible: 'Dental technicians' (code 32141) and 'Prosthetist-orthotists' (code 32142) appeared as independent groups in our national ISCO-08-based classification (national extensions at 5-digit level).

We retrieved numbers of cases for all OSDs, ACD, ICD, and contact urticaria/protein contact dermatitis (CU/PCD). We calculated incidence rates by using national labour force data of the year 2012 that we had retrieved from the webpage of Statistics Finland on the 6th of June in 2015 (not anymore available on the internet). We also retrieved causes of ACD in each occupation from the FROD data. In detailed analyses we excluded skin infections in order to facilitate comparison with previous literature.

3. Results

The search according to the registered branch of industry yielded 978 cases during the 12-year period. Their share of all OSDs in the FROD was 18.6%.

Distribution of the diagnoses

The most common diagnosis was ICD affecting 45% of all the cases, and in 43% it was the main diagnosis (**Table 1**). ACD was among the diagnoses in 25% of the cases, and contact urticaria/protein contact dermatitis (CU/PCD) appeared in 3% of the cases. When skin infections were excluded, ICD comprised 59% of the remaining cases, ACD 33% and CU/PCD 4%.

Skin infections

Skin infections were a large group comprising 24% of the cases. The vast majority, 223, of 238 skin infections were scabies. There were also 6 cases of impetigo and 2 other Staphylococci skin infections, 3 cases of dermatophyte infections, one chickenpox, one Pediculosis capitis, one Erythema infectiosum (parvovirus), and one Paravaccinia (in a veterinarian; veterinary medicine was not excluded in this search by branch of industry, only in the search by occupation, see below).

Health care occupations with cases in the FROD

In the search by occupation, we identified twenty health care occupations with cases. The largest groups (including skin infections) were nurses and midwives (N=423), health care assistants (N=399), and dental assistants (N=87). In Table 2 we present case numbers and incidence rates for all OSDs (skin infections excluded), ACD, ICD and CU/PCD in the individual occupations. The highest incidences were in dental professions (7–19/10 000 person years). The largest groups, nurses and assistant nurses, had incidences of 3.3 and 2.7, respectively. For comparison, the incidence of OSDs (infections excluded) in the total labour force was 1.71/10000 person years (95% CI 1.67–1.76; N = 4814). (With skin infections included, the corresponding figures were 1.88 cases/10 000 person years and 5265)

Causes of ACD

According to the search by industrial branch, rubber chemicals were by far the largest group of causes of ACD (Table 3). Occupation-specific search showed that rubber allergy was the leading cause in 9 occupations (Table 4). Acrylates, in turn, caused ACD only in dental professions. Isothiazolinones, formaldehyde, and other preservatives and disinfectants were all relatively

important as causes of ACD. Case numbers in Tables 3 and 4 differ, because the analysed subgroups are not equal.

4. Discussion

In this study, we wanted to describe OSD diagnoses and causes of ACD in health care -related occupations in more detail than in our previous reports of the same register material ⁴⁻⁶.

Health care workers comprised 19% of all OSD cases in the FROD (15% when skin infections were excluded). It is In Australia, health care workers comprised 21% of OSDs ¹, and in Denmark in 2010, there were 388 healthcare workers among a total of 1504 OSD cases (26%) ¹¹.

In line with the previous literature, ICDs dominated diagnoses in the present material: Skin infections excluded, they comprised 57% of primary diagnoses while ACD was diagnosed in 32%. In Denmark, ICD was diagnosed in 88% and ACD in 18% of their OSD cases ¹¹. In Australia ICD comprised 51% of all primary diagnoses and ACD 23% ¹. In our analysis on individual health care occupations, incidence of ICD was usually higher than that of ACD. Apart from the very small groups with three cases or less (Table 2), only medical doctors, dentists and dental technicians had a higher incidence rate of ACD than that of ICD.

It is not unambiguous which occupations should be included in health care workers. Hospitals and other health care institutions employ not only workers in the main function, i.e. health care, but also for example kitchen workers and staff in other support services. In our search by branch of industry their share was about 10% of the OSD cases. As regards registered occupations, for example 'Child-care workers' (5131) and 'Home care assistants, personal care workers' (5133) were classified under the same 3-digit code as 'practical nurses' (5132) in ISCO-88. In this study, we did include 'Home-based personal care workers', but not 'Childcare workers' that in ISCO-08 no more share the same 3-digit code as 'Health care assistants' (practical nurses). Inclusion criteria have impact on results especially when causes of ACD or incidence rates are studied.

In the present material, the incidence rates for OSDs varied a lot in different occupations. All four dental care professions had incidences of 7/10 000 person year or higher (skin infections excluded). Only prosthetist-orthotists' incidence rate was of the same order, 7.4, a figure that resulted from a single case during 6 years in a very small labour force (224 workers). Three pharmacy-related occupations had low incidence rates (0.48–0.52) together with medical doctors and head nurses ('Nursing and midwifery professionals'). The largest groups, nurses and assistant nurses, had incidences of 3.3 and 2.7, respectively. In Northern Bavaria in 1990s, the incidence rate was given for 'health care workers', 7.3/10 000 person years, and separately for dental technicians, 10.8 ². The incidence of 'health care workers' was much higher than the incidences of possibly comparable groups 'nurses' and 'assistant nurses' in our material, but the reverse was true for dental technicians (10.8 v. 19). In Australia, the incidence of all OSDs in healthcare workers was 2.1, which is somewhat lower than in our 'nurses' and 'health care assistants' ¹. In the UK, dermatologists reported an incidence rate of 1.1 and occupational physicians 3.4 for health and social care workers, which is of the same order as our results ¹².

As regards the registered causes of ACD, our analysis confirms previous findings that rubber compounds form the by far most important allergen group followed by preservatives. In Denmark rubber chemicals were the most common occupationally relevant contact allergens followed by biocides, perfumes and nickel/cobalt (50, 13, 6 and 3 cases respectively in 2010) ¹¹. In our study, isothiazolinones were the largest group of preservatives followed by formaldehyde and its liberators.

Among the 16 isothiazolinone ACD cases, 7 were due to benzisothiazolinone (BIT). During the study period, we had a small epidemic of BIT allergy due to PVC gloves and most cases were in dental professions¹³. In Finland, formaldehyde and its liberators haven't lost their importance as causes of ACD in healthcare workers, which is in contrast with a finding in nurses of the German-speaking countries³. We didn't have any cases of perfume allergy (in the industrial-branch-specific search), and acrylates, our third largest group, were not among the reported allergic exposures in the Danish material¹¹. Metals, mostly nickel, were the fourth largest allergen group in our material, which is in line with the Danish report¹¹. In Australia in 1993-2014, rubber and preservatives were also the most important causative allergen groups in healthcare workers with occupational ACD¹⁴. Formaldehyde was the third most important cause in the Australian study, followed by coconut diethanolamide (CDEA) that caused 3 cases of ACD in our material. In our material, cocamidopropyl betaine-related allergens¹⁵ caused more cases than CDEA.

We have discussed the strengths and limitations of the FROD material in our previous reports^{4-6,16}. In the FROD, recognized diagnoses of ACD and ICD are based on patch testing performed by dermatologists with few exceptions, and there must be a clear occupational exposure to the culprit agent(s). In insurance companies, occupational physicians evaluate the results of investigations and exposure data. Our national criteria for occupational ICD are possibly relatively strict. Moreover, some health care workers work as entrepreneurs with voluntary insurance for OSD (e.g. masseurs and dentists). This may lead to some underestimation of incidence rates, as not all entrepreneurs have taken the insurance.

5. Conclusions

The number of OSD cases in health care workers is high due to the large labour force, and generally ICD dominates the diagnoses. As incidences for all OSDs and especially ACD in different occupations vary a lot, workers in this field don't have a uniform risk for OSD, but they do share the risk for ACD due to rubber chemicals and preservatives.

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Table 1 Distribution of skin-related diagnoses in health care workers searched according to the branch of industry.

Diagnosis	As first diagnosis, N (fraction of all 978 cases)	Fraction of 740 cases, skin infections excluded	As secondary diagnosis	Total number of cases N (fraction of all 978 cases)	Fraction of 740 cases, skin infections excluded
Irritant contact dermatitis	424 (43%)	57%	16	440 (45%)	59%
Allergic contact dermatitis	235 (24%)	32%	7	242 (25%)	33%
Contact urticaria/protein contact dermatitis	29 (3%)	4%	1	30 (3%)	4%
Skin infections	238 (24%)	–	0	238 (24%)	–
Unspecific dermatitis	52 (5%)	7%	0	52 (5%)	7%

Table 2 Occupations/occupational groups, their codes in ISCO-08 and earlier ISCO-88 classifications, size of labour force in 2012, numbers of cases and incidence rates with 95% confidence intervals (C.I.) for all occupational skin diseases, allergic contact dermatitis, irritant contact dermatitis and contact urticaria/protein contact dermatitis (CU/PCD).

Occupation	Code (earlier code)	Labour force in 2012	Occupational skin diseases, infections excluded		Allergic contact dermatitis		Irritant contact dermatitis		CU/PCD
			N	Incidence/10 000 (95% C.I.)	N	Incidence/10 000 (95% C.I.)	N	Incidence/10 000 (95% C.I.)	
Medical doctors	221 (2221)	19 320	20	0.86 (0.54–1.3)	10 (50%)	0.43 (0.22– 0.77)	6 (30%)	0.26 (0.10–0.54)	2 (10%)
Nursing and midwifery professionals (head nurses)	222 (223)	5704	3	0.48 (0.11–1.2)	0		2 (67%)	0.29 (0.049–0.97)	1 (33%)
Health care assistants	5321 (513, 51321, 51322, 51324, 51326)	80 214	258	2.7 (2.4–3.0)	69 (27%)	0.72 (0.56– 0.90)	168 (65%)	1.7 (1.5– 2.0)	12 (5%)
Nursing and midwifery associate professionals	322 (323, 32311, 32312, 3232)	66 006	261	3.3 (2.9 – 3.7)	67 (26%)	0.85 (0.66 – 1.1)	171 (66%)	2.2 (1.9 – 2.5)	11 (4%)
Home-based personal care workers	5322, 53221, 53222 (5133, 51331, 51332)	23041	30	1.1 (0.75 –1.5)	6 (20%)	0.22 (0.088 – 0.45)	23 (77%)	0.83 (0.54 – 1.2)	1 (3%)
Hospital and institutional nurses	91123 (91321)	20 612	33	1.3 (0.93 – 1.9)	7 (21%)	0.28 (0.12 –0.56)	22 (67%)	0.89 (0.57 – 1.3)	0
Physiotherapy technicians and assistants	3255 (3226, 32261)	8 868	30	2.8 (1.9–4.0)	13 (43%)	1.2 (0.68 – 2.0)	17 (57%)	1.6 (0.96 – 2.5)	0
Medical and pathology laboratory technicians	3212 (32314)	5 734	30	4.4 (3.0 – 6.1)	7 (23%)	1.0 (0.44 –2.0)	19 (63%)	2.8 (1.7 – 4.2)	3 (10%)
Massage therapists and practical rehabilitation nurses	53294 (51413)	4 389	21	4.0 (2.5 – 6.0)	8 (38%)	1.5 (0.71 – 2.9)	13 (62%)	2.5 (1.4 – 4.1)	0
Equipment maintenance assistants	53292 (51327)	2 146	7	2.7 (1.2 – 5.4)	3 (43%)	1.2 (0.30 – 3.2)	3 (43%)	1.2 (0.30 – 3.2)	0
Ambulance workers	3258 (51323)	3 009	5	1.4 (0.51 – 3.1)	2 (40%)	0.55 (0.093 – 1.8)	2 (40%)	0.55 (0.093 – 1.8)	0
Medical imaging and therapeutic equipment technicians	3211 (32313)	2 846	5	1.5 (0.54 – 3.2)	1 (20%)	0.29 (0.015 –1.4)	2 (40%)	0.59 (0.098 – 1.9)	0
Occupational therapists	32591 (32262)	1501	3	1.7 (0.42 – 4.5)	1 (33%)	0.56 (0.028 – 2.7)	2 (67%)	1.1 (0.19 –3.7)	0
Prosthetist-orthotists ^a	32142 ^a	224	1 ^a	7.4 (0.37 – 37)	1	7.4 (0.37 – 37)			
PHARMACY OCCUPATIONS									
Pharmacists	2262 (2224)	1457	1	0.57 (0.029 – 2.8)	0		0		1

Pharmaceutical technicians and assistants	3213 (3228)	5249	3	0.48 (0.12 – 1.3)	3	0.48 (0.12 – 1.3)			0
Pharmaceutical assistants	53293 (5139)	3225	2	0.52 (0.087 – 1.7)	2	0.52 (0.087 – 1.7)	0		0
DENTAL CARE OCCUPATIONS									
Dental assistants	53291 (51325)	5 194	87	14 (11 – 17)	39 (45%)	6.3 (4.5 – 8.5)	42 (48%)	6.7 (4.9 – 9.0)	4 (5%)
Dentists	2261 (2222)	4 182	35	7.0 (4.9 – 9.6)	19 (54%)	3.8 (2.3 – 5.8)	13 (37%)	2.6 (1.4 – 4.3)	3 (9%)
Dental assistants and therapists (d. hygienists)	3251 (3225)	1 638	17	8.6 (5.2 – 14)	6 (35%)	3.1 (1.2 – 6.3)	11 (65%)	5.6 (2.9 – 9.7)	1 (6%)
Dental technicians ^a	32141 ^a	614	7 ^a	19 (8.3 – 38) ^a	5 (71%)	14 (5.0 – 30)	2 (29%)	5.4 (0.91 – 18)	0

^a After 6-year period 2011–2016 analysed

Table 3 Main causes of allergic contact dermatitis (ACD) in the industrial-branch-specific search

Allergen group	Cases (N)	Share of all ACD cases	Details of some allergen groups
Total number of ACD cases	242		
Rubber chemicals	84	34.7%	Thiurams 50, benzothiazoles 3, 1,3-DPG 2, DETU 1, N-(cyclohexylthio)phthalimide 2, ZDMC 1, unspecified rubber chemicals 28
Acrylates	28	11.6%	2-HEMA 3, MMA 3, EGDMA 1, bis-GMA 2, 'epoxyacrylate resin/plastics' 1, 'unspecified acrylates and methacrylates' 17
Isothiazolinones	16	6.6%	MCI/MI 8, BIT 7, 'unspecified isothiazolinone' 1
Formaldehyde	14	5.8%	
Other preservatives/disinfectants	14	5.8%	Glutaraldehyde 2, Glyoxal 2, PHMB 1, PHMG 1, 'saturated aliphatic aldehydes' 1, chlorotoluenesulfonamide 1, 'disinfectant' 5, 'other antimicrobial' 1
Metals	14	5.8%	Nickel 9, cobalt 3, chrome 1, mercury 1
Polyvinylchloride (PVC)	6	2.5%	
Epoxy compounds	4	1.7%	
Cocamidopropyl betaine -related	6	2.5%	
Cocamide diethanolamine (CDEA)	3	1.2%	
Ethanolamines	3	1.2%	
Drugs	3	1.2%	Local anaesthetics 1, gentamycin 1, cephalosporins 1
Colophony	2	0.8%	
Lanolin	2	0.8%	

MCI/MI = methylchloroisothiazolinone/methylisothiazolinone; BIT = benzisothiazolinone; PHMB = polyaminopropyl biguanide; PHMG = polyhexamethylene guanidine; ZDMC = Zinc dimethyldithiocarbamate; 1,3-DPG = 1,3-diphenylguanidine; DETU = diethylthiourea; 2-HEMA = 2-hydroxyethyl methacrylate; MMA = methyl methacrylate; EGDMA = ethylene glycol dimethacrylate; bis-GMA = bisphenol A glycerolate dimethacrylate

Table 4 Occupations with cases in the Finnish Register of Occupational Disease, numbers of allergic contact dermatitis (ACD) in each occupation, and main causes of ACD. One case may have more than one registered cause of ACD. For ISCO-08 codes and corresponding ISCO-88 codes see Table 2. Figures don't match with those in Table 2 because the analysed subgroups are not equal.

Occupation	Cases of allergic contact dermatitis, N	Causes of occupational allergic contact dermatitis, N
Medical doctors	10	Rubber 6 (thiurams 3, DPG 1), formaldehyde 1, protective glove 1, undefined plastics 2
Nursing and midwifery professionals	0	
Health care assistants (assistant nurses; practical nurses)	69	Rubber 20 (thiurams 14, MBT 1), isothiazolinones 9 (CMI/MI 6, MI 4), formaldehyde 6, lanolin 1, PVC 7, nickel 4, fragrances 3, protective gloves 4, CAPB-related 2, CDEA 2, epoxy resin 1, MDBGN 1, PHMG 1, PHMB 1, color agents 1
Nursing and midwifery associate professionals (nurses)	67	Rubber 26, formaldehyde 6, CDEA 1, DMAPA 4, Nickel 3, Chrome 1, MI 1, MCI/MI 1, lanolin 1, PHMB 1, N,N-dimethyltoluidine, disinfectants 2, protective gloves 2, PVC 1, PPD derivatives 1, gentamycin 1, neomycin 1, cephalosporines 1, local anesthetics 1, other plastics/resins 2
Home-based personal care workers	6	Rubber 2, BIT 1, MCI/MI 1, Polyethylene plastic 1
Hospital and institutional helpers	7	Rubber 4, PVC 1, MCI/MI 1
Physiotherapy technicians and assistants	13	Formaldehyde 3, fragrances 3 (linalool 1), thiurams 1, BIT 1, massage oil/cream 2, other preservative 1
Medical and pathology laboratory technicians	7	Rubber 5, MCI/MI 1, colophony 1
Massage therapists and practical rehabilitation nurses	8	Parabens 2, tea tree oil 1, aloe vera 1, imidazolidinyl urea/formaldehyde 1, massage oil 1
Equipment maintenance assistants	3	Rubber 2, MI 1
Ambulance workers	2	Thiurams 1, disinfectant 1
Medical imaging and therapeutic equipment technicians	1	Nickel 1
Occupational therapists	1	Skin creams and massage oils 1
Prosthetist-orthotists	1	undefined plastics 1
PHARMACY OCCUPATIONS		

Pharmacists	0	
Pharmaceutical technicians and assistants	3	Thiurams 2, colophony 1
Pharmaceutical assistants	2	Drugs 1
DENTAL CARE OCCUPATIONS		
Dental assistants	39	Acrylates 11, rubber 9, BIT 2, epoxy resin 2, ethanolamine 1, cobalt 1, nickel 1, Hg 1, DMAPA 1, glyoxal 2, glutaraldehyde 2, other plastics 2, disinfectants 2
Dentists	19	Acrylates 7, rubber 6 (5 thiurams, MBT 1), BIT 4, triethanolamine 1
Dental assistants and therapists (d. hygienists)	6	Thiurams 3, acrylates 1, methylhydroquinone 1, glove 1
Dental technicians	5	Acrylates 5

BIT = benzisothiazolinone; MBT = mercaptobenzothiazole; Hg = mercury; DMAPA = dimethylaminopropylamine; MCI/MI = methyl/chloroisothiazolinone; MI = methylisothiazolinone; PVC = polyvinyl chloride; CDEA = cocamide diethanolamine; CAPB = cocamidopropyl betaine; PPD = p-phenylenediamine; DPG = diphenylguanidine; MBGN = methyldibromoglutaronitrile; PHMB = polyaminopropyl biguanide; PHMG = polyhexamethylene guanidine