

Occupational irritant contact dermatitis from synthetic mineral fibres according to Finnish statistics

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Synthetic mineral fibres (i.e. man-made vitreous fibres, MMVF) are classified into glass filament, mineral wool (glass wool, rock wool and slag wool), refractory ceramic fibres, and fibres for special purposes. This paper analyses the data on occupational irritant contact dermatitis (ICD) caused by MMVF during 1990–99 in Finland according to the Finnish Register of Occupational Diseases (FROD). A total of 63 cases from MMVF were reported. 56 were diagnosed as ICD, and 2 as allergic contact dermatitis, both from rock wool. 53 out of 63 cases were due to mineral wool or glass filaments; half of the cases, according to a rough estimate, were due to mineral wool and a half due to glass filaments used in lamination work. Carpenters, building workers and insulation workers have the highest risk of ICD from mineral wool. 4 cases in carpenters, 4 in building workers and 2 in insulation workers were reported from MMVF. For every 100 000 employed workers, only 1.6 cases of ICD in carpenters, 2.7 in building workers and 9.1 in insulation workers were annually due to MMVF, respectively. Mineral wool used in construction work, insulation, etc., cannot be considered to be a common cause of occupationally induced ICD. However, information on harmful skin effects of MMVF is useful to exposed persons in the prevention of the effects.

Key words: building workers; carpenters; epidemiology; glass filaments; glass wool; insulation work; irritant contact dermatitis; mineral wool; MMVF; occupational dermatoses; rock wool; synthetic mineral fibres. © Blackwell Munksgaard, 2002.

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Synthetic mineral fibres (i.e. man-made vitreous (silicate) fibres, MMVF) are fibrous inorganic substances primarily made of rock, clay, slag or glass. These fibres are classified into 4 general groups: glass filament, mineral wool (glass wool, rock wool and slag wool), refractory ceramic fibres, and fibres for special purposes (1). Rock wool, glass wool and slag wool contain masses of entangled vitreous fibres not showing any 3-dimensional order. The diameter of the fibres in each wool product ranges from 0.2 to about 10 µm. The diameter of the fibres in continuous filament products is between 6 µm and 12 µm, and sometimes up to 25 µm (2).

Synthetic mineral fibre dermatitis is usually the consequence of mechanical irritation after direct, indirect (through clothing) or airborne exposure (2, 3). Petersen & Sabroe (4) discovered that two-thirds of construction workers who worked with mineral wool for 160–180 h per month had irritant symptoms of the eyes, skin, and upper respiratory

tract, once a week or more. The occurrence of symptoms was 2–3 times more frequent compared to construction workers not working with mineral wool. Solitary cases of allergic contact dermatitis (ACD) due to synthetic mineral fibre products have been reported, mainly from epoxy resins used in the finishing of glass fibres (2, 5) or in industries that use glass fibres in the production of reinforced plastic products or printed circuit boards (2). ACD from rock wool or glass wool is also rare. Only individual cases of ACD induced by phenol-formaldehyde resins used to bind mineral fibres together have been reported (6).

Mineral wool is classified as R 38 'irritating to skin' according to the European Commission Directive 97/69/EC (23rd adaptation of Council Directive 67/548/EEC). In this Directive, for the first time, a substance was classified as R 38 on the basis of temporary mechanical itching effects caused by the shape of the particles. All the other R 38 substances (about 350) in Annex 1 of the Di-

Table 1. Numbers of employed persons, and cases of occupational dermatosis and incidence of dermatoses according to the Register of Occupational Diseases (FROD) during 1990–99 in Finland

Occupation	All occupations	Carpenters	Building workers	Insulation workers
Average of employed persons during 1990–99	2 200 000	25 691	14 979	2208
All cases of occupational dermatosis during 1990–99	11 532	93	145	10
All cases per 100 000 employed person years	52	36	97	45
Cases from synthetic mineral fibres	63	4	5	2
Cases from synthetic mineral fibres per 100 000 employed person years	0.3	1.6	3.3	9.1
All cases of ICD during 1990–99	4498	41	65	6
Cases of ICD per 100 000 employed person years	20	16	43	27
Cases of ICD from synthetic mineral fibres	56	4	4	2
Cases of ICD from synthetic mineral fibres per 100 000 employed person years	0.3	1.6	2.7	9.1

ICD = irritant contact dermatitis.

rective 67/548/EEC are chemicals whose irritant effects are caused by their chemical properties. According to the European Commission Directive 2001/59/EC (28th adaptation of 67/548/EEC), the risk phrase R 38 shall be assigned in accordance with the following criteria:

- Substances and preparations which cause significant inflammation of the skin which persists for at least 24 h after an exposure period of up to 4 h determined on the rabbit according to the cutaneous irritation test method cited in Annex V.
- Substances and preparations which cause significant inflammation of the skin, based on practical observations in humans on immediate, prolonged or repeated contact.

There is no doubt that mineral wool fibres may cause an itchy rash, but do these reversible temporary effects justify the classification as R 38 according to the criteria laid down in Directive 2001/59/EC, i.e. do MMVF cause significant inflammation of the skin, such as irritant contact dermatitis (ICD), in a large population of exposed persons? In order to evaluate the irritant potential of MMVF, we have analysed the data on occupational dermatoses caused by synthetic mineral fibres during 1990–99 in Finland.

Materials and Methods

Finland has a population of about 5.2 million, and a workforce of about 2.2 million. In Finland all occupational diseases are diagnosed by a physician and, according to Finnish legislation, physicians are obliged to report every case of occupational disease to the Finnish Register of Occupational Diseases (FROD) on an official form. The Finnish Institute of Occupational Health (FIOH) has com-

puted these statistics on occupational skin diseases since 1975. The information received is checked and computerized into a data base. In the FROD not more than 3 diagnoses and 3 causes are listed in the cases of occupational dermatoses. The cases are classified according to the main diagnosis and the main cause. The FROD index of causative agents has a main category called 'synthetic mineral fibres' which is divided into 5 subcategories: 'glass wool', 'rock wool', 'slag wool', 'other synthetic mineral fibres' and 'unspecified synthetic

Table 2. Most frequent causes of occupational irritant contact dermatitis in 1990–99 (4498 cases) according to the Finnish Register of Occupational Diseases (FROD)

Cause	No. of cases	%	Ranking order
Detergents	1372	30.5	1
Wet work	550	12.2	2
Dirty work	356	7.9	3
Oils and lubricants, including metal-working fluids	325	7.2	4
Organic solvent mixtures	232	5.2	5
Handling of foodstuffs	200	4.4	6
Organic materials, e.g. animal-derived dusts or substances, flours, grains, and fodders, species of wood and plants	147	3.3	7
Mechanical friction of the skin	107	2.4	8
Cement, concrete	91	2.0	9
Sprays, fumes, dusts and smoke (mixture), e.g. plastic, paint and sanding dusts	87	1.9	10
Glues	76	1.7	11
Synthetic mineral fibres (MMVF)	56	1.2	12
Hairdressing chemicals	52	1.2	13
Warm moisture	49	1.1	14
Synthetic resins and plastics	42	0.9	15
Paints, varnishes and stains	33	0.7	16
Others	497	11.0	
Unknown factors	226	5.0	

mineral fibres'. Glass filaments were mainly registered under the 'glass wool' category. The occupations are classified according to the Finnish classification of occupations from 1987, which is based on international and Nordic classifications (7).

Fisher's exact test was used for comparing the incidences of ICD due to MMVF between occupations.

Results

General aspects

11 532 new cases of occupational dermatoses were reported to the FROD during the 10-year observation period 1990–99. Altogether, 3667 (31%) cases were diagnosed as ACD, 4498 (39%) as ICD and 3367 (29%) as other occupational dermatoses, of which 1680 were contact urticaria and protein contact dermatitis, and 633 were unspecified contact dermatoses (either ACD or ICD). 561 cases of skin infections were reported during the 10-year observation period (8, 9). The incidence of occu-

pational dermatoses was 52 new cases per 100 000 person years (Table 1).

The most common causes of all occupational dermatoses were (percentage of all occupational dermatoses in brackets): detergents (13%), rubber and rubber chemicals (12%), plastic chemicals (9%), wet and dirty work (9%), and animal epithelia (7%) (8, 9). The most common causes of ICD are given in Table 2. MMVF were the 12th most common cause of ICD.

Cases due to synthetic mineral fibres

A total of 63 cases of occupational dermatoses from synthetic mineral fibres were reported to the FROD during 1990–99 (Table 3). 56 of these (89%) were diagnosed as ICD. Only 2 cases of ACD, both from rock wool, were reported. 84% (53 out of 63) of the cases were due to mineral wool or glass filaments; half of the cases, according to a rough estimate based on the occupations of the notified cases, were due to mineral wool used in construction work, insulation, etc., and half due to glass

Table 3. Occupational dermatoses caused by synthetic mineral fibres according to the Register of Occupational Diseases (FROD) during 1990–99 in Finland

Diagnosis	Synthetic mineral fibres (total)	Mineral wool or glass filaments	Synthetic mineral fibres, other or unspecified
Irritant contact dermatitis (ICD)	56	47	9
Allergic contact dermatitis (ACD)	2	2	0
ACD/ICD	2	1	1
Contact urticaria	1	1	0
Other diagnoses or unknown	2	2	0
Total	63	53	10

Table 4. Occupational dermatoses in carpenters according to the Register of Occupational Diseases (FROD) during 1990–99 in Finland

Cause	Total	ICD	ACD	ICD/ACD	Other diagnoses
Cement-based products	13	10			3
Chromium	12		12		
Epoxy compounds	8		8		
Other metals	5	2	2	1	
Woods	5	2	2		1
Mechanical friction of the skin (unspecified)	5	4			1
Paints, lacquers and glues	5	2	1	1	1
Synthetic mineral fibres (total)	4	4			
mineral wool	4	4			
Phenol-formaldehyde resins	3	1	2		
Rubber chemicals	3		3		
Dirty work	3	2			1
Dusts	3	3			
Other causes	8	3	3		2
Unspecified chemical causes, other causes or unknown factors	16	8	3	3	2
Total	93	41	36	5	11

ICD, irritant contact dermatitis. ACD, allergic contact dermatitis.

Table 5. Occupational dermatoses in building workers according to the Register of Occupational Diseases (FROD) during 1990–99 in Finland

Causative agent	Total	ICD	ACD	ICD/ACD	Other diagnoses
Epoxy compounds	26	3	21	2	
Cement-based products	21	17	1	1	2
Chromium	15		14	1	
Dirty work	9	8			1
Rubber chemicals	6		6		
Synthetic mineral fibres (total)	5	4	1		
mineral wool	5	4	1		
Detergents	3	3			
Industrial oils and greases	3	3			
Unspecified chemical causes, other causes or unknown factors	57	27	8	8	14
Total	145	65	51	12	17

ICD, irritant contact dermatitis. ACD, allergic contact dermatitis.

filaments used in lamination work. The estimate was done by 3 of the authors after consulting a representative of the Finnish mineral fibre industry who knew the occupations in which mineral fibres were used.

The reported diseases had developed in various occupations. According to the data from FROD and our experience, carpenters, building workers and insulation workers have the highest risk of ICD from wool-like synthetic mineral fibres (mineral wool). 4 cases of occupational dermatosis in carpenters, 5 in building workers and 2 in insulation workers were reported from synthetic mineral fibres. Tables 4 and 5 show the occupational dermatoses by causes in carpenters and building workers during 1990–99. In these occupations, less than 10% (4/41 and 4/65, respectively) were due to MMVF. Only 10 cases of occupational dermatosis were reported in insulation workers. Out of 6 cases of ICD, 2 (33%) were from synthetic mineral fibres (1 from mineral wool, 1 from unspecified synthetic mineral fibres), and the rest from various causes. 2 cases were diagnosed as ACD, 1 from rubber chemicals and 1 from isothiazolinones. In addition, 2 cases with other diagnoses were reported.

Based on the numbers of employed persons in the occupations (Table 1), for every 100 000 employed workers, in total 16 cases of occupational ICD were annually reported in carpenters, 43 in building workers and 27 in insulation workers. Of these, only 1.6 cases in carpenters, 2.7 in building workers and 9.1 cases in insulation workers were due to synthetic mineral fibres. The incidence of ICD due to MMVF for all the 3 occupations was significantly higher than the incidence for all occupations (Fisher's Exact Test; $p < 0.001$). A difference in the incidence of ICD due to MMVF was found between carpenters and insulation workers at the 7% level of significance.

Discussion

Reporting of new occupational diseases to the FROD is legally defined, and a part of the Finnish labour protection. Despite this fact, the coverage of any occupational disease register, including the FROD, is not complete. Mild dermatoses of short duration are usually not reported to the FROD. In addition, some physicians neglect to report even more serious occupational diseases. Also, not all physicians have proper training in occupational medicine, including occupational dermatology, and thus are not able to connect a skin disease with exposure under working conditions. On the other hand, the FROD may also contain cases diagnosed or reported falsely. Nevertheless, in our experience the FROD forms a good basis for calculating statistical data on occupational dermatoses (10–13).

Most physicians, or even most workers handling mineral wool products, are unable to distinguish products made of glass wool, rock wool or slag wool from each other. In addition, the FROD classifies glass wool and glass filaments under the same category. Therefore, it was possible to arrive at only rough estimates of the proportions of cases due to mineral wool and those due to glass filaments. The estimates were based on the occupations of the notified cases, and they showed that the cases in the 'glass wool' category were mainly due to glass filaments.

Based on the data from FROD, there is indication of excess risk of ICD by occupation from wool-like synthetic mineral fibres in Finland. A statistically significant difference was not observed in the incidence of ICD due to MMVF between carpenters and insulation workers. However, the risk of ICD due to MMVF among insulation workers, assumed to be the most exposed group,

is probably higher than among carpenters. A significant difference could not be observed because of the small number of cases. This statement is supported by the fact that 20% of all occupational dermatoses in insulation workers were ICD due to MMVF. Thus those who are most exposed, i.e. insulation workers, have the highest risk. However, the mineral wool used in construction work, insulation, etc., cannot be considered to be a common cause of occupationally induced ICD. Based on the actual data from FROD, we are not able to make a clear-cut decision on the classification of MMVF as 'irritating to skin'. However, in our opinion the information on harmful skin effects of MMVF is useful to exposed persons in the prevention of the effects.

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