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Wet work in relation to occupational dermatitis

Jungbauer, Franciscus Henricus Wilhelmus

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Occupational contact dermatitis

Introduction and outline of this thesis

Occupational diseases, defined as any disease caused by exposure to which patients were subject through their work or working conditions, to a greater extent than others who do not have such work, affect the health of many persons, amounting to substantial costs to society. Therefore the management of reduction of occupation related health damage is important. The etiology of occupational diseases should be subject to more detailed scrutiny and preventive activities should be intensified. In order to set up preventive strategies detailed data about the injury-causing exposure factors are necessary. Occupational skin diseases include contact dermatitis and a variety of non-eczematous diseases such as fungal infection, acne, folliculitis, urticaria, cauterizations, changes in pigmentation, nail diseases, infectious diseases and skin cancer. Contact dermatitis, in particular irritant contact dermatitis, is the most common type of occupational disease. Factors such as water, soap, detergents, juices, occlusion are assumed to be the major determinant; at the work place these factors are conveniently summarised as wet work. In this thesis the exposure of the skin to wet work as major cause of contact dermatitis is considered in more detail.

Eczema, or dermatitis, is a reaction pattern manifested by variable clinical and histological findings that can cause many disabilities in daily life. Dermatitis is a predominantly lymphocytic inflammatory response of the skin. The clinical features of dermatitis are diverse and include itching, redness, papulovesicles and squames. Besides various endogeneous factors dermatitis may be induced by a wide range of exposure factors. Many working circumstances come with frequent and prolonged exposure to these skin-damaging factors.

Epidemiology of occupational contact dermatitis

Occupational skin diseases account for a large proportion of occupational diseases in Europe and are considered to be in the top 3 of registered work-related disorders⁽¹⁾. Publications on occupational dermatitis report a large range of prevalences. In some sectors of the Western economy⁽²⁻¹²⁾ 1 out of 3 employees has complaints related to hand dermatitis. Occupational disease registries provide national incidence data based on the notification of occupational skin diseases and are available in many countries. Although the comparison of national data are hampered by differences across countries in reporting occupational diseases, the average incidence rate of registered occupational contact dermatitis in some countries lies around 0.5 to 1.9 cases

per 1000 full-time workers per year⁽¹⁾. Most of the national registers combine all types of skin disease, while no distinction is made with regard to eczema or contact dermatitis. Skin diseases constitute up to 30% of all notified occupational diseases and it is estimated that eczema or contact dermatitis accounts for about 90-95% of all occupational skin diseases⁽¹³⁾. Contact dermatitis is predominantly located on the hands. Fregert observed contact dermatitis on the hands in 94% of the women and in 84% of the men from 1,752 patients considered having occupational dermatoses⁽¹⁴⁾. Some of the occupational disease statistics give a breakdown by gender and occupation or branch of industry. Most national statistics do not provide information on the actual cause of contact dermatitis and predisposing factors.

National registries are usually incomplete as a result of underdiagnosis and underreporting of the disease because the milder cases of skin disease are not being registered at all. The extent of underreporting is likely to differ between countries, because each country has its own system of notification and its own criteria for compensation. In the United States occupational disease statistics are collected annually from more than 170,000 private industries by the Bureau of Labor Statistics. A detailed analysis has been made of the register of occupational diseases in Denmark⁽¹⁵⁾. In Denmark the incidence is 17,700 cases in a workforce of about 2.6 million, i.e. about 0.8 per 1000 per year⁽¹⁵⁾. Out of 145 grouped exposure sources the 5 most frequently stated substances were detergents, water, metals, foodstuff and rubber in notified occupational skin diseases in Denmark. These substances caused approximately half of the dermatitis cases. The most important irritant seems to be wet work.

In the absence of prevalence figures on occupational contact dermatitis in the UK as well as in The Netherlands consultant-dermatologists report occupational skin diseases in voluntary surveillance schemes. These voluntary systems operate on the principle of simplicity, ensuring compliance. The epidemiological limitations are well recognised, but the system corrects the virtual absence of meaningful official statistics. In the UK the voluntary surveillance scheme for occupational skin disease, EPIDERM, estimates an annual incidence of occupational contact dermatitis of almost 13 per 100,000 workers⁽¹⁶⁾. Manufacturing industries account for the largest number of cases, employment in the health care came second. Dermatologists reports, EPIDERM, also indicate high rates of dermatitis in the personal service industries [mainly hairdressers and barbers] and in agriculture⁽¹⁶⁾. With the exception of an increase of the number of notifications from nurses, the numbers and proportions of cases of contact dermatitis remained fairly constant over a 6-year reporting period in the above mentioned schemes.

In The Netherlands, a voluntary system, more or less modelled to the British EPIDERM project is in operation since 2001. In 2002 a network of 25 consultant-dermatologists reported 956 cases of occupational skin disease in this Dutch system. The occupations with the highest rates are shown in Table I. From the data generated by 25 dermatology practices distributed across the country as sentinel stations, an annual occupational skin disease incidence of 1.5 per 1000 employees could be estimated (Coenraads: unpublished report to Ministry of Social Affairs and Employment).

Hairdressers	20%
Healthcare workers	13%
Caterers/foodindustry	13%
(Car) mechanics	12%
Professional cleaners	12%
Metal workers	8%
Florists	7%
Nail stylist	6%
Others	9%

Table I.
Occupations with highest reported occupational skin disease rates
in Dutch surveillance scheme by dermatologists ⁽¹⁷⁾

A population-based study of occupational skin diseases in North Bavaria and the Saarland, Germany, is one of the few that can claim completeness in terms of new cases [numerator] and size of the occupational population as denominator. In Germany, occupational skin diseases excluding skin cancer are officially registered by the code 'BK5101', which is defined as 'severe or recurrent skin diseases that force the discontinuation of any activity that causes or that could be causing the development, the worsening, or the recurrence of the skin disease'. In Northern Bavaria a detailed population-based prospective study was performed to classify all BK 5101 cases of occupational skin diseases. From 1990 to 1999 in total 5285 cases were recorded. In co-operation with the State Institute of labour and Occupation the number of all persons employed in different occupations during the same time period were collected. Since the number of employees in the different occupations was known, a population-based study was performed to investigate incidences and demographic characteristics in specific occupational groups. The estimate overall incidence is 6.7 cases per 10,000 workers per year in Northern Bavaria ^(18;19).

The highest incidence per 1000 per year is in hairdressers, bakers, and florists. The induction period is very short: about 2 years in hairdressers, 3 years in the food industry, and about 4 years in health services and in metal workers. The IR of contact dermatitis is highest between the age of 15 and 24 years. Hand dermatitis in relation to occupation was studied with a questionnaire by Meding and Swanbeck in an industrial city: the one-year period prevalence of hand eczema in their total sample of 20,000 was 11.8% ⁽¹⁰⁾. In a Dutch study, Smit et al reported in 1993 a point prevalence of hand dermatitis, including mild cases, among different occupational groups ranging from 2.9% in office workers to approximately 30% in nurses ⁽²⁰⁻²²⁾. In a Finnish study of 617 hospital workers, predominantly women, 44% had past or present hand dermatitis ⁽²³⁾. In 2003 the Dutch surveillance scheme for occupational skin disease occupational physicians considers 80% of all occupational skin diseases as a contact dermatitis ⁽¹⁷⁾. Occupational skin disease is predominantly diagnosed by

dermatologist instead of occupational physicians^(16;17;24). In both the British and Dutch surveillance schemes by dermatologists 90% of the cases were reported to be contact dermatitis.

In about half of all cases in the population-based study in Northern Bavaria a delayed-type sensitisation with occupational relevance was detected. Irritant contact dermatitis is the most common type of work-related skin disease⁽²⁵⁾, however occupational skin disease shows a very complex picture: incidence of irritant contact dermatitis versus allergic contact dermatitis is job-dependant^(25;26). In 360 patients who consulted a private clinic because of dermatitis at their hands, wrists and forearms and working in healthcare environments Nettis et al⁽²⁷⁾ observed a work-relation in allergic contact dermatitis in 16.5% of the patients and a work-relation in irritant contact dermatitis in 44.4% of the 436 total diagnoses. Occupational irritant contact dermatitis is usually caused by exposure to a wide range of irritants such as soaps, solvents, cleansers and protective gloves in the workplace. These irritants act by removing the skin lipid layer and may produce cellular damage.

Epidemiological data on gender distribution of occupational dermatitis point towards a higher risk among females, probably because they are relatively more often employed in risk occupations. Females had a considerable higher risk to develop OCD than men in Northern Bavaria in one of the few population-based studies⁽¹⁾. Females are considered to be more at risk compared with males. Meding and Swanbeck found that among cases of occupation-related hand dermatitis approximately two third were women^(28;29). Wall and Gebauer reported a sex ratio of 2.4 males to 1 female in Western Australia in 993 cases at an occupational referral clinic⁽²⁴⁾. Their data on gender distribution may reflect the higher proportion of men in their region that are employed in risk occupations and do not give information on gender as a risk factor.

Cohort studies on etiological factors for occupational dermatitis are difficult to conduct and reliable data are scarce; examples are a cohort study in the car industry by Funke et al⁽⁶⁾ and a study among hairdressers by Uter et al⁽³⁰⁻³²⁾. Atopic dermatitis is considered to be a risk factor to develop occupational dermatitis. Atopics account for a large proportion of the cases with occupational dermatitis. Dickel et al state that 19% of all cases that were reported to an occupational skin disease surveillance scheme have an atopic dermatitis⁽¹⁸⁾. Occupational skin disease with an atopic dermatitis is mostly seen in apprentices⁽³³⁾. Wall and Gebauer⁽²⁴⁾ reported that 75% of the apprentice hairdressers with hand dermatitis were atopics. These reports on atopic dermatitis in occupational skin disease lack control groups, the attributable risk of atopic skin disease can therefore only be estimated^(34;35).

The population-based study in Northern Bavaria, Germany, could demonstrate a significant decline in incidence of occupational skin disease among hairdressers between 1990 and 1999⁽¹⁸⁾. This supports a probable 'intervention effect' by legislative and preventive measures that came into effect over the last decade for hairdressers.

In summary, occupational skin disease is one of the most frequent reported occupational diseases, predominantly involves an irritant contact dermatitis located on the hands, and is often seen with employees with wet work.

Theory and backgrounds

Theoretically human skin can react in numerous ways to exposure in the working environment. In practice, the number of different response patterns is relatively small. The different responses can be listed as follows:

- Acute toxic reaction
- Contact dermatitis: (photo)allergic or (photo)irritant
- Contact urticaria
- Contact acne and folliculitis
- Pigment changes (de- or hyperpigmentations)
- Tumours: benign or malignant
- Rare diseases such as for example: scleroderma, erythema multiforme and lichenoid reactions⁽³⁶⁻⁴¹⁾.

Pre-existent skin diseases may be adversely affected by occupational exposure. Skin diseases known to deteriorate by specific occupational exposure are:

- Psoriasis by friction
- Atopic dermatitis, by exposure to detergents, occlusion, moisture, dry air
- Stasis dermatitis, by task that require long hours in an upright position
- Seborrhoeic dermatitis by occupational wearing of face masks or hats/caps
- Mycosis of the feet by wearing occlusive shoes or boots in wet and hot occupational environments or by using communal showers.

We can divide theoretically occupational skin exposures that may cause contact dermatitis into two groups: toxic exposures and exposures to allergens (often combinations of both types). Both exposure types can be subdivided into different subtypes:

1 Toxic exposures

- Direct acute toxic exposure to strong acids, alkalis and burns. These exposures cause a direct and strong skin reaction and are obviously rare.
- Cumulative exposures to skin irritants such as detergents, water, occlusion (wearing gloves)⁽⁴²⁻⁴³⁾. The importance of such exposures in the development of occupational dermatitis is often underestimated⁽⁴⁴⁾.
- Cumulative physical skin exposures such as heat, friction and radiation. Occupational exposure to sun radiation is a common cause of skin tumours; adequate protection is still sporadic.
- Exposure to histamine agents, causing (non-immunologic) contact urticaria. Unlike a type I allergy (contact urticaria syndrome) these reactions do not carry the risk of systemic reactions.

2 Exposure to allergens

- Type 1 allergic reactions: IgE-allergic reaction. These reactions vary from erythema via complete urticaria to generalised vasodilatation and shock. Best known occupational exposure for this type of reactions is the use of latex gloves in nursing. Proteins that can cause a type 1 reaction may, in situations of prolonged activation, induce a protein-contact-dermatitis.
- Type 4, T-cell-mediated allergic reactions. A wide range of substances in occupational environments can cause these delayed-type allergic reactions. Clinically it is difficult or impossible to distinguish these reactions from irritant dermatitis.

Pathology of irritant contact dermatitis

Dermatitis is an inflammatory response of the skin, characterised by a lymphocytic infiltrate around the upper dermal blood vessels, with spongiosis and varying degrees of acanthosis. This leads to various clinical features such as itching, redness, papulovesicles and scaling. In many occupations a cumulative irritation by weak toxic agents may cause dermatitis. This type of dermatitis is referred to as irritant contact dermatitis (ICD); synonyms for ICD are traumiterative dermatitis, cumulative insult dermatitis and ortho-ergic dermatitis. Irritant contact dermatitis develops as a result of a series of repeated and low-grade damaging insults to the skin. Examples of such insults are exposures to detergents, shampoos, polishes, solvents, physical factors such as dry wind, blow heaters, moisture and occlusion (use of glove). Generally, none of the minor damaging factors itself is strong enough to produce overt disease: accumulation is necessary. Dermatitis develops when the sum of all harmful influences exceeds the repair capacity of the skin⁽⁴⁵⁾, see Figure 1.

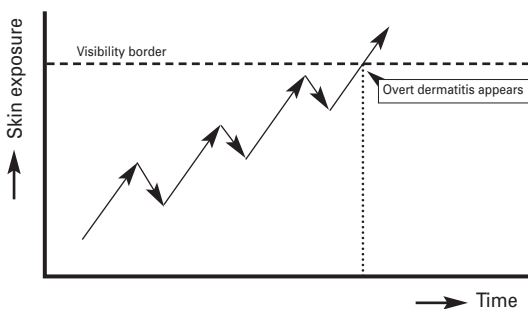


Fig. 1. Development of Irritant Contact Dermatitis because of cumulative barrier function impairment due to different influences leading to clinical signs of dermatitis (adapted from Malten, 1985)

A sub-clinical stimulus attacks the skin inducing a subsequent repair response. The repair capacity is insufficient to cope with the damage adequately before a new stimulus attacks the skin. This renewed damage on an already damaged skin area leads to an impaired function of the skin. After a series of cumulative insults, which may be of varying nature, the threshold may be surpassed. Once the dermatitis has developed, minor exposure to trivial everyday stress (detergents, cosmetics etc) will act as perpetuating factors and lengthen the healing period^(46;47).

Besides different levels of irritating capacity of various substances in an occupational environment and different susceptibilities of individuals, the risk of developing occupational irritant dermatitis is determined to a large extent by the duration and the frequency of the irritant exposure.

Occupations shown in table I have in common a typical high load of wet work. Wet work can be defined as all occupational activities that:

- 1 Cause the skin of either or both hands to be in contact with water or watery irritants;
- 2 Necessitate the wearing of protective gloves over a prolonged period, causing the hands become moist from perspiration.

The duration and the frequency of wet work determine the burden of skin exposure to irritants in such occupations and thereby determine the overall risk for developing irritant contact dermatitis. Specific Dutch or European legislation on preventive measures in wet work occupations is still lacking. Although wet work causes occupational skin problems, most countries do not have regulations on wet work exposure. Germany has guidelines on wet work exposure; the TRGS (Technische Regeln für Gefahrstoffe) 531 regulates the duration of wet work. Work with more than 25% of the activities that causes the hand to become wet (more than 2 hours and/or frequent; more than 20 times in an 8-hour shift) is considered as an occupation with a risk for hand dermatitis. For these occupations a specific prevention program should be in place. Unlike the risk of exposure to allergens the risk of irritants depends more upon the quantity than the quality of exposure. A prevention program is necessary to prevent workers in occupations with a high load of wet work. Such a prevention program should be an evidence-based advice on how to pursue the occupational activities and hand cleaning with a low level of skin irritations. Much effort has been made to assess the different irritating capacities of individual substances⁽⁴⁷⁻⁵⁴⁾. Of equal importance as the irritating capacity of substances, is an accurate assessment of the duration and frequency of exposures to irritants in different occupations.

Characteristics of an increased risk to develop ICD

Skin dryness is a common symptom with a heterogeneous background. Individuals with a typical dry skin are more likely to develop ICD.

Skin dryness is a characteristic feature in atopic dermatitis. Skin dryness may represent a subtle manifestation of chronic irritant dermatitis. Individuals with atopic dermatitis run a considerable risk of developing hand dermatitis when exposed to occupational agents that are a burden to the skin. Skin atopy at least doubles the effects of irritant exposure, and thus, doubles the risk in wet work occupations⁽³³⁾. Permeability of the skin is an important factor in the pathogenesis of dermatitis. Skin with areas of dermatitis has a defective barrier function at the site of the lesion as well as of the uninvolved skin^(55;56). A history of dermatitis increases the risk of a relapse. A possible explanation for the importance of an earlier dermatitis episode is that there is a characteristic of the skin, a skin vulnerability, which predisposes the individual to develop irritant contact dermatitis. This may correspond to an atopic skin diathesis as defined by Lammintausta and Nilsson^(57;58). This may be a lower threshold and/or an impaired regaining capacity as shown in Figure 2.

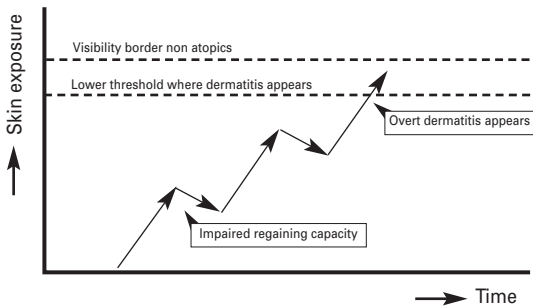


Fig. 2: Development of Irritant Contact Dermatitis in cases with an atopic diathesis (freely adapted from Malten, 1985)

Prevention of occupational irritant contact dermatitis

Both employer and the employee carry the responsibility of addressing occupational health risks. To address this responsibility they need professional advice from occupational health advisors on how to reduce occupational contact dermatitis.

An occupational health physician working for the employees in occupations that are mentioned in Table I should be aware of the increased health risk related to wet work. Secondly the physician should advise on reducing the exposure to irritants in working environments. Risk assessments for such occupations should pay sufficient attention to wet work conditions. In wet work occupations (Table I), a periodic examination for contact dermatitis should be implemented in order to monitor occupation-related health damage, although data on the effectiveness is still missing.

Essentials to meet the above mentioned obligations are:

- 1 Standards for acceptable exposure levels and conditions for wet work occupations
- 2 Tools for wet work risk assessment
- 3 Guidelines for health surveillance and other forms of prevention of occupational contact dermatitis

In the absence of these essentials occupational dermatoses have become one of the most common work related diseases, a phenomenon which, at least in the Netherlands is hardly recognised by the majority of the occupational health physicians⁽¹⁷⁾. Occupational health physicians who are obviously not confronted in their practice with cases of occupational contact dermatitis will therefore probably fail to recognise them and fail to advice on necessary preventive measures.

A modified version was published in Dutch by Jungbauer et al as a chapter on Occupational Dermatology in the volume on Occupational Diseases in the book series 'Praktijkgids Arbeidshygiëne 2002; Beroepsziekten: 60-68', series editors W. van Alphen, R. Houba, H.P. Pennekamp, K.B.J. Schreibers, R. Simonis

Outline of this thesis

Background

In The Netherlands many occupational physicians are not familiar with the nature and the quantity of work-related skin complaints in wet work occupations. They are not confronted with patients with skin diseases because of their focus on absenteeism; therefore they do not recognise risk factors for occupational dermatitis at the work place. Management tools to reduce occupational diseases are missing or not functioning in The Netherlands.

Objectives

The objectives of this study were:

- Description of the nature and the quantity of work-related skin complaints in wet work occupations.
- Evaluation of a method for health surveillance of employees with risk occupations for skin complaints and for a predisposition for developing skin complaints.
- Introduction and evaluation of a method to assess wet work as a risk factor for developing skin complaints at the work place.
- Introduction of a skin protection advice based on the findings of the risk assessments and aimed at avoiding hand dermatitis.

Chapter 2: A descriptive study on the severity of irritant contact dermatitis (ICD) 5 years after the initial diagnosis, with a focus on the ability and the efficacy to implement adjustments in occupational exposure to skin irritants as a result of the diagnosis of ICD.

Chapter 3: The point prevalence of hand dermatitis in nurses assessed with a questionnaire. This questionnaire is evaluated as a screening method for early detection of occupational skin disease for use in an occupational health clinic.

Chapter 4: An assessment of the risk of developing occupational dermatoses in a paper mill, using a questionnaire and clinical examination. With the questionnaire the signs of skin disease, atopic diathesis and the occupational exposure to skin irritants are assessed.

Chapter 5: The exposure of the hands to wet work in nurses. An assessment on the amount of wet work exposure in nurses. A questionnaire method was compared with an objective observation method.

Chapter 6: In addition to the amount of wet work activities and the comparison of to assessments method chapter 6 describes the characteristics of wet work activities in nurses. With this study the activities done while having the hands exposed to skin irritants is described. With an observation method the frequency and the duration of these wet activities in nursing is assessed.

Chapter 7: The characteristics of wet work in the office cleaning industry. A study to assess the frequency and the duration of wet work exposure in relation to the various tasks of office cleaners.

Chapter 8: The differences in skin irritation measured by TEWL induced by two different skin irritant exposure models: a model simulating regular skin exposure in nurses and a model simulating skin exposure with a completely implemented prevention program in nurses. These models are based on the assessments in chapters 5 and 6.

Chapter 9 Discussion of the studies described in his thesis. The studies and their results are discussed in the perspective of a proposed management system on reducing the prevalence of occupation-related skin disease.

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