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Skin disease in paper mill workers

F. H. W. Jungbauer¹, G. J. Lensen¹, J. W. Groothoff² and P. J. Coenraads¹

Background	Paper mill workers have frequent and prolonged exposure to skin irritants and allergens and may have a higher risk of developing occupational dermatitis.
Aims	The aim of this study was to determine the extent of skin problems in a paper mill and how much was attributable to contact with allergens.
Methods	A cross-sectional study was carried out among 80 paper mill workers having daily exposure to skin irritants and allergens. They all completed a questionnaire, underwent a standard interview and physical examination. Workers whose history indicated possible contact allergy were patch tested and prick tested.
Results	Workers reported a high exposure to skin irritants, especially when carrying out tasks that caused the hands and feet to become wet from perspiration and having contact with process water. Atopic dermatitis was seen in 3% of the workers. Contact dermatitis was seen in 26% of the workers and 36% were diagnosed with mycosis of the feet. All cases of contact dermatitis and mycosis could be attributed to occupational exposure to skin irritants. No cases of relevant contact allergy were seen.
Conclusion	Occupational dermatitis in paper mills is primarily related to the exposure to skin irritants. Occupational physicians should be aware of the risk of occupational dermatitis in paper mill workers.
Key words	Gloves; hand dermatitis; irritant contact dermatitis; occupational; paper mill; skin disease; skin irritants; wet work.

Introduction

During the production of paper, process operators are exposed to skin sensitizers and irritants. In addition, paper mill workers are also exposed to exceptional climatic conditions. The working environment alternates from hot and moist to cold and dry for several times during a shift. Previous studies have found 32% prevalence of hand dermatitis in paper mill workers (compared with 29% among office worker controls) [1] and between 7.3% and 16.4% in paper and pulp mill workers [2]. However, surveillance schemes for occupational skin diseases by Dutch as well as British occupational physicians and dermatologists do not report detectable rates for this occupation [3–5].

Several case reports have been published about sensitizers in paper mills, including rosin used to make paper water-resistant, and known to be one of the most

frequently positive test results in the European Standard series. Other potential allergens include organic bromine, methylene-bis-thiocyanate and methylisothiazolinones. Fregert has listed slimicides (chemicals used in paper mills to inhibit the proliferation of slime-forming microorganisms that may spoil the paper products) as potential skin sensitizers [6]. Cohn *et al.* [7] used gas chromatography mass spectrometry (GC MS) techniques and fungal culturing methods to identify contaminants in a pulp mill environment. They were able to implement appropriate control methods that eliminated the fungal spore contaminants believed to cause the dermatological illness.

Several pulp mills are located in the districts around our occupational dermatology clinic in the eastern part of The Netherlands. Statistics Netherlands reports that while this area contains 13% of the Dutch working population, 20% (1400) of all pulp mill workers are located here. This study was initiated following a request from a local company for advice about the management of a perceived increase in skin complaints within their workforce.

The aims of this study were to determine the prevalence of skin problems in an environment with a theoretically high risk of occupational skin diseases, the

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frequency with which occupational skin disease in a paper mill is based on contact and to study the exposure of skin to irritant conditions.

Methods

As part of a cross-sectional study among 80 workers who work full time in a paper mill, we recorded the time worked in environments with different skin exposure to irritants and allergens, the percentage of workers with a history of atopic skin disease, the prevalence of skin disease, the prevalence of occupational skin disease, the distribution of dermatitis on the skin and the contact allergens present in a paper mill environment.

The study was carried out in a cardboard mill exclusively used for recycling paper. The working environment involves exposure to water, steam, detergents, bleach, ink from old paper, binders such as clay and resin, formaldehyde, slimicides and rosin. Contact with chemicals such as glues and dust occurs in the glue kitchen where there may be exposure to allergens such as 2-bromo-2-nitro-1,3-propanediol (Bronopol) and rosin. The work environment varies from hot and humid to cold and dry along the length of the process. The risk of contamination with formaldehyde, slimicides and rosin is highest in the hot and steamy area at the beginning of the process. One team of 15 workers operates two paper machines, and five teams provide a 24-h, 7-day operating schedule.

All 80 exposed workers received a questionnaire. The questionnaire consisted of three parts: part A: on signs of atopic dermatitis, part B: on occupational dermatitis and part C: on occupational exposure to skin irritants and allergens. Additionally, all exposed workers were invited for a standardized interview by a trained nurse, and a physical examination was carried out by an occupational physician.

For parts B and C of the questionnaire, we adapted the Nordic Occupational Skin Questionnaire [8,9] for a paper mill situation in combination with the validated questionnaire of Smit *et al.* [10,11]. We used the validated scoring system to identify the hand dermatitis scores based on our questionnaire as described by Vermeulen *et al.* [11].

Signs of atopic skin disease were assessed with part A of the questionnaire and the standardized interview and physical examination. Part A of the questionnaire followed Diepgen's diagnostic scores for atopic dermatitis [9]. We classified workers as having a possible atopic skin disease if they registered positively for more than 6 out of 15 symptoms. Workers with a history of occupational related skin disease that could be based on a relevant allergic contact dermatitis were invited to our clinic for patch testing with the European standard series. In

addition, a specific patch test series, with relevant substances used in this paper mill, was tested (Table 1).

Results

Seventy-four of 80 male workers with daily occupational exposure to the paper mill environment participated in the survey. Four workers did not fill out certain parts of the questionnaire correctly. The mean reported duration of work in a hot environment was 206 min per day including 63 min in an environment that was also moist. A mean of 141 min per day was reported for the duration of occupational activities in a cold and dry environment.

Wet feet while wearing safety shoes was reported in 92% of cases, 85% reported wet skin while wearing their overalls and 47% frequently had wet hands while wearing protective gloves. The majority of situations causing wet skin occurred during the time spent in moist and hot environments.

Itching was reported as the most frequent skin complaint (44%), followed by erythema (37%), rhagades (32%), squames (30%) and vesicles (23%). The feet were the most affected body parts as a location for skin complaints, followed by hands and arms. Figure 1 shows the percentages of workers with skin complaints on different body areas.

From the questionnaire, 3 out of 70 workers reported more than six positive signs related to atopic skin disease, 42 workers reported less than three atopic-related signs and 25 reported more than two but less than six atopic related signs.

From physical examination in combination with the interview, two were positively diagnosed as having atopic skin disease. Figure 2 shows the results of the questionnaire on atopic disease-related symptoms.

Screening with the self-reporting questionnaire on skin complaints identified 15 workers with possible contact dermatitis and/or mycosis of the feet or hands, although 50% of the workers reported skin complaints on their feet and 33% of the workers reported skin complaints on their hands.

The results of the standardized interview and the physical examination of all exposed workers showed that 27 (36%) could be diagnosed with mycosis of the feet and 19 (26%) with a contact hand dermatitis. In 12 cases (16%), we found both contact hand dermatitis and mycosis of the feet.

Dermatological examination through additional patch testing (using the European standard series and specific paper mill series), prick testing and mycological examination was considered necessary in six cases, based on the history of skin complaints and the physical examination. This was performed in four cases as two cases refused further examination. None of the four patch tested

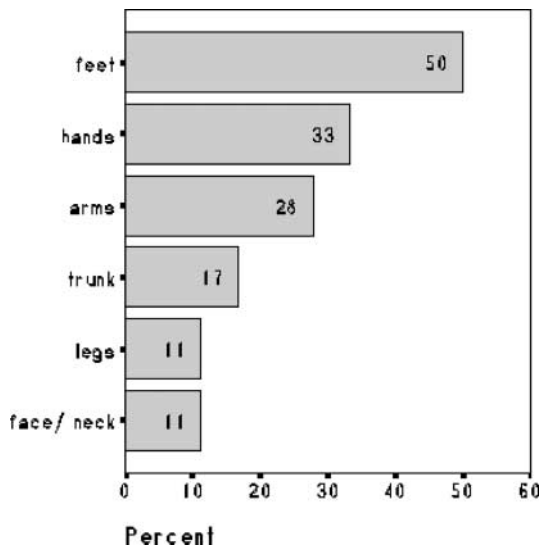


Figure 1. Percentage of workers with skin complaints related to body area.

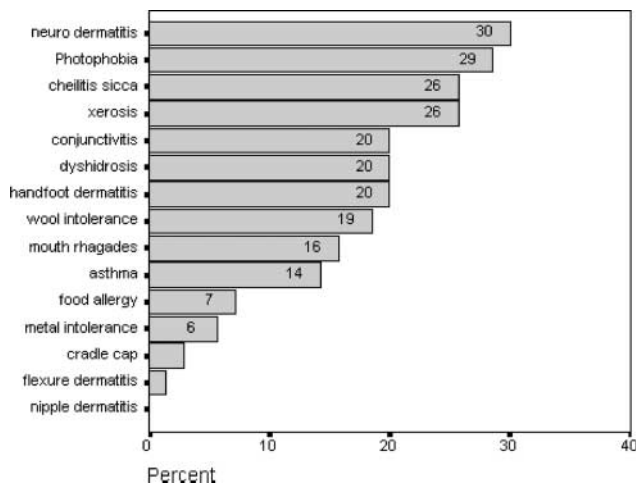


Figure 2. Results of questionnaire/standardized interview for Diepgen's criteria for atopic dermatitis related complaints [9].

workers had a positive reaction to any substance in our series. All cases showed an irritation reaction to the highest tested polymin KE concentration of 1.0% in aq.

Discussion

Our study found a prevalence of work-related hand dermatitis of 26% and work-related feet mycosis of 36% in a population of paper mill workers exposed to wet conditions and other skin irritants. The occurrence of atopic skin disease in this population was 2–3%, but we found no evidence of contact allergic dermatitis.

The weakness of our study was that it was cross-sectional, carried out in one paper mill with relatively few exposed workers and without a control group. Because we used validated questionnaires on hand dermatitis, occupational dermatitis and atopic dermatitis, we could compare our results with previously published results for non-exposed populations.

The prevalence of 36% of mycosis of the feet was high in comparison with large general practice studies [12], but comparable with the prevalence found in an industrial population [13]. Contact dermatitis was seen in 26% of the workers, most often on the feet and hands. The occurrence of 2–3% of atopic skin disease in this population is not low compared with the prevalence of atopic skin disease in the general adult population, even when adjustments for age are made [14,15]. We expected a lower prevalence of atopic skin disease and our results do not suggest a healthy worker selection in this paper mill. Despite the potential for exposure to known allergens, we did not find evidence of a high prevalence of occupational contact allergy in this study (although a survivor effect cannot be excluded, with those developing allergy leaving employment).

Although wet work causes occupational skin problems, many countries do not have regulations for wet work exposure. Germany has guidelines for wet work exposure: the TRGS (Technische Regeln für Gefahrstoffe) 531 regulates the duration of wet work. Work that causes the hands to become wet for more than 25% of the working time (more than 2 h and/or more than 20 times in an 8 h shift) is considered an occupation with a risk of hand dermatitis and a specific prevention program should be implemented for these occupations.

Table 1. Paper mill patch test series. The test concentrations are given in the last column

Neonal-HSC	Alkalic cleaning substance	0.01–0.1% and 1% aq
Sursol*VL	Increasing bulk: aliphatic alcohol alkoxylate	0.01–0.1–1% and 10% aq
Polymin KE 2035	Promotes drainage during the web formation on the paper machine: cationic polymer	0.01–0.1% and 1% aq
HM Polymin	Polyethylene amine	0.01–0.1–1% and 10% aq
Imbacin-I	Acidic cleaning substance	0.01–0.1% and 1% aq
Astra Malachitgruen	Dye: triarylmethane	0.01–0.1% and 1% aq
Keydime D15 glue	Alkyl ketene dimer	0.01–0.1–1% and 10% aq
Kartonol AW-12	Polyvinyl alcohol, china clay	0.01–0.1–1% and 10% aq
Nalco 77223	Kettle water cleaning: natrium polyphosphate	0.01–0.1–1% and 10% aq
Nalco 4221	Oxygen binder	0.01–0.1–1% and 10% aq

Because of the risk of irritant contact dermatitis in this environment, protection of the skin against exposure to process-water and perspiration is important and personal protective equipment should suit the environmental conditions. Workers should also be instructed to change their attire as soon as the skin under their clothes and shoes becomes wet.

Finally, larger studies are suggested to clarify a possible healthy worker effect and to reveal the impact of exposure to allergens in paper mills on occupational skin disease.

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