

High-fat petrolatum-based moisturizers and prevention of work-related skin problems in wet-work occupations

KAREN MYGIND, LEA SELL, MARI-ANN FLYVHOLM AND KAREN FRYDENDALL JEPSEN
National Institute of Occupational Health, Copenhagen, Denmark

The study presented is a randomized, controlled intervention study with the purpose of implementing an evidence-based skin disease prevention programme. The hypothesis explored in this article is whether a high-fat petrolatum-based moisturizer can be an alternative to protective gloves in wet-work occupations. The study population was all gut cleaners in Danish swine slaughterhouses, and data were collected by telephone interviews using a standardized questionnaire – The Nordic Occupational Skin Questionnaire (NOSQ-2002). At baseline, 644 (88%) gut cleaners responded and at 1-year follow-up 622 (72%). 135 gut cleaners in the intervention and 277 in the comparison group responded at both telephone interviews. In the intervention group, the eczema frequency was reduced significantly. Detailed analyses revealed that protective gloves are the overall most effective protective means and did not indicate that a high-fat moisturizer could be an alternative. Furthermore, the most extensive improvements could not be explained by combinations of protective behaviour but was found among those who had received information on, and was having discussions on prevention of skin problems. This only applied to the intervention group. A continuous focus on prevention of skin problems with information and discussions on the shop floor therefore seemed to be most important for reducing skin problems.

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For many years, occupational skin diseases, in particular hand dermatitis, have been the most frequently recognized work-related diseases in Denmark as well as in many other industrialized countries. They constitute up to 30% of all occupational diseases for which economical compensations have been paid (1–3). The healthcare sector and the food-processing industry, both wet-work occupations with high hygienic demands, represent major risk groups with a high frequency of skin problems (4, 5). Although automations reduce manual handling in some parts of the food-processing industry, growing demands on hygiene may lead to increasing risks of work-related skin problems. Accordingly, it is necessary to proceed with the development of effective skin protective procedures applicable to and acceptable for the workers in their daily working routines.

Skin protection programmes can be defined as series of practical recommendations on skin protection and skin care, aimed at well-defined

groups of workers, and are preferably based on epidemiological, clinical and experimental studies (6). Implementing an evidence-based skin protection programme among wet workers in old people's homes reduced clinical skin symptoms after 5 months of intervention (7), despite the fact that the time workers were wearing protective gloves remained unchanged during the study period, indicating potential benefits from means of prevention other than gloves. Among first-year baker's apprentices at an occupational school for food-processing trades, only 43% had accepted to use protective gloves after 6-month intervention (8).

The reluctance against using protective gloves in daily work practice corresponds to clinical and experimental evidence on side-effects such as skin irritation and allergic reactions caused by the glove material and the chemicals added during the manufacturing process (9–11). In addition, occlusion of the skin impairs the skin barrier and increases the risk of irritant and allergic

contact dermatitis, in particular in compromised skin (12).

Many attempts have been made to develop effective protective creams, which are able to prevent the development of contact dermatitis by reducing the penetration and absorption of irritative substances into the skin. White petrolatum (pet.) is a refined, purified and hydrogenated derivative from mineral oil, consisting of a complex combination of long chained aliphatic hydrocarbons (13). Experimental studies using *in vivo* techniques have proved that white pet. effectively protects the skin from water-soluble skin irritants in moderate concentrations (14–16) and accelerates barrier recovery (17). A moisturizer based on pet. with 70% total amount of lipid was able to prevent irritant skin reactions and accelerate barrier recovery (18), and the barrier recovery in general is shown to correlate positively with the total amount of lipid, with 100% white pet. being the most effective in a test of 6 different moisturizers (19).

A field study showed that cleaners and kitchen assistants benefited from using a high-fat moisturizer and that this moisturizer was acceptable for the workers to use during working hours (20). Still, there is no field study evidence that a high-fat pet.-based moisturizer can replace protective gloves in wet-work occupations.

The present randomized, controlled intervention study was carried out among gut cleaners in Danish swine slaughterhouses – gut cleaning being an extremely wet and dirty manual work and therefore representing a worst-case wet-work occupation (21).

The aim of this article is to test the hypothesis that a high-fat pet.-based moisturizer can be an alternative to protective gloves in wet-work occupations. To do this, the gut cleaners' behaviour on protection or lack thereof before and after an intervention to reduce work-related skin problems was analysed. The risk of eczema for various subgroups in regard to protective behaviours was estimated and compared with the equivalent data for slaughterhouses with no planned intervention activities going on. Details on the study population and an evaluation of the intervention process are published elsewhere (22, 23).

Materials and Methods

Study population

In Danish swine slaughterhouses, the gut-cleaning department is a separate unit belonging to another company – the gut-cleaning company – having in this way a decentralized nationwide production structure. The study population

consisted of all gut cleaners in Denmark spread on 18 different slaughterhouses with a total of 736 employees in January 2002 and 748 employees in January 2003. A total of 121 persons stopped working as gut cleaners before January 2003 and 133 started during the same period.

The intervention group consisted of gut cleaners from 6 randomly allocated gut-cleaning departments exposed to planned intervention activities. The gut cleaners from the remaining 12 departments constituted the comparison group. Data from both groups were collected by thorough telephone interviews at baseline (March to April 2002) and at the same time the following year (1-year follow-up, March 2003); those who stopped working as gut cleaners during the year were included in the study population as a special group. The procedure of randomization and allocation as well as a flow chart for the whole study population is published elsewhere (22).

A total of 644 (88%) answered the telephone interview at baseline, and a total of 622 (72%) answered the 1-year follow-up telephone interview.

A cohort including 136 persons from the intervention group and 280 persons from the comparison group did not stop working as gut cleaners during the year and did answer both the baseline and the 1-year follow-up telephone interviews. A dropout analysis of those responding in the first telephone interview but not in the second showed that these gut cleaners were slightly younger and had worked as gut cleaners for a shorter time, but no differences in the reporting of eczema within the past 3 months were observed. For the group of gut cleaners who had stopped working during the study period, a slightly higher frequency of eczema at the baseline telephone interviews was observed. All together, the cohort we focus on represents a slightly more healthy and a slightly older proportion of the employees in January 2002.

Questionnaire

The questionnaire used for the telephone interviews was based on a standardized questionnaire for the investigation of work-related skin diseases and exposure – The Nordic Occupational Skin Questionnaire (NOSQ-2002) (24, 25). By incorporating specific exposures from the gut-cleaning departments, the questionnaire was adapted to work and exposure. Additional questions on specific preventive measures and information and discussion of prevention of skin problems were included as well. A few additional questions on

the use of specific moisturizers were added to the questionnaire at the 1-year follow-up.

The intervention

The purpose of the intervention was to implement an evidence-based prevention programme with focus on use of protective gloves, cotton inner gloves and a high-fat moisturizer. The method of implementation included a top-down strategy with establishment of a management system focusing on skin risk, and a bottom-up strategy involving 2–5 gut cleaners and the officially elected safety representatives as change agents. At each department, an empowerment-based educational programme for the local manager and the change agents initiated the process of change. The intervention activities among the gut cleaners consisted of written and oral information according to the management system and hands-on training with immediate feedback in use of protective gloves, cotton inner gloves and skin care, the local manager and the change agents being responsible for this (23).

The gut-cleaning company introduced a high-fat pet.-based moisturizer (70% lipids) as a supplement to or a substitute for a low-fat moisturizer (<30% lipids) previously provided. As the moisturizer was available for both the intervention and the comparison group, it was possible to compare the differences in the actual acceptance and uptake of this high-fat moisturizer.

Eczema risk

The assessment of the risk of eczema was estimated on the basis of self-reported eczema in the questionnaires. Having eczema is defined in this article as 'eczema on hands or forearms within the past 3 months' and is based on the answer 'yes' to the following questions: 'Have you ever had hand eczema?' or 'Have you ever had eczema on your wrists or forearms (excluding fronts of elbows)?' in combination with the answer 'I have it just now' or 'Not just now but within the past 3 months' to the question: 'When did you last have eczema on your hands, wrists or forearms?' (NOSQ-2002: Question D1, D2 and D5) (24).

Exposure and protective behaviour

Questionnaire data on different work-related exposures were analysed to investigate how the gut cleaners were exposed during working hours. As no major change in technology or equipment occurred in the departments during the study period, only data from baseline were examined for this purpose.

Data on skin protection were used to quantify and compare the gut cleaners' behaviour at baseline and at the 1-year follow-up. Different combinations of use of gloves, cotton inner gloves and either low-fat or high-fat moisturizers made up 10 categories of protective behaviour, all ordered in an increasing level of protection according to the skin protection programme. The worst category (No. 1) was specified as using only cotton gloves – a method probably used to get a good grip on the working material (26). The best category (No. 10) was specified as using protective gloves, cotton inner gloves and high-fat moisturizer. All 10 categories were in use after 1 year of intervention, but not before the intervention (see Table 1) as the question on high-fat moisturizer only occurred in the questionnaire at follow-up.

Statistical analysis

Estimated risk of eczema – including confidence intervals – was calculated for each subgroup referring to a well-defined category of protective behaviour or for specified groups of categories (e.g. all categories where protective gloves are included).

The chi-square test was used for testing the significance of differences between intervention and comparison group as well as for comparing baseline measurements with measurements from after the intervention (27).

SAS 8.2 was used for data processing.

Results

135 in the intervention group and 277 in the comparison group answered the questions, analysed in this article. Table 1 summarizes the observations in the cohort, divided into the intervention and the comparison group, at baseline, and at 1-year follow-up, as a whole and divided into subgroups referring to different categories of protective behaviour and with the corresponding estimated eczema risk. The goal of this analysis is to simply measure protective behaviours and the associated risks of eczema, not to go in-depth with who's behaviour has changed and into what.

The risk of eczema decreased significantly from 0.56 ± 0.08 to 0.41 ± 0.08 in the intervention cohort. This decrease was distributed on 6 subgroups – 5 subgroups using protective gloves (Cat. no. 5, 6, 7, 8 and 10) and 1 subgroup using neither protective gloves nor moisturizer (Cat. no. 2). In the comparison cohort, a minor non-significant increase from 0.46 ± 0.06 to

Table 1. Protective behaviour at baseline and at 1-year follow-up

Category of protective behaviour	Intervention			Comparison		
	Baseline		1-year follow-up	Baseline		1-year follow-up
	n (%)	Eczema risk	n (%)	Eczema risk	n (%)	Eczema risk
1. Cotton gloves only	29 (23)	0.55 ± 0.18	5 (4)	0.80 ± 0.35	18 (7)	0.67 ± 0.22
2. No moisturizer and no protective gloves	51 (38)	0.63 ± 0.13	25 (19)	0.32 ± 0.18	65 (24)	0.38 ± 0.12
3. Low-fat moisturizer but no protective gloves	n.d.	n.d.	28 (21)	0.57 ± 0.18	77 (28)	0.57 ± 0.11
4. High-fat moisturizer but no protective gloves	7 (5)	0.43 ± 0.37	14 (10)	0.57 ± 0.26	14 (5)	0.64 ± 0.25
5. No moisturizer but protective gloves without cotton gloves	5 (4)	0.20 ± 0.35	8 (6)	0.13 ± 0.23	23 (8)	0.26 ± 0.18
6. No moisturizer but protective gloves and cotton gloves	33 (24)	0.58 ± 0.17	3 (2)	0.33 ± 0.53	14 (5)	0.64 ± 0.25
7. Low-fat moisturizer and protective gloves without cotton gloves	n.d.	n.d.	16 (12)	0.31 ± 0.23	31 (11)	0.42 ± 0.17
8. High-fat moisturizer and protective gloves without cotton gloves	10 (7)	0.50 ± 0.31	13 (10)	0.31 ± 0.25	4 (1)	0.50 ± 0.49
9. Low-fat moisturizer and protective gloves and cotton gloves	n.d.	n.d.	10 (7)	0.50 ± 0.31	26 (9)	0.58 ± 0.19
10. High-fat moisturizer and protective gloves and cotton gloves	135 (100)	0.56 ± 0.08	13 (10)	0.23 ± 0.23	5 (2)	0.80 ± 0.35
Total			135 (100)	0.41 ± 0.08	277 (100)	0.50 ± 0.06

Values in bold indicate significant differences.

n.d. = no data; the question on high-fat moisturizer was not included in the baseline survey.

0.50 ± 0.06 was observed. Only 2 subgroups in the comparison group had a low eczema risk at 1-year follow-up, both subgroups not using any moisturizer (Cat. no. 2 and 5).

The best subgroup according to the recommendations in the skin protection programme (Cat. no. 10) has the lowest eczema risk in the intervention group (0.23 ± 0.23), but not in the comparison group (0.80 ± 0.35), this difference raising an additional question. Furthermore, the subgroup not using any protection (Cat. no. 2) has a rather low eczema risk in both the intervention and the comparison group (0.32 ± 0.18; 0.38 ± 0.12).

Taking all the subgroups using protective gloves (Cat. no. 5–10) at baseline and 1-year follow-up in the intervention group, an insignificant increase in glove users from 41 to 47% was observed with a corresponding significant decrease in the risk of eczema from 0.51 ± 0.13 to 0.30 ± 0.11 ($P = 0.022$). In the comparison cohort, at baseline, 43% used protective gloves with a risk of eczema of 0.40 ± 0.09. At the 1-year follow-up, 37% were glove users but with an increase in eczema risk to 0.48 ± 0.10. The latter results point to that effects not only stem from the use of protective gloves.

Significantly, more gut cleaners in the intervention group used a high-fat moisturizer at 1-year follow-up than in the comparison group (30 versus 8%). The subgroups using a high-fat moisturizer as the only protection at follow-up (Cat. no. 4) had an eczema risk at 0.57 ± 0.26 in the intervention group and 0.64 ± 0.25 in the comparison group, thus indicating that high-fat moisturizer alone is not an alternative to protective gloves.

Further analyses

Some of the differences in the estimated eczema risks could not be explained by differences in protective behaviour. Therefore, the analyses proceed with investigating the effects from other parts of the intervention, namely having received information on, and having discussions on prevention of skin problems.

Table 2 presents the risk of eczema divided on gut cleaners who reported they had and those who had not received information about prevention of skin problems and Table 3 presents the same for the gut cleaners who had discussed and had not discussed prevention of skin problems at the workplace.

In the intervention cohort, at 1-year follow-up, there was a significant association between having received information and a low risk of eczema

Table 2. The association between information and eczema risk

	Intervention				Comparison			
	Baseline		1-year follow-up		Baseline		1-year follow-up	
	<i>n</i> (%)	Eczema risk	<i>n</i> (%)	Eczema risk	<i>n</i> (%)	Eczema risk	<i>n</i> (%)	Eczema risk
Have received information on prevention of skin problems	82 (61)	0.52 ± 0.11	101 (75)	0.35 ± 0.09	143 (52)	0.44 ± 0.08	167 (60)	0.50 ± 0.08
Have not received information on prevention of skin problems	53 (39)	0.60 ± 0.13	34 (25)	0.59 ± 0.17	132 (48)	0.48 ± 0.09	109 (40)	0.51 ± 0.09
Total	135 (100)	0.56 ± 0.08	135 (100)	0.41 ± 0.08	275 (100)	0.46 ± 0.06	276 (100)	0.50 ± 0.06

Values in bold indicate significant differences.

(0.35 versus 0.59, $P = 0.013$). This was not the case in the comparison group. For all the respondents who reported to have received information at the 1-year follow-up, there was a significant difference in eczema risk between the two cohorts (0.35 versus 0.50, $P = 0.016$), indicating that the information had more impact on the eczema risk in the intervention group than in the comparison group.

As there were only minor differences in the eczema risk at baseline among those who had received information and the ones who had not, there must have been a difference in the quality of the information the gut cleaners had to begin with, and the quality of the information given in the intervention. Looking into the answers on how they have had access to information at baseline, there is a big variation in how the gut cleaners have acquired information, before the intervention.

At follow-up, some association, although not significant, between having discussed prevention of skin problems and eczema risk, was observed in the intervention cohort but not in the comparison cohort. The ongoing discussions on prevention had apparently more impact in the intervention group as well, as the risk of eczema was significantly lower in the intervention

cohort (0.37 versus 0.52, $P = 0.022$). Among those having discussions on prevention of skin problems in the intervention group, the eczema risk was 0.37 whereas among those in the intervention group not having discussion, the eczema risk was 0.59.

Discussion

A randomized, controlled intervention study minimizes the probability of selection bias, and in the present study, the workplaces in concern furthermore belonged to the same company and were identical in regard to exposures and skin hazards, all aspects which add to the total reliability of the study.

Use of questionnaires to monitor change in behaviour and attitudes is a well-documented sociological method, but monitoring change in eczema frequency using self-reported skin problems could have some limitations. An effect in the frequency of self-reported eczema could originate from the fact that the respondents became more aware of skin problems because of the attention drawn to it by the intervention activities or even just by answering the telephone interviews. Concerning the validity of self-reported eczema, studies have indicated that the result is

Table 3. The association between discussions and eczema risk

	Intervention				Comparison			
	Baseline		1-year follow-up		Baseline		1-year follow-up	
	<i>n</i> (%)	Eczema risk	<i>n</i> (%)	Eczema risk	<i>n</i> (%)	Eczema risk	<i>n</i> (%)	Eczema risk
Discuss prevention of skin problems at the workplace	80 (59)	0.56 ± 0.11	110 (82)	0.37 ± 0.09	152 (56)	0.47 ± 0.08	147 (54)	0.52 ± 0.08
Do not discuss prevention of skin problems at the workplace	55 (41)	0.55 ± 0.13	25 (19)	0.56 ± 0.19	123 (45)	0.46 ± 0.09	128 (47)	0.49 ± 0.09
Total	135 (100)	0.56 ± 0.08	135 (100)	0.41 ± 0.08	275 (100)	0.46 ± 0.06	275 (100)	0.51 ± 0.06

Values in bold indicate significant differences.

more likely to underestimate than overestimate the true prevalence of hand eczema (25). As the same method was used at both baseline and follow-up, this is considered of minor importance for the conclusions.

The study does not give evidence to the hypothesis that a high-fat pet.-based moisturizer can be an alternative to protective gloves in general. The analysis of the eczema risk in subgroups with different protective manners confirmed that using protective gloves either alone or in combination with inner gloves and moisturizer is the best protective means in wet and dirty work, even though gloves have documented side-effects. The study illuminates the difficult processes of changing habits and working routines among the workers, i.e. the uptake and acceptance of new protective manners as a consequence of an intervention with the aim of reducing work-related skin problems by the introduction of new forms of information and qualified discussions at the shop floor. In this setting, the introduction of a high-fat moisturizer has been an important factor.

An interesting fact is that some gut cleaners apparently have a very strong skin barrier. At 1-year follow-up, 25 (19%) in the intervention group and 65 (24%) in the comparison group did not use neither protective gloves nor moisturizer and still these 2 subgroups had an under-average eczema risk.

These considerations, in combination with the fact that the intervention group improved their protective manners significantly more than the comparison group and the fact that information and discussions on prevention of skin problems not only had significantly more impact in the intervention group than in the comparison groups, but also accounted for the largest difference in the risk of eczema, provide an insight into the 'black box mechanisms'. The black box refers to those changes in behaviour and understanding that lead to an observable decrease in the reported health problems during an intervention, not explained explicitly by the measurements of protective behaviour. Thus, it seems plausible that it is the systematic information according to the management system and the hands-on training and discussions initiated by trained and empowered colleagues that has given the gut cleaners a better understanding of their individual needs for moisturizing and protection in accordance with their own skin properties and their exposures during working hours. Furthermore, the lower eczema risk in the intervention cohort for all categories except 2 supports these considerations of information and discussions causing a

more proactive behaviour in the intervention departments, proactivity meaning use of adequate protection at the moment, irrespective of having skin problems or not. In contrast to this, the gut cleaners in the comparison cohort seem to have a reactive behaviour, i.e. not using adequate protection before skin problems appear and not continuing this behaviour after skin problems have disappeared.

Conclusions

The results do not give evidence to the hypothesis that a high-fat pet.-based moisturizer can be an alternative to protective gloves in general, but the study does give evidence to the fact that a high-fat moisturizer is a crucial supplement to protective gloves. The study demonstrates the complex process of changing the habits of the workers and documents that a continuous focus on prevention of skin problems with information and discussions on the shop floor, aligned with the accessibility of the right protective means, is the most important factor to reduce skin problems. Under these circumstances, a high-fat pet.-based moisturizer seems to be an essential factor in reducing skin problems, because in contrast to protective gloves it is susceptible to influence – that is to be applied and accepted of the workers who require it as an effective skin care product.

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Address:
M.-A. Flyvholm
National Institute of Occupational Health
Lersø Parkallé 105
DK-2100 Copenhagen
Denmark
Tel: +45 3916 5200
Fax: +45 3916 5201
e-mail: maf@ami.dk