

Skin symptoms in the seafood-processing industry in north Norway

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A survey of occupational skin problems, based on a questionnaire, was carried out among 883 workers in different types of seafood-processing industries in northern Norway. The prevalence of dry skin, itching, rash/eczema, chapped skin and chronic sores was significantly higher among production workers (55.6%) in the white fish-, shrimp- and salmon-processing industries, compared to administrative workers in the same industries (27.5%). Among production workers, there was a significantly higher prevalence of skin symptoms among females (60.2%) compared to males (50.1%). A strong sex division of work tasks rather than sex itself may explain this. There was no sex difference among administrative workers. Several risk factors for skin symptoms to occur are indicated. The workers are exposed to raw materials and a mixture of water and juice from the fish or shrimp, salt, detergents and disinfectants. Gloves may also cause skin problems. Major risk factors believed to cause skin symptoms were contact with raw materials, fish juice, water and gloves. The results also indicate that skin symptoms are of moderate severity and seldom interfere with working capacity.

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Occupational skin disorders are prevalent in all industrialized countries, and are common in the seafood-processing industry (1–4). Studies have demonstrated that many of the workers in this industry experience skin problems during contact with fish or shrimp in their work. It has been shown that 80% of the workers in the white fish industry in Denmark had occasionally skin symptoms (2). Many agents are associated with skin symptoms in occupational settings in general. In the cod-processing industry, skin irritancy was related to the postmortem age of the fish and caused by high-molecular-weight compounds from the fish (5, 6). Occupational protein contact dermatitis caused by contact with raw material has also been demonstrated (3, 7–11). In addition, frequent contact with water and use of gloves may cause occupational skin disorders (12–15). However, even though it has been shown that skin contact with raw material may cause skin problems, there are very few epidemiologic data on skin problems in all parts of the seafood-processing industry.

We carried out a study among 883 employees in 101 seafood-processing plants in north Norway, which processed white fish (cod, haddock and pollack), salmon or shrimp. The investigation was based on a questionnaire. The aim of this study was to investigate the prevalence and to identify risk factors of skin symptoms in different types of seafood-processing industries.

Materials and Methods

Questionnaire

A self-administered questionnaire was mailed to 3551 employees in 118 seafood-processing plants in north Norway in December 2000. Altogether, 1767 (49.8%) responded after 1 reminder. The questionnaire included several aspects concerning occupational environment and health issues; however, only a limited part is referred to in this article. Specific questions about skin symptoms while working during the last 12 months were included. The participants were asked, 'Have you, while working, had any of these skin

symptoms during the last 12 months'. The alternative responses were dry skin, itching, rash, eczema, chapped skin and fissures. We categorized a positive answer to one or more of these symptoms as subjects with skin symptoms. The questionnaire included questions on glove use, localization and duration of skin symptoms, but not traumatic sores. The workers were also asked if they considered the symptoms to be work related, with the following response alternatives: contact with cod, pollack, haddock, salmon, shrimp, fish juice, water, water splash, fish waste, gloves, salt, detergents and disinfectants. The questionnaire included questions about eczema and urticaria diagnosed by a medical doctor, but none concerning non-work-related skin problems such as atopy or dry skin. The Regional Ethical Committee, University of Tromsø, Norway and the Norwegian Data Inspectorate approved the study.

Study population

Of the 1767 persons answering the questionnaire, a group of 883 employees in 101 seafood-processing plants was selected on the basis of completeness of relevant data in the questionnaire, type of industry and exposed or nonexposed work tasks (Table 1). Included are 752 exposed processing workers in white fish, shrimp and salmon industries. These workers are exposed in their daily work to fish or shrimp. Also included are 131 administrative workers (nonexposed) in all types of industries serving as the control group. We did not include workers exposed to herring ($n = 24$) due to too few subjects. We did not include workers not exposed to fish or shrimp in their daily work, as forklift drivers, engineers, maintenance workers, cleaning workers and canteen workers in the white fish-, shrimp- and salmon-processing industries.

Work tasks

White fish industry. Cod and haddock may be stored in a cooling room for 1–4 days until pro-

cessing. Pollack is processed fresh. Processing includes salting or fillet production. Salting is done manually or by machines. There is often a fine aerosol of salt particles in this area. Production of fillets starts with machine filleting where skin and large bones are removed, often in the same area as sorting and salting. The work environment is cold and often wet. The machine operators are exposed to aerosols produced when fish are fed into the machines. Manual filleting, where small bones and other remnants are removed manually, takes place in separate, heated production areas. In the manual fillet production areas, the concentration of wet aerosols may be high due to water nozzles along the production line.

Shrimp industry. Shrimps are delivered fresh or as frozen blocks. Frozen shrimps are thawed. The thawing machines are fed manually, and in this area the concentration of wet aerosols is high. Fresh or thawed shrimps are then transported to automatic cooking machines. After cooking, the shells are removed mechanically by rubber rollers. Air- and/or water jets are used to blow incompletely shelled shrimps back to the production line. Automatic processes are normally located in separate rooms where some workers inspect the process occasionally. The rest of the shells are removed manually outside this room, often in the same area as the shrimp are packed. The concentration of dry aerosols is normally high in the machine rooms, and lower in the manual peeling and packing area.

Salmon industry. In the salmon industry, most processing takes place in the same area. Owing to heavy water splash from the containers with living salmon and also extensive use of water nozzles to rinse the fish along the process lines, the concentration of wet aerosols is often high.

Statistical analysis

The results are given as means $\pm$ SD. Statistical analysis was performed by Pearson Chi-square test using SPSS[®] 11.0 (SPSS, Chicago, IL, USA). The level of statistical significance was set to P -values less than 0.05.

Results

Skin symptoms

Table 1 summarizes that the white fish and shrimp industries had more female workers compared to the salmon industry and the group of administrative workers. Except in the salmon-processing industry, production and administrative

Table 1. Proportion of female employees (%), mean age and average length of employment among exposed production workers and control group according to types of seafood industry ($n = 883$)

	White fish ($n = 393$)	Shrimp ($n = 148$)	Salmon ($n = 211$)	Control group ($n = 131$)
Females (%)	54	66	46	40
Mean age (years $\pm$ SD)	39.2 $\pm$ 12.1	39.7 $\pm$ 11.6	37.8 $\pm$ 12.8	41.4 $\pm$ 10.5
Average length of employment (years $\pm$ SD)	13.5 $\pm$ 9.8	13.4 $\pm$ 8.8	7.5 $\pm$ 6.3	15.1 $\pm$ 11.0

workers were similar with respect to age and duration of employment.

Overall, 55.6% of the production workers had experienced 1 or more skin symptoms, with a significantly higher prevalence among females (60.2%) compared to males (50.1%) (data not shown). Table 2 summarizes the prevalence of skin symptoms in males and females at different work positions in different types of industry. Table 2 summarizes that the work tasks performed in the white fish and shrimp industries differ according to sex, while this is less pronounced in the salmon industry. As shown, there was a high prevalence of skin symptoms in production workers compared to administrative workers (non-exposed) in all types of industry. In the white fish industry, there was a significantly higher prevalence of skin symptoms in females compared to males ($P < 0.05$). However, the sex difference was seen only among manual filleting workers in this industry. Among all production workers, sex, age and duration of employment did not differ between those who had skin symptoms related to work and those who had not (data not shown). The table indicates that, except for workers in the shrimp industry, most workers use protective gloves. There was neither a sex difference nor a difference between workers with and without skin symptoms in the use of gloves (data not shown).

Location and duration of skin symptoms

In the group of workers with skin symptoms ($n = 418$), the symptoms were mostly located on the hands and/or face, as summarized in Table 3. Among workers in the white fish industry, 28.6% of the fillet workers reported that skin symptoms

Table 3. Localization, duration of skin symptoms and interference with working capacity among 418 production workers who have reported skin symptoms while working

	White fish ($n = 210$)	Shrimp ($n = 97$)	Salmon ($n = 111$)
Localization of skin symptoms			
Hands	152 (72.4)	67 (69.1)	66 (59.5)
Forearms	42 (20.0)	7 (7.2)	7 (6.3)
Face	67 (31.9)	43 (44.3)	49 (44.1)
Duration of skin symptoms			
Minutes/hour	74 (35.2)	16 (16.5)	30 (27.0)
More than 2–3 days	118 (56.2)	71 (73.2)	69 (62.1)
Interference with working capacity			
Yes, often	7 (3.3)	3 (3.1)	1 (0.9)
No, never	116 (55.2)	49 (50.5)	74 (66.7)

Values are expressed as n (%). Some workers reported that skin symptoms were located in more than one place. Regarding duration and interference, there are several missing values.

were located on the forearms, compared to 2.6–11.5% in other worker groups in the same industry (data not shown). Skin symptoms tended to last for 2–3 days or more.

Interference with working capacity

Only 2.6% of all production workers with skin symptoms reported that these often interfered with their work, and 57.2% reported that the symptoms never interfered with working capacity. These data are shown for the white fish, shrimp and salmon industries in Table 3.

Suggested risk factors

A total of 57.9% of workers doing manual processing of fish or shrimp reported skin symptoms

Table 2. Occurrence of skin symptoms in different types of seafood-processing industries according to sex

Type of industry	Skin symptoms percentage (n)		Use of gloves almost always
	Male	Female	
White fish	41.8* (177)	63.0*† (211)	93.9
Manual filleting	46.4* (28)	66.3*† (169)	94.4
Machine operators	40.0* (45)	– (4)	96.0
Receivers	41.8* (55)	50.0 (4)	88.3
Salt fish	40.8* (49)	52.9* (34)	95.3
Shrimp	66.7* (48)	65.3* (98)	47.3
Thawing	66.7* (36)	40.0 (5)	90.2
Residual peeling	50.0 (4)	59.3* (54)	34.5
Packing	75.0* (8)	76.9* (39)	26.5
Salmon	56.1* (114)	49.0 (96)	91.5
Butchery	53.2* (94)	48.8 (80)	94.3
Trimming/packing	70.0* (20)	50.0 (16)	77.8
Administrative workers	23.1 (78)	34.6 (52)	–

The frequency of the use of gloves among workers at different work tasks is also shown.

*Chi-square test for differences between exposed workers and control group, $P < 0.05$.

†Chi-square test for differences between corresponding male and female workers, $P < 0.05$.

are compared to 15.1% doing machine processing (data not shown). There was neither a difference between types of industry nor a sex difference. Workers in different types of industry reported different risk factors during processing of fish or shrimp, and also factors in the environment, as causes of skin symptoms. In Table 4, subjective risk factors as causes of skin symptoms are shown for workers with skin symptoms related to work in different types of industry. In the white fish industry, the 3 most frequently reported risk factors were contact with fish (cod, haddock and/or pollack), gloves and contact with fish juice. Females suggested these factors more frequently than males. Both males and females in the shrimp industry believed that contact with shrimp, disinfectant and contact with water were the most important risk factors. In the salmon industry, water splash, gloves and contact with water were the 3 most important risk factors. More females than males thought gloves to be a risk factor ($P < 0.05$).

Diagnosed skin diseases

The participants were asked if they had skin diseases such as urticaria and/or eczema diagnosed by a medical doctor. There were no sex differences nor differences in the prevalence of either eczema or urticaria among the production workers compared to the administrative workers. However, Table 5 summarizes that workers in the white fish industry, who reported skin symptoms, had a significantly higher prevalence of eczema compared to the workers with no skin symptoms. The prevalence of eczema was highest among manual fillet workers, both males and females.

Discussion

Our study shows that the majority of those exposed to fish or shrimps experience skin symp-

Table 5. Occurrence of eczema and urticaria diagnosed by a medical practitioner in workers reporting skin symptoms ($n=418$) and workers reporting no skin symptoms ($n=334$) according to type of industry

	White fish		Shrimp		Salmon	
	<i>n</i>	% of <i>n</i>	<i>n</i>	% of <i>n</i>	<i>n</i>	% of <i>n</i>
Occurrence of eczema						
With skin symptoms	210	16.2*	97	16.5	111	17.1
No skin symptoms	183	5.5	51	7.8	100	15.0
Occurrence of urticaria						
With skin symptoms	210	6.2	97	6.2	111	2.7
No skin symptoms	183	4.4	51	–	100	5.0

*Chi-square test for differences between exposed workers with and without skin symptoms, $P < 0.05$.

toms during a year, with a higher prevalence among female production workers compared to males. Skin problems on the hands or face were most frequently reported. Most workers reported that the duration of skin symptoms was more than 2 days, but that these seldom interfered with their work capacity. Skin problems due to contact with fish and shellfish have been shown to be of both irritant and allergic origin (1–4). One limitation with our study is that we are not able to separate allergic from irritant contact dermatitis, as this requires patch testing.

Work-related skin problems have been shown to affect women more often than men. It has been proposed that the higher prevalence of skin irritation in females compared with males is due to different exposure, both occupational and non-occupational (16). Our study shows that men and women have different work tasks in the white fish and shrimp industries, regardless of plant. In the white fish industry, most women work in the manual fillet department. They use thin gloves to be able to feel and remove small bones in the fillets. They work in separate rooms, and workers often have rolled-up sleeves due to relatively higher temperatures than in other processing rooms. Based on this observation, it is more likely that the observed differences in skin symptom localization and suggested risk factors may be explained by different work tasks rather than by sex itself.

Most workers in all types of industry reported skin problems on the hands or face. This may be explained by exposure to wet aerosols and some times water splash. As much as 44% of the workers with skin symptoms in the salmon industry reported that skin symptoms were located on the face. At the same time, water splash was the most frequently suggested risk factor for skin symptoms to occur in this industry. The heavy water splashing came from the containers with living

Table 4. Risk factors believed to cause skin symptoms among by 418 production workers reporting skin problems while working

Risk factor	White fish (<i>n</i> = 210)	Shrimp (<i>n</i> = 97)	Salmon (<i>n</i> = 111)
Fish/shrimp	33.3*	43.3	20.7*
Fish juice	26.7*	–	20.7
Gloves	28.6*	11.3	32.4*
Contact with water	24.8	22.7	28.8
Water splash	22.4	17.5	37.8
Salt	17.1	20.6	8.1
Detergent (hand soap)	23.8	20.6	27.0
Disinfectant	10.0	24.7	24.3

Values are expressed as percentage of *n*.

*Chi-square test for differences between male and female workers, $P < 0.05$, with a significant higher prevalence among female workers.

salmon and the extensive use of water nozzles to rinse the fish along the production line.

The causes of occupational skin diseases are complex and multifactorial. Wet-work conditions may be an important causative factor in the development of hand eczema and may also promote skin drying (12, 15). Contact with water was an important self-reported risk factor for the development of all types of skin symptoms in the seafood-processing industry. During processing, workers wash their hands several times during the workday, and water is also used to rinse the shrimp, fish, fish fillets and the working table. The fluid surrounding the fish, fillets and shrimps actually represents a mixture of water and juice from the raw material, and sometimes also salt.

In a previous study, in the white fish industry in Denmark, 89% of the fillet workers, controllers, weighers and wrappers stated that fish juice was responsible for the skin symptoms and 7% mentioned the fish meat. The fish, codfish, haddock, pollack and whiting, were stored on ice for a maximum of 14 days before processing, and skin symptoms were positively correlated to the postmortem age of the fish (10–12 days) (5). Postmortem age in the seafood-processing industry in northern Norway depends on the species processed as explained above. Our study indicates that skin symptoms occur even from contact with fresh fish or shrimp, and contact with raw materials was an important risk factor. Contact with fish juice was a less important risk factor. Among workers in the white fish industry in Denmark, skin symptoms were associated with high-molecular-weight compounds from the fish (6). It has been shown that fish enzymes, such as pepsin and trypsin, are highly effective in degrading human epidermal keratin *in vitro* (17, 18). This suggests one possible mechanism for the development of skin symptoms caused by exposure to fish.

Gloves may have both a positive and a negative effect on skin symptoms, as they protect the skin from external exposures but may cause skin problems themselves. The protection from gloves may also be reduced because of the effects of occlusion on the skin (14). It has been shown that occlusion caused by gloves may be an important factor in the pathogenesis of irritant contact dermatitis (13). Gloves were reported as a risk factor for skin symptoms to occur by 29–32% of the workers in the white fish and salmon industries. It has been shown that allergy to rubber gloves is common while allergy to plastic gloves is rare (19). However, we have no information about the specific type of gloves used by the workers at different positions in the production line, which is another limitation of this study.

Males and females may use different types of gloves according to different types of work. The glove type used by male receivers and female fillet cutters in the white fish industry is probably different. However, even if almost all fillet cutters used gloves, the prevalence of skin symptoms was as high as in peelers and packers in the shrimp industry, where only 1/4 used gloves almost always.

In a study from Tromsø carried out 20 years ago, among female shrimp peelers, 25% of the peelers claimed skin problems due to working conditions (4). In our study, more than 40% of the peelers report this. There has been a change during recent years in shrimp processing from manual peeling to automated peeling by use of a laser technique. This process takes place in separate rooms, and most of the shells are removed before entering the manual peeling room. However, even though skin contact with shrimp has been reduced, this does not seem to have improved the frequency of skin symptoms reported by the peelers. One explanation might be that only 27–35% of the packers and peelers in the shrimp industry use gloves when working. Even if gloves were reported as a risk factor, using gloves to protect the skin might be of major importance for this worker group.

Not unexpectedly, we found that some group of workers with skin symptoms due to work also had a diagnosis of eczema/urticaria to a larger extent than the group with no skin symptoms. In this study, we cannot conclude whether this diagnosis was work related or not. The group with skin symptoms had been working in this industry just as long as the group with no skin symptoms. Workers with severe symptoms may not be able to continue working, and thus a healthy worker survival effect will be evident.

The response rate of the questionnaire part of the study was relatively low (49.8%), mainly due to production shutdown at some factories. Periods of production shutdown are normal events in this industry, and are often related to sparse raw materials or low market prices. During such periods, most workers, though not all, are laid off. If we exclude participants in plants where we assume there was a production shutdown, the response rate would have been 56.2% instead of 49.8%. However, all plants and all workers are included in our study as described above. The questionnaire was not translated into other languages because earlier attempts to do so had shown that answers were difficult to interpret equally, due to differences in cultural aspects. Even if the overall response rate was relatively low, the response among Norwegian workers

actually at work receiving the questionnaire was much higher. Our results are therefore probably representative of Norwegian workers in the seafood industry.

In conclusion, our study shows that skin symptoms due to work are common in all parts of the seafood-processing industry in north Norway. Skin symptoms were predominantly moderate and they seldom interfered with working capacity. A strong sex division in different work tasks, and thus exposure to different risk factors, might to some degree explain the observed higher prevalence of skin symptoms in females compared to males.

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