A MODEL FOR MANAGING COLD-RELATED HEALTH AND SAFETY RISKS AT WORKPLACES

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ABSTRACT

Cold conditions increase health and safety risks at work in several ways. The effects of cold have not been sufficiently taken into consideration in occupational safety and health practices. A systematic model and methods were developed for managing cold-related health and safety risks at workplaces. The development work was performed, in a context-bound manner, in pilot industries and workplaces. The model can be integrated into the company's occupational health and safety management system, such as OHSAS 18001. The cold risks are identified and assessed by using a checklist. The preventive measures are systematically planned in a written form specifically produced for cold workplaces. It includes the organisational and technical preventive measures, protective clothing and personal protective equipment, as well as training and information of the personnel. According to the model, all the workers, foremen, occupational safety personnel and occupational health care personnel are trained to recognise the cold risks and to conduct preventive actions. The developed model was evaluated in the context of cold outdoor (construction) and indoor work (fish processing), and by occupational health and safety professionals. According to the feedback, the model and methods were easy to use after a one-day introduction session. The continuum between the cold risk assessment and management worked well, although there was some overlap in the documentation. The cold risk management model and its methods form an essential part of ISO CD 15743 Strategy for risk assessment, management and work practice in cold environments.

Keywords: cold, work, cold risk management

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INTRODUCTION

Cold conditions increase health and safety risks at work. Cold stress decreases physical, and especially manual performance (1,2). Cold is also related to an impaired safety-behaviour of workers (3). As the temperature decreases, an increased rate of cold-related injuries (4) has also been demonstrated. Cold air and wind have shown to increase occupational accident rates (5). In outdoor work, seasonal variations are seen in the accident rates, with the highest incident rate during the late fall (6). Methods have been developed for assessing and managing cold-induced health and safety risks at workplaces (7,8,9). In order to integrate the cold risk assessment and management methods into a company's safety and quality management systems, and into the occupational health and safety practices at the workplace, a systematic model is needed. The aim of this study was to develope a cold risk management model for workplaces and evaluate its usability.

OHS management systems

Cold risk management should be fully integrated into the occupational health and safety (OHS) management system and practices of the company, in order to ensure the implementation and continuance of the activities. It shall thus follow the international and national OHS legislation and norms.

The OHSAS 18001 Occupational health and safety management systems Specification was developed as a recognisable OHS management system specification against which the OHS management systems of the organisations could be assessed and certified (10). It lays down the requirements for a OHS management system to enable an organisation to control its OHS risks and improve its performance. It is accompanied by OHSAS 18002: guidelines for implementation (11). The approach of continual improvement is common to most current OHS management systems and information systems related to health and safety issues (12,13). OHSAS 18001 is also compatible with the standards ISO 9001:1994 and ISO 14001:1996 in order to facilitate the compatibility and integratability of the quality, environment and OHS management systems (14,15). OHSAS 18001 was chosen as a basic framework, into which the cold risk management model shall be integrated (figure 1).

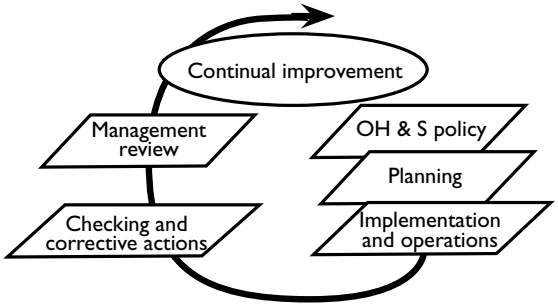

Figure 1. Elements of successful OH&S management (OHSAS 18001).

Standards. Risk assessment and management methods

ISO thermal standards provide guidelines of assessment and evaluation methods for thermal environments. Several of these standards can be used for assessing thermal risks caused by cold exposure. Most of the methods are self-contained, but they should be used in conjunction with each other in a comprehensive assessment. At present, there are no guidelines on how to systematically assess the effect of cold on human health and performance. The existing guidelines for cold work apply to cold indoor conditions (16,17) and are limited with regards to practical instructions for the assessment and management of cold. It is important to recognise that, in order for the standards to be utilised as instruments for assessing thermal environments at workplaces, they have to be practically orientated and usable (18).

Cold risks shall be identified and analysed to the extent required to solve the problems. If the personnel of the workplace cannot solve the problem, more complicated risk assessment and management methods are applied. The different levels of risk assessment and management procedure can be described, for example, as screening, observation, analysis and expertise levels (9, 18). A cold risks assessment and management model, with its methods, should also be compatible with a general risk assessment and management procedure, such as that described in the risk management toolkit developed for small and medium size enterprises (19).

The draft standard "ISO CD15743 Strategy for risk assessment, management and work practice in cold environments" combines the different elements of cold risk assessment and management, training and information and occupational health care activities for cold work (20). It was produced as a practical guide for utilising the different standards and methods. The cold risk management model is an essential part of the standard.

Process and results

The Finnish Institute of Occupational Health conducted a national action program during 1997-2001, in order to apply cold-related research knowledge to working practices in cold work. In the Cold Work Action Program, a systematic model and methods were developed for assessing and managing cold-induced health and safety risks at workplaces, for training and informing the workers and keypersons, and for the occupational health care activities related to the cold work. The methods were developed and tested, in a context-bound manner, in pilot workplaces and industries in cold outdoor and indoor work. The personnel of the companies participated in the developement work as experts in their own work. The industries represented different types of work, including, for example, construction, seafaring, stevedoring, food processing, tourism etc.

The cold risk management model was further developed, tested and revised in a co-operation project entitled "Risk assessment and management of cold-related hazards in arctic workplaces", which was funded by The European Regional Development Fund (ERDF) and its specific programme, Barents INTERREG IIA (21). The model was also evaluated at the 3rd International Course on Performance in Cold Environments, organised in March 2002 by NIVA (The Nordic Institute of Advanced Training in Occupational Health and other Work Life Matters).

A systematic model for managing cold risks

The action model produced for assessing and managing the cold-induced health and safety risks at work is shown in figure 2. The activities must follow the norms given by general occupational safety laws, trade agreements and industry-specific safety regulations. In order to ensure the implementation and continuance of the activities, the cold risk management is integrated into the company's OHS management system and general risk assessment and management practices (18, 19). The influences, costs and benefits of the cold risk preventive actions should also be analysed at the company management level, as shown in figure 1 (18, 22). The actual cold risks assessment and preventive actions are planned and carried out at each individual workplace. The key persons responsible for it shall have all the necessary supporting information for planning and carrying out the actions, and the whole personnel of the workplace shall be informed about the actions.

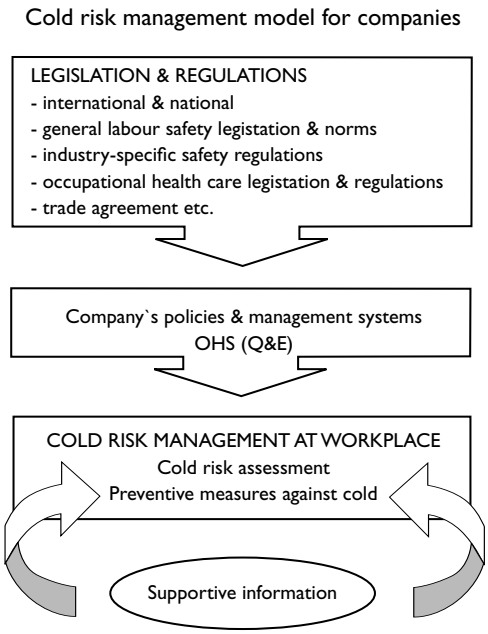

Figure 2. Cold risk management model for a company.

Cold risk assessment

Concerning the cold risk assessment, the usability of the present ISO thermal standards was recently evaluated based on which relevant methods, or elements from the methods, for the different levels of risk assessment were recognised (18). In addition, based on this evaluation, it was recognised that new practical methods for the identification of cold hazards are needed. Therefore, a checklist for workplaces was produced and tested by end-users (23). The method is based on observation and does not require comprehensive training, or knowledge in e.g. ergonomics. Furthermore, for a person at the workplace who is well aware of the contents of the work, conducting the observation does not require a long time, and is inexpensive for the company.

Cold risk management plan

According to the identified and assessed cold risks, various preventive measures against these hazards shall be planned and carried out at the workplace by the occupational safety delegates, supervisors and workers. All parties need to be informed about the actions to be made. The responsible person for each action are named. The activities shall be planned in written form, either as a part of the general

occupational safety plan of an individual workplace, or as a separate cold risk management plan (figure 3). The purpose of the planning is to systematically take into account different aspects related to cold, as well as to guarantee the successful timing for implementing different preventive activities.

COLD RISK MANAGEMENT PLAN FOR WORKPLACE

Workplace:				
Plan is prepared by:				
Responsible persons:	**Name & initial letters:**			
Foreman of the work place				
Occupational safety responsible				
Occupational safety delegate				
etc.				
Who is controlling the activities ?				
COLD RISK ASSESSESMENT				
Fill in the procedure for cold risk assessment at this particular workplace		**resp. person**	**date**	**control**
Cold risk assessment				
Assessment using the checklist				
PREVENTIVE MEASURES AGAINST COLD RISKS				
Fill in the needed cold risk preventive measures		**resp. person**	**date**	**control**
1. Organisational preventive measures, planning of the work	**Measures to be conducted**			
In the planning phase of project				
Before every work shift				
During the actual work shift				
2. Technical preventive measures	**Measures to be conducted**			
Tools, equipment, machinery				
Work area				
Slippery surfaces				
Lighting				
Walking on stairs, work at heights				
Others				
3. Protective clothing & PPE	**Measures to be conducted**			
Clothing				
Handwear				
Footwear				
Head and face protection				
PPE				
4. Information and training	**Measures to be conducted**			
5. Occupational health care	**Measures to be conducted**			

Figure 3. Example of a cold risk management plan for workplace.

Planning and organising the work

Organisational cold preventive measures are planned while planning and organising the work. Their main purposes are to control the duration and intensity of the cold exposure and to provide sufficient time, measures and spaces for recovery. For example, in outdoor work, extra manpower can be provided to reduce the cold exposure time. The work load should also be kept at a rather constant level to avoid excessive sweating and evaporative cooling after it.

Technical preventive measures

Technical preventive measures are conducted to reduce the radiative, convective and conductive heat loss from the worker. For example, a wind-shelter reduces both the convective heat through the clothing and the risk of frostbite on the bare skin. In indoor work, for example, the temperature gradients shall be reduced and the heat conduction to cold surfaces and products decreased.

Protective clothing and personal protective equipment (PPE)

Protective clothing and PPE are chosen and used on the basis of the workplace risk assessment. The need for thermal insulation can be roughly determined by, for example, the IREQ index (24), and individual adjustment is achieved through the selection of underwear and intermediate layers. Guidelines for required protective and functional properties of cold protective clothing and protective clothing against foul weather are given in the European standards (25,26). In addition, protection of the extremities shall be taken care of. Attention should also be payed towards the compatibility of the protective clothing with the PPE.

Training and information

In order to ensure the successfull implementation of the cold risk management model and preventive methods, the workers, foremen and occupational safety persons need to be trained for recognising the cold risks and knowing the ways to prevent, or reduce them. Training and information, as well as learning and guidance material, shall be context-bound.

Occupational health care

The individual cold-related health aspects of the workers shall be identified and taken into consideration in the occupational health care of a workplace. For the identification of health-related problems, a specific health check for cold work has been designed (20). Thus, the information from the hazards at the workplace and the individual health aspect may be used in combination.

Testing the model and methods at the pilot workplaces

The cold risk assessment and management model and methods were applied to construction work (in Finland) and to fish processing

work (in Norway), and feedback was collected. In the construction work, the work tasks, physical load, the work environment and the weather conditions change continuously. Wind, rain, snow and icy surfaces are additional environmental risk factors related to cold. In the fish processing work, the work tasks of an individual worker are similar and repetitive. Furthermore, the environmental conditions are rather constant. However, the temperature gradient, air movements, frozen products and moisture, all increase the adverse effects of cold.

Construction work

In Finland, the key persons of a construction company located in northern Finland evaluated the cold risk management model. The company employs 25 officials and 60-70 workers, depending on the size of the sites. Preceeding the activities, a short training of the purpose and principles of the methods were given to the key persons. The activities were planned by three key persons for two different worksites. The cold risks were assessed by using the resulting checklist (21). A systematic planning for cold risk management activities for the two specific worksites was conducted using the structurized form (figure 3). Based on the planning, technical preventive measures were implemented at the worksites. These included, for example, building temporary wind-shelters, removing snow and ice, using ladders suitable for winter conditions etc. Cold protective clothing was purchased and consultation for appropriate clothing was given by professionals. The workers and key persons of the company were also trained by the researchers. A practically-orientated cold guide was distributed to the workers (27), and more comprehensive information was given to the foremen and work safety delegates, as well as the occupational health care personnel associated with the company.

The opinions of the key persons were assessed by a questionnaire using both closed and open-ended questions. These included questions related to the duration of the method, as well as opinions of their usability. The duration to fill in the plan was 45-90 min at the two workplaces. The instructions and material provided was considered adequate. The key persons indicated that the material required some degree of familiarization, but was considered meaningful in the long run.

Fish processing work

In Norway, two fish processing companies participated in the project. As a part of the present state analysis, 52 workers completed the health check questionnaire. The most striking finding was that 96% reported some level of unpleasantness for the fingers and 88% reported the same discomfort for the feet. Periodical circulatory disturbances in hands and/or feet were reported by 52% of the respondents. Neck and shoulder, back, or hip pains were also reported. 49% considered the problems to have significant negative effects on their concentration and motivation. The cold risks assessment checklists that were completed during the evaluation period identified the same problem areas and the need for improved protective clothing.

Actual temperature measurements of the work environment, and of the body surface for some of the workers, confirmed the conclusions from the health checks and the checklists. The air temperature at the level of the head of the workers was 22-24°C, while the temperature at the level of the feet was 10-13°C. The fish meat the workers were handling was kept at a temperature of 6-7°C for food quality reasons. The finger temperatures measured for the filet cutters were found to be in the area of 9-11°C, while the foot temperatures measured on the ankle dropped below 25°C during the work period, indicating temperatures below 20°C for the toes and the foot sole.

Results were presented to the managers and workers, and corrective actions were planned systematically (figure 3). There was no need for major organizational cold risk preventive measures, and corrective technical measures were proposed for the unacceptable temperature gradients of the work environment. Replacing the standard work boots used and the cotton socks commonly used with other boots, allowing more air space for the feet and with a much thicker sole, eliminated the cold problems for the feet. The results was confirmed both by the workers' subjective evaluations, as well as by the temperature measurements performed. Replacement of the cotton inner glove worn inside the latex gloves with a polypropylene one also reduced the problems of painfully cold fingers for the filet cutters. Information and training of the personnel were emphasized. The managers and all the workers participated in information sessions. The workers received practically orientated, written information about cold. The occupational health care personnel was trained in a two-day course.

The gathered feedback showed that the factory management and the workers confirmed that they had become more aware of their responsibility and possibilities for improving the comfort and safety of the cold work. It was also demonstrated that, with a systematic approach, these kinds of development and training activities could be performed for a group of workers without a common language.

Evaluating the model and methods by OHS and OHC professionals

The model was further evaluated by occupational safety and occupational health care professionals, instructors, researchers and postgraduate students (n=33) participating in an advanced training course dealing with performance in cold environments. The persons were not familiar with the methods beforehand.

The developed model and methods were evaluated in groups, which were formed based on the various types of cold work. The leader of the group worked at the branch in question and was therefore familiar with the cold-related problems in that specific work. The groups discussed the following industries and work:

- Food processing (light repetitive work, cool indoor room, cold products)
- Airport personnel's work (light to moderate work, indoors and outdoors, wind)
- Fishing (moderate outdoor work, wetness, wind)
- Maintenance work at offshore oil industry (light work, wind, moisture, other risks)
- Cold storages (cold indoor work, air velocity)

The group leader described the cold work and environment to the group. Following this, the whole group assessed the possible cold-related health and safety risks at the work by using the cold risks assessment checklist (21). The group planned the preventive measures using the structurized form (Fig. 3.) As a summary of the feedback, three major points were brought to light:

1. The developed methods were easy to use after a short introduction
2. The persons familiar with the profession identified the specific cold risks related to each industry by using the checklist and were able to plan the preventive measures

3. The continuum between the checklist and the cold work plan worked well. They were partially overlapping. The immediate preventive measures were recorded already when identifying the cold risks by the checklist.

DISCUSSION AND CONLUSIONS

The developed model and methods for cold risk management practices can be integrated into the existing occupational health and safety practices in the industries involving cold work. Special attention should be payed to the compatibility of the methods with the company's OHS management system and practices, including the evaluation of the costs and benefits. The model may need some simplifications for industries conducting process-type cold work, in which the work conditions are steady.

According to the feedback, the cold risk management model and its methods are easy to use after a short introduction. The primary target group for using the methods are the key persons of a company, such as foremen, the occupational safety delegate of the workers, the occupational safety personnel and the occupational health care personnel. A one-day user training course is needed for the optimal use of the methods. The overlap between the cold risk assessment checklist and the cold work plan is due to the different documentation requirements: the checklist is used when making the observations at the worklace, the cold risk plan can be used in a computer-based planning system of the company. Nevertheless, the compatibility shall be further developed. A Method Handbook for Cold Work accompanied by user-training is prepared to meet these challenges.

A systematic approach to prevent cold-related health and safety risks is beneficial to the company also in a economical sense. A parallel study made at a construction site of 20 workers showed that the costs of cold risks management activities were approximately 4000€ for one cold season, while the savings gained by those activities were approximately 10000€ (22).

The cold risk management model, the cold work plan and the cold risk assessment and management methods are essential parts of ISO CD 15743 (20).

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