

IS COLD EXPOSURE A FACTOR THAT INCREASES THE RISK TO MUSCULOSKELETAL DISORDERS (MSD'S)?

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Abstract

Both, physical conditions and psychosocial work factors at the workplace are implicated in the development of Musculoskeletal Disorders (MSD's) or Chronic Work-Related Myalgia (CWRM); however the evidences are stronger for physical conditions. Between these physical conditions consistently reported included: maintained postures; force application; vibration; direct mechanical pressure on the body tissues and cold work environment. But the knowledge concerning with the relationship between MSD's and cold exposure is limited and the pathophysiological mechanisms underlying this problem is poorly understood. The evaluation of cold exposure as an etiologic or contributing factor of musculoskeletal symptoms or diseases, as MSD's, is difficult and there is a lack of controlled studies in this filed. The multi-factorial risk factors affecting musculoskeletal system, makes difficult to evaluate the effect of cold exposure as a causative factor and probably make that the cold will be a modifying factor.

Some epidemiology approaches have tried to look a relationship between exposure to cold and the developing of some MSD's, especially for upper extremity. For measure the prevalence of perception of musculoskeletal symptoms between 162 workers cold-exposed and non-cold exposed in a large meat processing company in Colombia, a cross-sectional epidemiologic study was carried out using the Standardized Nordic Questionnaire. The workers were divided in two groups: Exposed group (50 workers) working in very cold areas +2°C, and Non-exposed group (112 workers) working in less severely exposed areas +9.4°C. There was a high prevalence of musculoskeletal symptoms among the more exposed workers, especially for low back, neck and shoulders. The prevalence ratios for neck and low back symptoms interfering with usual work were 11.2 (95% CI 1.3 – 93.4) and 4.5 (95% CI 1.6 – 12.4), respectively.

This study, as others epidemiology approach, was a cross-section design, and for analysis the causes is necessary to design case-control or preferably cohort studies. The association between cold exposure and musculoskeletal complains or diseases are mainly still obscure and the need of further research is apparent.

Key words: Musculoskeletal Disorders (MSD's); Cold exposure; cross-sectional study; Standardized Nordic Questionnaire for Musculoskeletal Symptoms.

Introduction

Musculoskeletal Disorders (MSD's) are a significant world-wide public health problem (human suffering and cost of society). In USA during 2002, the MSD's were the most common problem suffered by the workers in private industries with 34% of all cases (Bureau Labor Statistics BLS, 2004). In 1999, 67% of work-related disorders in Sweden were MSD's (Nordian H. and Benstsson B.2001). In Denmark, the MSD's account for 39% of all occupational illness (Punnett L. and Gold J. 2004). The cost of MSD's has been estimated to lie between 0.5% and 2% in Nordic countries and Holland (Blair et al. 2004) and in USA is estimated between 45 to 54 US billion per year (National Research Council and Institute of Medicine, 2001).

Many workers can suffer the risk of getting cold injuries in their routine activities. Outdoors work in hard climate (for example fishing, agriculture, construction, gas and oil exploration

and reindeer herding in arctic and sub arctic areas) and in indoor work carried out in cold environments (food industries) can all involve danger of cold injury.

Musculoskeletal disorders have multi-factorial origin, including workload, psychosocial factors and organization factors. According to Buckle P. and Devereux J. (1999), the risk factors for MSD's (neck and upper limb) include: maintained postures, force application to hand, hand-arm exposure to vibration, direct mechanical pressure on body tissues, psychosocial work factors (work organization) and Cold work environment exposition.

The knowledge concerning with the relationship between musculoskeletal disorders and cold exposure is limited and there are only some hypothetical physiological and epidemiology approach. The evaluation of cold exposure such as an etiologic or contributing factor of musculoskeletal symptoms or diseases is difficult and there is a lack of controlled studies in this filed.

From epidemiology point of view there are some studies showing a relationship between exposure to cold and the developing of some musculoskeletal disorders, especially for neck and upper extremity (Chen et al., 1991; Ding 1994; Hildebrandt et al. 2002; McGorry et al. 1998; Pope et al., 1997; Niedhammer et al., 1998; Kurppa et. al., 1991). In these studies an indirect actions of cold were investigated. The other hand, other authors have indicated that moderate cold exposure may be a co-factor in the development of chronic problems with muscles and joints (Lundqvist 1990). Hagberg (1995) has indicated that the cold has two ways to act as a risk for chronic musculoskeletal disorders: directly, by its effects on tissue and indirectly, from the possible problems caused by the personal protective equipment used to alleviate the cold effects.

It is unclear whether cold exposure is an independent risk factor or a co-factor in the development of chronic problems with muscles and joints (Lundqvist 1990). Environmental humidity and direct contact with cold water or wet products have also been noted as potential contributors. Few extant occupational health surveillance systems recognize cold as a primary risk factor.

Objective

With the object to investigate the effect of cold exposure on skeletal muscle function, a cross sectional study was developed in a large meat processing company comparing the possible effect to cold on musculoskeletal system between exposed and non-exposed workers.

Methods

This was a cross-sectional study whose base was all packing workers (162) in at meat processing company. The examination consisted of a questionnaire including questions about demographic aspects such as age, gender, educational level and other questions such as years on the job, right or left-handed, discomfort with cold draught. The questions about musculoskeletal symptoms were adopted from the so-called Standardised Nordic questionnaire (Kuorinka I. et al. 1987).

The workers in this study were classified into two groups according to the cold exposition. One group was composed by 50 subjects working in packing areas with a low temperature (2°C), and 112 workers working in packing areas with a temperature to 10°C. The first group (50 workers) was denominate such as "exposed group", and the second group (112 workers) was named "non-exposed group".

Ergonomic Workplace Analysis for Ergonomics Section, Finnish Institute of Occupational Health, Ahonen, M. et al. (1989), was used for job analysis.

The cold conditions were measured in all areas where the workers packing: Web bulb temperature (°C), Dry bulb temperature (°C), WBGT In (°C), Humidy (%) and air velocity (m/s). The Statistical Package for Social Sciences (SPSS) 8.0 for windows was used for the statistics analysis throughout the study. The Relative Risk estimate was calculated in the comparison of musculoskeletal symptoms between both groups. The effect of age, years on

the job, cold protection, shift, discomfort with cold draught, hours working per week and type of contract were researched by logistic regression models.

Results

The ergonomics risk conditions in both groups were similar. The most important conditions identified from the ergonomics point of view were high repetitive movements with hands, low force work and standing position all day.

According to environment measurements the most important results indicated that air velocity was higher in exposed areas compared with non-exposed areas, 0.41 m/s and 0.14 m/s respectively. This aspect had a relationship with subjective discomfort to cold draughts. The workers working at exposed areas refer more discomfort than the non-exposed group, 62% and 51.8% respectively. There weren't significant difference among other environmental measurement.

A significant positive association was found between exposed group (exposed to cold) and neck, shoulder, wrist/hands, low back and hips/thighs symptoms. Similarly a positive association was found between exposed group and neck and low back symptoms which prevented workers from doing normal work. There was a high prevalence of musculoskeletal symptoms among the more exposed workers, especially for low back, neck and shoulders. The prevalence ratios for neck and low back symptoms interfering with usual work were 11.2 (95% CI 1.3 – 93.4) and 4.5 (95% CI 1.6 – 12.4), respectively. (Table 1)

Table 1
Estimate of Relative Risk (RR) of symptoms between exposed and non-exposed group

Body regions	Symptoms of disorders during last year RR and 95% Confidence Interval CI	Symptoms that prevented from doing work RR and 95% Confidence Interval CI
Neck	3.36 (1.75 – 6.44)*	11.2 (1.34 – 93.4)*
Shoulders	3.84 (1.61 - 9.17)*	4.48 (0.85 – 23.6)
Elbows	1.12 (0.21 – 5.92)	2.24 (0.14 – 35.1)
Wrist / Hands	2.57 (1.28 – 5.14)*	2.24 (0.58 – 8.6)
Upper Back	2.24 (1.12 – 4.48)	2.24 (0.32 – 15.45)
Low Back	2.24 (1.52 – 3.92)*	4.48 (1.61 – 12.4)*
Hips / Thighs**	13.44 (1.66 – 108.8)*	RR ignored
Knees	1.34 (0.52 – 3.45)	1.49 (0.26 – 8.66)
Ankle/Feet	1.87 (0.60 – 5.83)	2.24 (0.14 – 35.1)

*p<0.05

** For this body part the cases were 1 in exposed group and 0 in non exposed group

Discussion

The results showed that the reported Neck, Shoulders and Low Back symptoms were more common among the cold exposed workers than among non-cold exposed workers.

Other studies have found high prevalence of MSD's among cold exposed worker: Griefahn et al (1997), Chen et al (1991), Viikari-Juntura (1983).

Due the inconsistency use of cold clothing protection was not possible to evaluate its protection and/or effect of its weight on the musculoskeletal system.

The exposed group worked mostly at night (shift 3, 10 pm to 6 am). 92% of exposed workers work in shift 3. There were no workers in the night shift working in exposed areas. These characteristics were not analyzed in this research and could have some influence in the results, because the physical and physiological changes that produce the circadian rhythm could have some influence over the musculoskeletal system.

On the other hand, 90% of cold-exposed workers have an indirect contract with the company (by outsourcing), as opposed to 62.5% of those not exposed to cold. The type of contract with the company is important because when workers have an indirect contract it is possible that they work harder, more hours per week (as was true in this case), and possibly accept more strenuous activities.

Another consideration that is important to discuss is about the psychosocial work-related risk that in this research was not evaluated. According to the National Research Council and Institute of Medicine (2001), the epidemiological evidence provides support for the association between the physical workplace and psychosocial exposure of the worker, and both back and upper extremity MSD's. The difference between psychosocial exposures between both groups was not explored in this research.

Conclusions

- It was a cross sectional study, that does not look for causative conditions. It only explores the MSD's between two groups of workers that had similar ergonomic conditions, except the cold environment exposition.
- The lack of prospective studies and uncertainty about the precise pathophysiology mechanisms involved in the development of MDS's limits our ability to definitively identify causative factors, such as cold exposure.
- There are a few studies focused on cold exposure and musculoskeletal disorders or diseases, although the possible association or contributing role of cold exposure has been proposed in many studies, principally for neck, shoulder and low back.
- Most epidemiological studies that look for the association between cold exposure and musculoskeletal disorders have been cross sectional studies, but there are a limited number of cohort and case control studies.
- The prevalence of some MSD's had a clear relationship between workers who are exposed and non-exposed to cold, especially for neck, shoulders and lower back.
- Musculoskeletal disorders have multi-factorial origin (including workload, psychosocial factors and organization factors); this condition makes it difficult to evaluate the effect of cold exposure as a causative factor and probably makes exposure to cold a modifying factor.
- In this study some considerations were omitted and non-controlled: psychological aspects of the job, effects of job shift, and type of contract.
- The associations between cold exposure and musculoskeletal complaints or diseases are mainly still obscure and the need for further research is apparent.

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