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Influence of musculoskeletal pain on workers' ergonomic risk-factor assessments

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ABSTRACT

This study compares the ergonomic risk-factor assessments of workers with and without musculoskeletal pain. A questionnaire on the musculoskeletal pain experienced in various body regions during the 12 months and seven days preceding the data collection was administered to 473 workers from three industrial sectors. The *Ergonomic Workplace Analysis* method, developed by the Finnish Institute of Occupational Health (FIOH), was then used by the workers and an ergonomics expert to assess the workstations. The ergonomic quality of the workstations and the need for change were also assessed by the expert and the workers at the workstation, using visual analog scales (VAS). Results show that the workers in this study were exposed to significant musculoskeletal disorder (MSD) risk factors, according to the FIOH assessment and the high percentages of reported pain. The results also show that those who reported pain in the seven days prior to the assessment evaluated their workstations more negatively than subjects who reported no pain, while the expert found no difference between the two groups' exposure to MSD risk factors.

1. Introduction

The prevalence of musculoskeletal disorders (MSDs) in workplaces is a major problem (NRC/IM, 2001; Stock et al., 2011). Several studies have been conducted to assess exposure to ergonomic risk factors in worker populations. For extensive surveys, worker self-report questionnaires are used to estimate the worker's exposure to a variety of risk factors (Burdorf and van der Beek, 1999). Self-assessment can also be used by ergonomics practitioners when implementing an ergonomic intervention project in a company. Measuring exposure to risk factors is an important MSD prevention tool for both epidemiologists and ergonomists.

Some studies have examined the factors influencing the reliability and validity of workers' self-reports and self-assessments (Burdorf, 1992; Stock et al., 2005; Winkel et al., 1991). Sources of error and bias in subjective ratings have also been studied, among others, by Poulton (1982) and Toomingas et al. (1997). Other studies have focused specifically on the effect of musculoskeletal pain on the worker's assessment of physical workload (Leijon et al., 2002; Roskes et al., 2005; Wiktorin et al., 1993; Viikari-Juntura et al., 1996). This question is becoming particularly important for epidemiological studies with large-sized samples as well as for ergonomics practitioners and merits attention when an employee's assessment is taken into account to determine the workstation risk level and establish intervention priorities.

The assessment of a workstation's MSD risk factors usually relies on observational methods. Several methods from the ergonomics literature are available to researchers and practitioners (David, 2005; Li and Buckle, 1999). Many have the advantage of being fast and inexpensive to implement (Viikari-Juntura et al., 1996). Some were developed with the intention of supporting industry-led MSD-prevention efforts (Cole et al., 2003). Among other things, they can help prioritize ergonomic interventions. Some of these methods combine worker and expert assessments to determine a workstation's MSD risk level. Given the significant presence of MSDs in the population, it is only natural to assume that these methods can be used to assess workstations where workers are experiencing MSD symptoms. Therefore, it is important to know whether the workers' perception may be influenced if they are experiencing pain when these methods are being used. So far, only

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a few studies have focused on this subject. Some researchers have observed that workers with MSDs and those who were in pain reported greater exposure to MSD risk factors (Balogh et al., 2004; Hansson et al., 2001; Leijon et al., 2002; Viikari-Juntura et al., 1996; Wiktorin et al., 1993). These studies compare the differences between the exposure ratings of workers with pain and those with no pain in relation to exposure variables such as manual handling activity, movement repetitiveness and the posture of specific body regions. According to the findings of Donders et al. (2007), workers suffering from illness or chronic pain responded more negatively to questions characterizing their work than those not suffering from illness or chronic pain. Since all the study subjects worked for the same company and at similar workstations, this study shows that a negative perception of the job was strongly related to chronic pain rather than actual poor working conditions. The studies published to date have revealed similar levels of exposure to MSD risk factors. Furthermore, since none of these studies used an observational method developed for ergonomics practitioners, it is not clear whether such methods used in the context of an ergonomics practice would produce the same results as those developed by researchers for a specific research project.

Observational methods are still those most commonly used by practitioners (Takala et al., 2010; Dempsey et al., 2005). Often developed for practitioners and adapted to requirements of SMEs in a context of health and safety management at work, they are easier to use, less costly and more flexible when it comes to collecting data in the field. Many methods have been proposed over the last 30 years for the systematic and comprehensive assessment of a workstation. The *Ergonomics Workplace Analysis* method developed by the Finnish Institute of Occupational Health (FIOH) (Ahonen et al., 1989) which includes both expert and worker opinions, is one of them and among the best known (Malchaire, 1997, 2002).

The goal of the present study is to determine whether a worker's report of musculoskeletal pain during the prior 12 months or 7 days influences the worker's perception of his/her workstation's ergonomic risk factors, when assessed using the FIOH's *Ergonomics Workplace Analysis* observational method (thereafter named FIOH). This is the first study to use this type of method to examine the influence of reported pain on workers' perceptions.

2. Methods

2.1. Subjects

The characteristics of the 473 subjects participating in the study are described in Table 1. They were employed in either of one appliance assembly plant, four plastics and composites plants, or six public-sector tree nurseries. The workstations assessed in the various plants were chosen either because they had been targeted by CSST (Quebec's Workers Compensation Board) inspectors as having a history of MSDs or because the company had identified them to be at risk for causing MSDs or following workers' complaints. The 473 workers were interviewed at 182 workstations over a four-year period. In the tree nurseries, up to 22 workers could be working at similar workstations. Subjects participated in the study on a voluntary basis.

Table 1
Main characteristics of the respondents ($n = 473$).

	Appliances	Plastics/composites	Tree nursery
Number	45	53	375
Age (years)	41.2 ± 10.8 (24–62)	42.9 ± 10.7 (19–60)	46.6 ± 9.7 (17–66)
Weight (kg)	81.6 ± 16.4	79.1 ± 15.3	66.5 ± 12.9
Height (cm)	1.7 ± 0.1	1.7 ± 0.1	1.6 ± 0.1
BMI	27.3 ± 5	27.2 ± 4.3	24.6 ± 4.2
Length of employment (years)	10.4 ± 9.1 (1–37)	12.6 ± 10.4 (0.1–42)	16 ± 9.8 (0.02–34)

While the overall sample was 60% female, their representation in the tree nursery sector (69%) was higher than in the other two sectors (36%). Workers were between 17 and 66 years of age and had between 0.02 and 42 years of seniority in the company.

2.2. Data collection

All subjects were interviewed at their workstations. They were released for a period of about 45 min to respond to the pain questionnaire and conduct the ergonomic assessment of their workstation. While the workers were given a copy of the questionnaire, the ergonomics expert asked the questions in the form of an interview, noting the worker's responses and providing clarification whenever necessary. The data for this study were collected by three experienced ergonomics practitioners and four graduate students with training and field experience in ergonomics, all of whom are referred to as “experts” for this study. The experts had no employment relationship with the companies that participated in this study. The first part of the questionnaire established the subjects' general characteristics: age, sex, weight, height and length of employment. The second part of the questionnaire can be separated into three sections: musculoskeletal pain, worker self-assessment of ergonomic risk factors at the workstation, expert assessment of ergonomic risk factors at the workstation.

The workers' musculoskeletal pain was assessed using two series of questions from the Enquête sociale et de santé du Québec of 1998 (Daveluy et al., 2001), which was adapted from the Standardized Nordic Questionnaire (Kuorinka et al., 1987). A first set of questions pertained to pain experienced in 11 body regions (neck, shoulders, arms, elbows, forearms/wrists, upper back, lower back, hips/thighs, knees, calves and ankles/feet) during the 12 months preceding the data collection. A second set of questions related to pain felt in the same body areas in the seven days prior to the data collection. For each body region, workers were to indicated whether they had experienced any pain that had interfered with their normal activity over the past 12 months: *no*, *never*; *yes, sometimes*; *yes, often*; *yes, all the time*. In the case of musculoskeletal pain experienced during the past seven days they were to indicate whether or not the pain was work-related for the same 11 body regions: *no pain*; *yes, entirely related to my work*; *yes, partly related to my work*; *I don't know if related to my work*; *not related to my work*.

The FIOH method covers 14 topics: (1) work site, (2) general physical activity, (3) lifting, (4) work postures and movements, (5) accident risk, (6) job content, (7) job constraints, (8) worker communication and personal contact, (9) decision making, (10) repetitiveness, (11) attentiveness, (12) lighting, (13) thermal environment and (14) noise. In the FIOH method, the worker subjectively assesses his workstation on each topic using a four-level rating scale: *very poor*, *poor*, *good*, *very good*. With this method, the expert assesses the workstation on the same 14 topics using a four or five level scale (in the FIOH some topics use a four-level scale while others use five for the expert assessment only). A score of five (or four for some topics), represents maximum risk for the worker on the topic being evaluated. For each workstation assessed, the data collected not only provided the information needed to complete the 14-point FIOH assessment, but also included other useful information as well (e.g., weight of loads handled, magnitude and direction of forces applied to objects as measured with a digital force gauge, working heights, any significant distances or movement, shift length, light and noise levels). A video recording was