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Proposal of parameters to implement a workstation rotation system to protect against MSDs

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Abstract

The aim of this study was to propose parameters to be taken into account for implementing a workstation rotation system, which reduces the risk of musculoskeletal disorders (MSDs). The case study has shown that the benefit provided by workstation rotation has a positive impact on psychosocial factors, which partly explains why most operators are either not at all or only slightly stressed. Workstation rotation is found to be relatively ineffective in relation to MSD prevention, notably on account of the lack of variability and the intensity of the biomechanical demands. The assessment of a workstation rotation system intended to prevent MSDs must encompass all the dimensions of the work. To achieve this, it is necessary to describe the rotation system in detail, ascertain the characteristics of the population concerned, assess its experience of the work, and measure the degree of biomechanical demand of the workstations. A logic diagram is proposed which can assist in arriving at a better identification of the conditions of success of a workstation rotation system. It is based on four complementary dimensions: ergonomic study of the context, integration of scientific knowledge, mastery of the implementation of the rotation system and evaluation and follow-up of the results.

Relevance to industry

This study provides information for those responsible for implementing a workstation rotation system in their enterprise. Parameters and a logic diagram are proposed to assist them in their task.

Keywords: Workstation rotation; Parameters; MSDs; Risk factors; Multiskilling

1. Introduction

In meeting flexibility objectives, companies today seek greater leeway than before in terms of labour deployment and task distribution (St-Jacques et al., 2003). Multiskilling and workstation rotation enable them to achieve this. The former requires extending ranges of operator skills and is reflected, particularly in organisational terms, by workstation rotation. As a human resource tool, multiskilling is used to ensure possible replacements (for sickness or holidays) and to cope with increased workload, which depends on the company's orders and its sector of activity (Rérat, 1985; MacLeod and Kennedy, 1993). From the operator's standpoint, workstation rotation implies regular station changeover according to a cyclical order and a pre-established work rate (Falardeau and Vézina, 2002). The definition of workstation rotation embraces a number of characteristics, such as the number of workstations included, rotation frequency and order.

At present, application of this organisational device is becoming increasingly popular in companies as a response to the growth in musculoskeletal disorders (MSDs) (Axelsson and Ponten, 1990; Henderson, 1992; Hinnen et al., 1992; Ellis, 1999; Kuijer et al., 1999), which together constitute the largest recognised occupational disease. According to these authors, changing workstation in fact diversifies the operator's physical and psychological demands. It therefore has an impact on both biomechanical

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and psychosocial risk factors influencing MSD appearance. In the case of precision tasks, it has been shown that workstation rotation is necessary to allow physiological recovery associated with visual and muscular fatigue (Mikami et al., 1987). Moreover, some authors (Rissen et al., 2002) agree that workstation rotation has a positive impact on the operator's subjective perception of work. In this respect, a comparative study of multiskilled employees has revealed that multiskilled operators experience a feeling of work satisfaction linked to skills development, lack of monotony, more widespread work relationships and a feeling of greater responsibility (Thomas et al., 1994). The operator feeling of fatigue decreases, when light and heavy workstations are alternated, because this change allows him/her to recovery physically (Kuijer et al., 1999).

Workstation rotation, to have a positive effect on reducing MSD risk factors, requires a real willingness and participation on the part of operators in both developing new skills and setting up the rotation system (Baggerman, 1993; Ellis, 1999; Vézina et al., 2003). Introducing this organisational device to unwilling operators could trigger the appearance of stress symptoms in contradiction with the pursued objectives (Thomas et al., 1994). Prior employee training is also necessary. In this respect, Christmansson et al. (1999) showed that, in repetitive manual assembly tasks, reorganisation of the work resulted in a increase in the number of postural pains, primarily on account of the operators not being skilled enough to take on a wider variety of tasks. Moreover, different demands at the various workstations must be guaranteed to offer the operator the opportunity of alternating work-related demands (Kuijer et al., 1999; Roquelaure et al., 1997). The workstations occupied during rotation must allow a variation in biomechanical demands (St-Vincent et al., 2003). Demand diversification requires a preliminary assessment of these different biomechanical demands. This can be carried out on the basis of work activity observation to identify the joint segment subjected to the greatest demand at the workstation concerned (Van Velzer, 1992). The order of the rotation system is then defined on the basis of alternating low-demand and high-demand workstations. For example, based on work activity observation, Henderson (1992) allocates a value of between 1 and 3 to the level of demand sustained by each back and upper limb joint. Then he suggests organising the rotation system such that each workstation with a high level of demand is followed by a low-demand workstation, whilst allocating a maximum of three high-demand workstations per day. Frazer et al. (2003) estimate that it is still difficult to find proof in the literature concerning the advantages of workstation rotation in relation to MSD prevention. Moller et al. (2004) are even more careful, considering that greater exposure variability is not necessarily sufficient for reducing MSD risks. On the other hand, delegates at the 2003 Montreal Symposium on Workstation Rotation concluded that this technique can prevent MSDs by curtailing excessive muscle and tendon demand, and that it can also have a positive impact on work satisfaction by breaking the monotony of repeating the same work movements (Vézina, 2003). However, this twofold positive impact remains subject to compliance with a number of principles involving adherence to rules whose outlines require further detailing.

The aim of this study is to suggest an approach for defining a workstation rotation system, which reduces MSD risk factors, and to list parameters enabling an efficient system to be set up. To achieve this, an ergonomic study was conducted on two household electrical appliance assembly lines subject to workstation rotation.

2. Methodology

The two production lines (A and B) are dedicated to assembling a range of ovens. Workstation type and distribution as well as psychosocial context are similar on both lines. Two workstation rotation systems can be observed on each line: a so-called large system embracing the assembly stations and a second one called the shell system. This rotation had been set up several months prior to the study. There are 38 operators on the two lines. They remain approximately 2 h at each station and change stations during work breaks.

The methodology included the use of a questionnaire during an interview conducted among 38 employees as well as a detailed description of the rotation of line B and a study of the biomechanical risk factors and the work actions of each of the workstations comprising it.

2.1. Interviews

Firstly, all the operators on the two assembly lines were asked to complete a questionnaire comprising 52 questions taken mainly from INRS's MSD questionnaire (Cail et al., 2000). The researchers carried this out during a personal interview with the operators.

This questionnaire allows the target population to be analysed in terms of age, length of service, type of contract and level of multiskilling.

The questionnaire also addresses state of health by means of 11 closed questions taken from the Nordic questionnaire (Kuorinka et al., 1987). These questions enable the health problems experienced by employees in nine anatomical regions (neck, upper back, lower back, right shoulder, left shoulder, right elbow, left elbow, right hand/wrist, left hand/wrist) to be researched.

State of psychological stress is assessed through a single question, namely "Do you feel stressed at present?", with three response options: "not stressed", "moderately stressed" and "very stressed".

The questionnaire also focuses on perception of psychosocial factors represented by workload (three questions), pressure of work (two questions), participation (three questions), monotony (two questions) and work satisfaction (one question). The operator has five options of