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Forms of work organization and associations with shoulder disorders: Results from a French working population

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ABSTRACT

The aim of this study was to identify forms of work organization in a French region and to study associations with the occurrence of symptomatic and clinically diagnosed shoulder disorders in workers. Workers were randomly included in this cross-sectional study from 2002 to 2005. Sixteen organizational variables were assessed by a self-administered questionnaire: i.e. shift work, job rotation, repetitiveness of tasks, paced work/automatic rate, work pace dependent on quantified targets, permanent controls or surveillance, colleagues' work and customer demand, and eight variables measuring decision latitude. Five forms of work organization were identified using hierarchical cluster analysis (HCA) of variables and HCA of workers: *low decision latitude with pace constraints, medium decision latitude with pace constraints, low decision latitude with low pace constraints, high decision latitude with pace constraints* and *high decision latitude with low pace constraints*. There were significant associations between forms of work organization and symptomatic and clinically-diagnosed shoulder disorders.

1. Introduction

Several models of work systems coexist in industrial and service sectors, such as the Japanese lean production (or Toyotism), the American human resource model, the Swedish sociotechnical systems, the Italian flexible specialization and the German diversified quality production (Coutrot, 1998; Drago, 1995). They differ according to the target market (mass consumption, niche market, upscale, etc.), the work organization (defined by Hagberg et al. as the more "objective aspects of how the work is organized, supervised and carried out" (Hagberg et al., 1995), such as for example the application of an ISO quality standard, teamwork, job rotation, autonomy), human resource management (modality of payment, training, etc.) and professional relations (trade union, participation, etc.). For example, lean production aims to eliminate waste and is based on several principles including Total Quality Management (TQM) and just-in-time (JIT) (Brännmark and Håkansson, 2012; Coutrot, 1998; Koukoulaki, 2014; Landsbergis et al., 1999). However, all production systems tend to offer more flexibility and reactivity to the market and customer demands and can, according to some studies, lead to work intensification (Westgaard and Winkel, 2011; European Foundation for the Improvement of Living and Working Conditions, 2003).

Musculoskeletal disorders (MSDs) are the most commonly occurring occupational diseases in France, representing 87% of occupational diseases (45079 cases) in 2014 (Assurance maladie - Risques professionnels, 2015). Shoulder disorders represented 29% of all MSDs. The shoulder is the second most frequent location of MSDs, after the wrist/hand locations (40%) but it causes longer periods of absence from work, loss of productivity and higher economic costs for employers (Hopman et al., 2013; Kuijpers et al.,

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2004; van der Windt et al., 2000; van Rijn et al., 2010).

Most studies of the risk factors for shoulder disorders have focused on direct biomechanical risk factors (e.g. postures, vibration) determining the mechanical load applied to soft tissues. Some studies have taken psychosocial risk factors into consideration, classically defined by Hagberg et al. as "the subjective perceptions of work organizational factors" and how they are perceived by workers (Hagberg et al., 1995). Most epidemiological studies in the literature refer to the models of stress at work such as the Job Demand Control (JDC) model and the Effort-Reward Imbalance (ERI) model. However, few have studied the influence of factors related to the work organization. Factors related to the work organization correspond to many dimensions (e.g. processes, rotation, links with hierarchy, training) and can be evaluated by consulting the company's internal documents and by interview or self-administered questionnaire for the management (Amossé and Coutrot, 2008; Amossé et al., 2014; Härenstam et al., 2004) or workers (Carayon, 1994; Engkvist et al., 2001; European Foundation for the Improvement of Living and Working Conditions, 2012). Hagberg et al. indicated that "organizational and psychosocial factors may be the same (e.g. career structuring in an organization), but psychosocial factors carry 'emotional' value for the worker".

Several conceptual models linking work organization and MSDs have been developed (Bellemare et al., 2002; Carayon et al., 1999; Karsh, 2006; Sauter and Swanson, 1996). Our research group has proposed a multidimensional conceptual model of MSDs for the purpose of epidemiological studies (Roquelaure, 2016). According to these models, the work organization is a major determinant of biomechanical and psychosocial constraints. For example, the temporal (cycle time, work/rest period, etc.) and physical (workstation dimensions, loads and force level required, etc.) characteristics of the work situation determine exposure to biomechanical factors (Askenazy et al., 2002; Askenazy and Caroli, 2010; Brännmark and Håkansson, 2012; Koukoulaki, 2014; Landsbergis et al., 1999; St-Vincent et al., 2014; Westgaard and Winkel, 2011). Similarly, work organization and management practices influence work-related psychosocial factors by determining the human resources allocated to the production activity, and also the quality of work relationships and social support. Factors related to work organization therefore determine the main risk factors for MSDs (i.e. biomechanical and psychosocial factors) and can be considered as indirect risk factors for MSDs. For example, the pace of work production determines the repetitiveness of arm movement, and consequently it is important to act on the pace of work in order to reduce the repetitiveness and thus reduce the risk of MSDs. Work organization and management practices influence not only work-related constraints, but also individual resources to interact with their work environment and to cope with these constraints (Lazarus, 1991; St-Vincent et al., 2014). Indeed, as suggested by Sauter & Swanson (Sauter and Swanson, 1996), the development of musculoskeletal symptoms is mediated not only by physiological strain of the soft tissues, but also by a complex of cognitive processes involving the detection and labelling/attribution of somatic information as symptoms of MSDs. The latter psychological mechanisms have a major role in the appearance and prognosis of MSDs (Bongers et al., 2006), but are difficult to evaluate by epidemiological studies.

There is conflicting evidence regarding the relationships between organizational practices (e.g. application of an ISO quality standard, teamwork, quality circles, job rotation) and the risk of MSDs (Askenazy and Caroli, 2010; Askenazy et al., 2002; Brännmark and Håkansson, 2012; Ferreira Júnior et al., 1997; Landsbergis et al., 1999; Marklund et al., 2008; Westgaard and Winkel, 2011). Using the data of the epidemiologic MSD surveillance system in the Pays de la Loire region (Loire Valley district, west-central France) (Ha et al., 2009), we studied the role of biomechanical, psychological and organizational factors in MSDs. We showed no or moderate associations between organizational (e.g. work pace dependent on automatic rate, work with temporary workers) and psychological factors (e.g. high psychosocial demand, low decision authority, low social support) and shoulder disorders, biomechanical factors being predominant (Bodin et al., 2012a, 2012b, 2012c; Roquelaure et al., 2011).

Nevertheless work organization cannot be summarized in a single variable which could wrongly express several embedded dimensions, such as teamwork, job rotation and autonomy (Caroly et al., 2010). A few studies have identified forms of work organization based on several organizational and psychosocial variables using classification methods (Amossé and Coutrot, 2008; Amossé et al., 2014; Carayon, 1994; Daubas-Letourneux and Thébaud-Mony, 2002; Engkvist et al., 2001; Härenstam et al., 2004; Leijon et al., 2006; Lorenz and Valeyre, 2005; Valeyre, 2006; Valeyre et al., 2009), but none has focused on the risk of shoulder pain.

We hypothesize that some forms of work organization with high organizational constraints carry more risk for shoulder disorders than others. Identifying such forms of work organization more accurately could be useful to improve understanding of the relationships between work organization and MSDs, in particular shoulder disorders. From a practical point of view, organizational factors might be levers for action for ergonomists to reduce exposure to biomechanical and psychosocial factors and thus reduce the prevalence of shoulder disorders. This could help ergonomists to implement preventive actions for workers exposed to these deleterious forms of work organization (Roquelaure, 2015).

The aim of the present epidemiological study was first to identify forms of work organization characterized by patterns of organizational and psychosocial variables in a sample of French workers, and secondly to compare symptomatic and clinically-diagnosed shoulder disorders according to these different forms of work organization.

2. Methods

2.1. Participants

This cross-sectional study was based on a large sample of workers of the Loire Valley region (West Central France, French Public Health Agency). All salaried workers in France, including temporary and part-time workers, undergo a mandatory health examination by an occupational physician (OP) in charge of the medical surveillance of a group of companies. All OPs practicing in this region between 2002 and 2005 were invited to participate, and 83 of them (18%) volunteered to take part in the study. Workers were selected at random, following a two-stage sampling procedure: first, 15 to 30 half-days of scheduled examinations for each OP were chosen for sampling by the investigators. Next, each OP was asked to randomly select one from the scheduled ten workers on the selected half-days of worker examinations (Roquelaure et al., 2006). The selected workers were then examined by the OPs. A total of 3710 workers were included (2.0% of workers surveyed by the 83 OPs). Comparison of their socio-economic status with the French census (1999) (http://www.insee.fr) showed no major differences for either gender. Overall, the distribution of occupations was close to that of the regional workforce, except for the few occupations not surveyed by OPs (e.g., shopkeepers and independent workers) (Roquelaure et al., 2006).

Craftsmen, salesmen and managers who are mainly self-employed workers can decide for themselves about their work organization, and thus they were not comparable to salaried workers. Moreover, there were very few ($n = 16$) and thus were not