Applied Ergonomics 58 (2017) 386–397

Contents lists available at ScienceDirect

Applied Ergonomics

journal homepage: www.elsevier.com/locate/apergo

Review article

Job rotation designed to prevent musculoskeletal disorders and control risk in manufacturing industries: A systematic review

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ARTICLE INFO

Article history:
Received 17 November 2015
Received in revised form
27 July 2016
Accepted 29 July 2016

Keywords:
Task rotation
Ergonomics
Industrial workers

ABSTRACT

To better understand job rotation in the manufacturing industry, we completed a systematic review asking the following questions: 1) How do job-rotation programs impact work-related musculoskeletal disorders (MSDs) and related risk control for these MSDs, as well as psychosocial factors? and 2) How best should the job rotation programs be designed? We searched MEDLINE, EMBASE, Business Source Premier, ISI Web of Knowledge, CINAHL, PsyINFO, Scopus, and SciELO databases for articles published in peer-reviewed journals. Eligible studies were examined by two independent reviewers for relevance (population of manufacturing workers, outcomes of musculoskeletal disorders, physical factors, psychosocial factors, and strategies used in job-rotation implantation) and methodological quality rating. From 10,809 potential articles, 71 were read for full text analysis. Of the 14 studies included for data extraction, two were non-randomized control trial studies, one was a case-control study, and 11 were cross-sectional comparisons. Only one, with a case-control design, was scored with good methodological quality. Currently, weak evidence exists supporting job rotation as a strategy for the prevention and control of musculoskeletal disorders. Job rotation did not appear to reduce the exposure of physical risk factors; yet, there are positive correlations between job rotation and higher job satisfaction. Worker training has been described as a crucial component of a successful job-rotation program. The studies reported a range of parameters used to implement and measure job-rotation programs. More rigorous studies are needed to better understand the full impact of job rotation on production and health.
PROSPERO register: CRD42014013319.

Contents

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http://dx.doi.org/10.1016/j.apergo.2016.07.018
0003-6870/

1. Introduction

Job-rotation programs emerged in the 1980s and 1990s as organizational strategies aimed at increasing the performance and the flexibility of workers (Cristini and Pozzoli, 2010; Kernan and Sheahan, 2012). These programs have often been adopted by engineers and managers to reduce time and production costs (Azizi and Liang, 2013; Corominas et al., 2006; Moreira and Costa, 2013). The initial motivations for implementing job-rotation programs were part of a lean production system and total quality, focused on the need for more workers with more autonomy (Corominas et al., 2006; Cristini and Pozzoli, 2010).Job-rotation programs are also frequently recommended to mitigate continuous exposure to risk factors for musculoskeletal disorders (MSDs) (Comper and Padula, 2014; Leider et al., 2015a; Mathiassen, 2006).

The definitions for job rotation are many and vary according to the purpose for which this strategy is adopted. In terms of management, it can be defined as alternating workers between tasks and jobs that require different skills and responsibility (Huang, 1999). In terms of MSD risk control, job rotation is defined as a strategy for alternating workers between tasks with different exposure levels and occupational demands (Howarth et al., 2009; Jorgensen et al., 2005), which aims at avoiding overloading specific body parts (Mathiassen, 2006).

The specifics in planning and implementing job-rotation programs vary across each professional sector, which is essential to the success of the intervention (Frazer et al., 2003). The success depends also on training workers in several jobs and defining the specific parameters needed to generate the most effective job rotation in risk control and prevention of MSDs (Leider et al., 2015b). In order to be successful, the planning and implementing needs to identify physical, cognitive, and organizational demands; to determine exposure levels; and to evaluate and define how the job-rotation schedule will be created. All workers should then be trained in each job to develop competence and skills and to ensure process and product quality (Guimaraes et al., 2012). The planning and implementation needs to also consider how other factors, such as psychosocial (e.g., job satisfaction, engagement) and environmental factors can affect worker health outcomes and the success of the health promotion and prevention programs (Ho et al., 2009; Park and Jang, 2010).

There are numerous reasons justified by the manufacturing industry and described in the literature for using job rotation as an ergonomic organizational strategy (Corominas et al., 2006; Jorgensen et al., 2005). As a result, studies that have evaluated the effects of job rotation do not always use the same criteria to evaluate the positive or negative aspects of this intervention, leading to challenges in practical application for practitioners and researchers.

The review presented here aims to identify evidence for the benefits of job rotation on improving musculoskeletal health and to investigate whether or not this evidence varies across different implementation designs. The definition of job rotation used in this study is the rotation of workers in tasks with different exposure levels and job demands for workers who have a daily work period of 8 h (480 min), with a break for lunch.

The specific questions addressed in this review are:

1. What is the effect of job rotation in manufacturing workers? In terms of:
   a) specific work-related musculoskeletal issues (disorders, complaints, injury, pain, discomfort)
   b) risk control for MSDs, specifically exposure to physical load (posture, force, biomechanics, fatigue, effort exertion)
   c) psychosocial work factors (job satisfaction, stress, job control, engagement)
2. How should such job-rotation programs be designed?

2. Methods

2.1. Search strategy

Independent searches were conducted in electronic databases: MEDLINE, CINAHL, EMBASE, Business Source Premier, ISI Web of Knowledge, PsyINFO, Scopus, and SciELO, in the English language, with no restriction on publication data. The search terms were defined based on the list of terms used in the systematic review studies of the Institute for Work and Health (IWH) and the National Institute for Occupational Safety and Health (NIOSH). The search terms were grouped into three categories according to the principles of PICO: *population*, *intervention*, *comparison*, and *outcomes*. The following includes examples of the group terms: *population* (*workers* or *employees*), *intervention* (*job rotation* or *task rotation*), and *outcomes* (*musculoskeletal disorders* or *work ability*). The groups of terms used for search strategies can be seen in Appendix 1. The last search was completed on October 17, 2014.

2.2. Inclusion and exclusion criteria

The eligible studies contained the following criteria: (1) the population of manufacturing workers; (2) exposures to known risk factors (biomechanical overload, repetitive tasks, fatigue, posture at work, force, etc.), MSDs (pain, discomfort, injury, absence from work, absenteeism), and psychosocial factors (job satisfaction, stress, job control, engagement); (3) written in English; (4) full text papers published in peer-reviewed journals; and (5) designed observational studies: cohort, case-control, randomized control trial, and cross-sectional. Excluded studies comprised the following: outcomes of productivity and costs only, outcomes that were assessed through qualitative methods only, studies in which the definition of job rotation was different from our aforementioned definition, and those that evaluated the variability of factors within a single given task without changing tasks. The design of