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A four-year follow-up study of physical working conditions and perceived mental and physical strain among food industry workers

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ABSTRACT

This study hypothesized that in a longitudinal setting deteriorating physical working conditions increases the perceived physical and mental strain among food processing employees. The study was conducted in 2003 and 2007. It examined 248 blue-collar workers, all of whom were in the same occupation throughout the entire follow-up period. The data were obtained through a structural questionnaire distributed to the employees at the workplace. Mental strain had increased (7%) significantly among younger employees during the follow-up. The changes in mental strain for the younger employees were positively associated with the changes in physical strain. The changes in physical strain were also significantly associated with the changes in physical working conditions among both younger and the older workers. The results of this study partly support the study hypothesis, namely that deteriorating physical working condition increases physical strain and also increases mental strain, especially among younger employees.

1. Introduction

Although the demands of work have changed from physical to more mental demands in recent decades (Frese, 2000; Sutela, 2007), there are still branches where the physical demands are heavy. Food manufacturing is an example of such branches where the work still includes a lot of lifting and carrying, repetitive movements and other heavy physical load. The work environment of the food processing industry is also characterized by low and high temperatures, draught, noise and poor lighting which are risk factors for early cessation of working life, especially in that industry (Salonen et al., 2003). Additionally, in many situations the environmental factors and physical factors may act independently or collectively as stressors (LaDou, 2007). As a result, repetitive strain injuries are the most prevalent work-related diseases in the food processing industry in Finland (Riihimäki et al., 2004).

Industrial workers are most exposed to job strain (Nicot, 2007). The high job strain is mostly due to the physical work environment in the industry. Several other studies have reported that physical working conditions, especially heavy lifting and uncomfortable work postures are associated with sick-leave (Laaksonen et al., 2010; Lund et al., 2006; Allebeck and Mastekaasa, 2004). Consequently, the risk for sick leaves and early retirement is typically increased in such working conditions (Ilmarinen et al., 1997; Nygård et al., 2005; Sell, 2009). Food industry workers have been shown to have twice as much sick leave as the average among industry workers in Finland and the EU (Ilmarinen, 1999; Vahtera and Kivimäki, 2004; Gimeno et al., 2004). The branch is also at the top of the early retirement statistics (Salonen et al., 2003; Ilmarinen et al., 1997).

Our study was based on a four-year follow-up of stress and strain in four food processing factories. The stress-strain concept (Rutenfrantz, 1981; Cox et al., 2000) assumes that the stress on a worker depends on objective environmental factors acting upon the person, whereas strain denotes the effects of stress which will be individually different. The use of the stress-strain concept is practical in the study of the effect of physical workload on the cardiovascular system which is directly related to the individual's physical work capacity (Rutenfrantz, 1981). It also emphasizes the role of individual characteristics such as age, gender, and health status and work ability as modifiers of the relationship between physical working condition and strain. Work ability is a comprehensive concept for occupational health research and prevention (Ilmarinen, 2009). The relationship between the physical strain and heart rate depends on the type of muscular

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Table 1
Attrition of the study cohort ($N = 603$) from the baseline survey in 2003 to the follow-up survey in 2007 by age, gender and baseline working conditions.

	Resigned in 2007		Non-respondent in 2007		Respondent in 2007	
	$N = 126$	Percentage	$N = 229$	Percentage	$N = 248$	Percentage
Age						
<45 years	89	72	138	60	170	69
≥45 years	37	28	91	40	78	31
Gender						
Female	89	71	166	72	173	70
Male	37	29	63	28	75	30
Working conditions (mean, SD)						
Physical (3–15)	9.53 (2.78)		9.09 (2.78)		9.08 (2.83)	
Environmental (6–30)	17.52 (3.59)		17.22 (4.05)		17.28 (4.02)	

work (Ilmarinen, 1984). Heart rate at a given physical strain is the highest in industrial work that also includes much static work (Ilmarinen, 1978). Moreover, the associations of work stressors and individual stress symptoms with work ability are unclear: there seems to be a strong effect in particular among the aging (Tuomi et al., 1991), but there are also studies (Gamperiene et al., 2008) that have not found a relation between physical strain and work ability. Also, the physical working conditions among younger and older workers are poorly understood, as some previous research concluded that in the same occupation younger workers are at greater risk of physical strain than older workers (Pailhe, 2005). But the subjects of the aforementioned study were not only the blue-collar but also the others who were working in different job settings. Another study by Nygård et al. (1997) reported higher strain among older municipal employees in both blue- and white-collar jobs.

Although many studies have previously assessed the association between work environment and strain, the association between changes in physical working conditions and parallel changes in perceived strain has rarely been studied before. One of the experimental study found that physical capacity is adversely affected by mental stress (Mehta and Agnew, 2012) and that also mental stress adversely affect biomechanical responses during low back exertion (Marras et al., 2000). Our study is an original contribution to studies of the links between physical working conditions and perceived strain among food industries workers. We hypothesized in this study among industrial blue-collar workers that; a) deteriorating (negative changes) of the physical working condition increases the perceived physical and mental strain among younger and older workers and b) the perceived mental and physical strain interact with each other among younger and older workers.

2. Method

2.1. Study subjects

The study subjects were employees from four factories and from one office department of a food industry company employing more than 2000 people in Finland. Food processing is a universal industry, employing substantial number of workforce, e.g. in Finland, 34,000 workers (1–2% of the workforce) (Neupane et al., 2013a). The questionnaires were distributed in the workplaces, filled in during working hours, and the closed response envelopes were collected and sent to the researchers. A questionnaire survey was conducted among all employees of the company in spring 2003 ($N = 1995$, 1581 blue-collar and 414 white collar employees) with a response rate of 56% ($N = 1220$). Of the respondents, 71% ($N = 861$, 603 blue-collar and 258 white-collar employees) gave consent to being identified. The majority of the blue-collar employees were working in food processing and maintenance departments, which entails muscular work with a lot of lifting and carrying, while majority of white-collar employees worked in the management department (Neupane et al., 2013a, 2013b). The 603 blue-collar employees are the cohort of interest in the present study. In a corresponding survey in 2007, 126 of them were no longer in the service of the company; among those who had not resigned, the response rate was 52% ($N = 248$). Their mean age at the beginning of the follow-up was 39 years (SD = 9.5) ranging from 20 to 60 years, and 70% of them were women which is similar to European statistics where food manufacturing blue-collar workers are mainly female dominated (Eurofound, 2012). Statistics on sample attrition revealed that non-respondents were somewhat younger than the other groups, there was no gender difference, and the working conditions at baseline tended to be worse among those who had resigned between the surveys visits (Table 1). The study was approved by the ethical committee of Pirkanmaa Hospital District, Tampere, Finland.

2.2. Measurement of strain

Perceived mental strain was assessed by a modified version of the occupational stress questionnaire (Elo et al., 1992), using a single question ("Stress means a situation in which a person feels excited, apprehensive/concerned, nervous or distressed or she/he cannot sleep because of the things on her/his mind. Do you feel this kind of stress nowadays?") (Elo et al., 1992), with the reply scale from 0 (not at all) to10 (very much). Perceived physical strain was elicited with the rating of perceived exertion (RPE) with the question "How physically hard/exhausting do you feel your job is on a normal work day?" on a scale from 6 (not at all) to 20 (very much) (Borg, 1970) Box 1.

2.3. Measurement of physical working conditions

Factors in the physical working condition were asked by the question "Do the following factors increase your strain at your work? draught, noise, poor indoor climate, hotness, coldness and blinding lighting" on a scale going from 1 (very little) to 5 (very much) (Lehto and Sutela, 2009). In our study, the variable describing environmental factors was summed into a single variable ranging from 6 to 30. In a similar way, the variable describing physical working conditions (restless work environment, repetitive movements, bent or twisted working postures) was asked in a scale 1 (very little) to 5 (very much) and the answers summed up into a variable ranging from 3 to 15 (Virtanen et al., 2008). The Cronbach's alpha from the reliability test of the sum measures for physical working condition was 0.80 and environmental factors were 0.78.