Authors:	Neupane Subas, Virtanen Pekka, Luukkaala Tiina, Siukola Anna, Nygård Clas-Håkan
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Physical and mental strain in the food industry: A 4-year follow-up study

Neupane S, Virtanen P, Luukkaala T, Siukola A, Nygård C-H

School Health Sciences, University of Tampere, Finland

Abstract

This study examined the associations between working conditions and the changes in strain among food processing employees. Blue-collar (n=248) workers aged from 20 to 60 years were followed. Mental strain had increased significantly whereas physical strain remained unchanged at follow-up. The changes in mental strain for the older employees were positively correlated with the changes in physical strain (β = 0.25, p=0.05). We conclude that the increase in unfavorable ergonomics may increase physical strain but may also increase mental strain, especially among older employees.

Key words: Mental strain, physical strain, physical factors, food factory, follow-up study

Introduction

Food manufacturing is a branch where the work still includes a lot of lifting and carrying, repetitive movements and other heavy physical loads. The work environment of the food processing industry is characterized by extreme temperatures, draught, noise and bad lighting, which are risk factors for early retirement from working life (1). The most prevalent group of work-related diseases in the food processing industry in Finland is repetitive strain injuries (2). This indicates that food industry workers are highly susceptible to strain in the hands, wrists, and elbows. The risk for sick leaves and early retirements is typically increased in such of working conditions (3-5), and food industry workers have been shown to have twice as many sick leaves as the average among industrial workers in Finland and the EU (6-8). Indeed, the branch is also at the top of the early retirement statistics (1, 3). As regards the associations of physically stressful working conditions to strain among the workers, the food processing industry serves as a good source for research material. The aim of the present study was to analyze whether changes in the work environment and ergonomics are related to changes in physical and mental strain.

Materials and methods

Study setting and data

The study subjects were employees from four factories and from the office department of a food industry company in Finland. A questionnaire survey in the company in 2003 yielded, with the response rate 77%, 1,120 respondents and the corresponding figures were 90% and 1,564 respondents in the follow-up 2007. This study concerns the blue-collar employees (N= 248) who responded to both questionnaires. Their mean age was 39 years (SD=9.5) ranging from 20 to 60 years at the beginning of follow-up. The study was approved by the ethical committee of Pirkanmaa Hospital District.

Measures

Strain:
Mental strain was assessed by a single question ("Strain means the situation in which a person feels excited, apprehensive/concerned, nervous or distressed or she/he can't sleep affected by the things on her/his mind. Do you feel this kind of strain nowadays?") with reply options from 0 (not at all) to 10 (very much). The question from Borg (9), with a scale from 6 (not at all) to 20 (very much), was used to measure physical strain.

Working conditions:
The variable describing environmental exposure was constructed of the questions concerning draught, noise, bad indoor climate, heat, cold and blinding light by summing up the replies (scaled from 1=not at all to 5=very much) into a single variable ranging from 6 to 30. In a similar way, the variable describing ergonomics was summed up of the questions concerning repetitive movements, uncomfortable working postures and restlessness into a variable ranging from 3 to 15.

Statistical methods
Changes in strain during follow-up were calculated by subtracting the values for 2003 from the values for 2007. Associations between changes in ergonomics and environmental exposure with the changes in mental and physical strain were first studied with Spearman's correlation coefficients. Then corresponding multifactorial analysis was conducted using linear regressions with the Enter method, with age, gender and work ability in the model. Perceived work ability was assessed on a scale from 0 (poor) to 10 (excellent) (10). Distributions of the change from 2003 and 2007 were shown as means and standard deviations and tested by paired samples t-test. We were particularly interested in studying aging workers; therefore the participants were divided into those aged 45 or under (young) and those over 45 years (old) (11).
Statistical analyses were performed using SPSS for Windows version 16.0.2.

Results

Table 1 describes that environmental exposure and ergonomics remained almost unchanged during follow-up. Mental strain had increased significantly (p = 0.04) whereas physical strain remained unchanged.

Table 1. Descriptive statistics of the participants (n=248) and means of the variables at baseline in 2003 and at follow-up in 2007.

Variables	Baseline	Follow-up	P- value[1]
Gender			
Men	30 %	-	
Women	70 %	-	
Age			
All (Mean)	39 yrs		
≤45 yrs	68.5 %	-	
>45 yrs	31.5 %	-	
Work ability (mean, SD) (0-10)	8.39 (1.18)	8.37 (1.28)	0.60
Work environment (mean, SD)			
Ergonomics (3-15)	9.08 (2.83)	8.95 (2.88)	0.79
Environmental exposure (6-30)	17.28 (4.02)	17.15 (4.11)	0.41
Strain (mean, SD)			
Physical (6-20)	14.47 (2.93)	14.49 (3.05)	0.93
Mental (0-10)	3.67 (2.52)	4.07 (2.82)	0.04

[1] P-value tested from paired sample t-test

Table 2 shows the un-standardized β – coefficients with 95% confidence intervals and p-values from age, gender and work ability adjusted linear regression models. The change in mental strain was correlated with the change in physical strain among older workers (β = 0.25, p=0.05). As to the change in physical strain, statistically significant correlations were seen with the changes in ergonomics both among the young and the old workers, and there was also a significant correlation with the change in mental strain among the older employees.

Table 2. Associations of the change in mental or physical strain, change in ergonomic and environmental factors for change in mental and physical strain from 2003 to 2007 separately for workers under 45 and older than 45 years. Adjusted linear regression models with enter method (N=248).

	Change in mental strain					
	≤45 yrs (n=170)			**> 45 yrs (n=78)**		
	Un-standardized coefficient β	(95% CI) for β	P[2]	Un-standardized coefficient β	(95% CI) for β	p
[3]Change in physical strain	0.06	-0.08-0.21	0.40	0.25	0.00-0.51	0.05
Change in ergonomics	0.16	-0.03-0.36	0.09	0.10	-0.27-0.49	0.57
Change in environmental exposure	0.04	-0.07-0.15	0.46	-0.02	-0.23-0.19	0.85
	Change in physical strain					
	≤45 yrs (n=170)			**> 45 yrs (n=78)**		
	Un-standardized coefficient β	(95% CI) for β	p	Un-standardized coefficient β	(95% CI) for β	p
[4]Change in mental strain	0.06	-0.09-0.22	0.40	0.22	0.00-0.45	0.05
Change in ergonomics	0.26	0.06-0.46	<0.01	0.30	0.04-0.74	0.02
Change in environmental exposure	0.05	-0.06-0.17	0.34	0.02	-0.17-0.22	0.82

The linear regression model was adjusted for age, gender and changes in work ability

[2] P-value; the level of significance is 5%

[3] Exposure variable for outcome changes in mental strain

[4] Exposure variables for outcome changes in physical strain

Discussion

In this study we found an association between a change in unfavorable ergonomics and changes in physical strain among both the young and among the older workers, whereas the associations of environmental exposure with both the physical and the mental strain proved non-significant.

In our study changes in ergonomic stress were positively correlated with the changes in physical strain. Employees in the food factory often stand for long periods and may be required to lift heavy objects or use cutting, slicing, grinding, and other dangerous tools and machines, which may be non-ergonomic. Tuomi (12) explained that people involved in high physical demands at work, poor physical environment and poor work postures were more physically strained than other people. Within occupations with comparable work demands for all employees, individual differences in e.g. actual working methods may finally result in a variation in working postures (13, 14) and add to the strain.

The high physical strain among the employees is important. The physical strain in this study had not changed at follow-up despite the technical changes in the working environment intended to improve the ergonomics during the follow-up years, for instance modernization of the production lines. However, mental strain had increased significantly during follow-up, which could be due to changes in environmental conditions which are considered the prime cause of mental strain (15). Thus, awareness of problematic ergonomics is important, in particular because food processing work includes many females and there are also older people. It has been shown (16) that older employees experience more strain than younger employees. Our study also shows higher perceived physical strain among younger employees than their older counterparts.

This study might have some bias because all the information regarding mental and physical strain and perception of work environment was collected using a questionnaire, i.e. no objective measurements for the work environment were taken. The study concerned only the food

processing industry, and the specific environment and homogenous employee group are one of the strengths of the study. There is a need for future research with corresponding design, as other types of workplaces may have different challenges in the physical environment and different strain-physical environment interaction. It can be concluded that the increase in unfavorable ergonomics may increase physical strain but also increase mental strain, especially among older employees.

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