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Prospective study of physical and psychosocial risk factors for sickness absence

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Aim To investigate the associations between psychosocial and physical work environment exposures and sickness absence from work taking into account health, health behaviour and employer characteristics known to affect sickness absence.

Methods In 1995, a random sample of 5574 employees aged 18–64 years were interviewed. In 2000, 3792 of those still employed supplied data on days absent from work the year preceding the date of follow-up. Associations between risk factors at baseline and sickness absence at follow-up were studied. Logistic regression analyses were performed.

Results Sickness absence was associated with working with arms lifted/hands twisted, extreme bending/stooping of the back/neck, repetitive monotonous work, low skill discretion, low decision authority, obesity, current and former smoking, poor self-rated health, female gender, increasing age and public employer. The aetiological fraction attributable to differences in work environment exposures was calculated to be 40%.

Conclusion The study suggests a potential for reducing sickness absence through multifactorial interventions towards smoking, obesity, physical and psychosocial work environment exposures. The study showed that differences in work environment exposures account for 40% of the cases of high sickness absence.

Key words Aetiological fraction; Denmark; employer characteristics; sickness absence; work environment.

Introduction

A wide variety of physical work environment exposures related to uncomfortable work positions, monotonous movements and high physical demands have been found to be associated with sickness absence [1,2]. In addition, psychosocial work environment exposures such as low job satisfaction, low decision latitude, lack of control and high demands have been associated with sickness absence [1,3–7]. Only a few studies have analysed for the effects of psychosocial and physical exposures simultaneously [8], and even fewer provide estimates for the effects of health and health behaviour at the same time [3]. It is important to identify risk factors on all levels, given the complexity in the network of stakeholders, institutions and system-specific characteristics associated with sickness absence [9].

Health is naturally associated with sickness absence, and global health measures such as self-reported health have been proven as predictors of sickness absence in previous studies [10].

The aim of the study was to investigate associations between psychosocial and physical work environment exposures and sickness absence from work 5 years after exposure among Danish employees, taking into account health, health behaviour and employer characteristics known to affect sickness absence. A secondary aim was to estimate the potential gain in sickness absence reduction through work environment improvement.

Methods

The study was based upon the Danish Work Environment Cohorts Study [11]. In 1995, a random sample of 5574 employees aged 18–64 years were interviewed regarding work environment exposures, health behaviour, employer characteristics, health, age and gender. These measurements constituted the baseline of this study. The subjects had no self-reported sickness absence 2 months prior to baseline measurements. In 2000, the cohort was reinterviewed regarding work status and days absent from work the year preceding the date of follow-up.

The outcome of this study, 'high sickness absence in year preceding follow-up', was based on self-reported days of sickness absence the year preceding the date of

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follow-up using one question: 'How many workdays in total have you been sickness absent within the last 12 months?'

The outcome was dichotomized into high (>6 days in the last 12 months) and low (≤6 days in the last 12 months) sickness absence according to the mean of the distribution.

Physical exposures were measured using seven items combined into three scales: extreme bending/twisting of the neck/back, working mainly standing/squatting and work with arms lifted/hands twisted. The scale characteristic is described elsewhere [12].

Psychosocial exposures at work were measured using 18 items combined into five scales: skill discretion, decision authority, social support, job demands and conflicts at work. The first four psychosocial scales were divided into quartiles. The scale for conflicts at work was dichotomized around the mean. The scale characteristic is described elsewhere [13].

Furthermore, the population was classified as having repetitive monotonous work or not [13].

Global self-rated health (SRH) was measured using a single question: 'How do you rate your health in general?' with five response options (very good, good, fair, poor, very poor). In the analyses, SRH was dichotomized with 'very good' and 'good' as one answer category (good) and the remaining three options as the second answer category 'poor' [13].

Smoking status was divided into three categories: current smokers, previous smokers and never smokers. Body mass index (BMI) was divided into four categories: underweight was BMI < 18.5 kg/m^2, normal weight was $18.5 \leq$ BMI < 25 kg/m^2, overweight was $25 \leq$ BMI < 30 and obesity was BMI ≥ 30 kg/m^2.

Employer size was measured by number of employees at the workplace of the respondent in seven categories: '1–4', '5–9', '10–19', '20–49', '50–99', '100–499' and '≥500' employees.

Public or private employer was defined by the workplace being a publicly or privately owned company. The study included data on gender and baseline age of the individual employee. A list of the 16 independent variables used in this study is shown in Table 1.

Logistic regression methods were used to analyse the associations between the risk factors and the outcome variable. The analysis was performed in three stages: initially, univariate analysis was performed to establish the association between each baseline risk factor in 1995 and high sickness absence at follow-up. Risk factors showing a significant association of $P < 0.25$ were selected for further analysis. This relatively high-level of significance was chosen as previous studies have shown that the use of lower levels involves a risk of overlooking important variables due to interacting effects with other variables [14].

The work environment variables selected accordingly entered a basic model controlled for age and gender. Logistic regression with backward elimination was performed for this model, preserving risk factor variables with a level of significance of $P < 0.05$. Exception from this rule was made if elimination of a variable changed the beta estimates of the remaining variables in the basic model by >10% and thereby indicating possible confounding. They were then preserved for further analysis without regard to the P value.

The next stage of modelling combined the reduced work environment model with the introduction of health behaviour and employer characteristics. The third and

Table 1. Variables included as risk factors in 1995 for high sickness absence (above mean) in 2000 (n = 3792)[a]

Risk factor category	Risk factor	P value, univariate models
Work environment	**Extreme bending/twisting of neck/back**	**0.000**
	Work with arms lifted/hands twisted	**0.000**
	Working mainly standing/squatting	**0.004**
	Repetitive monotonous work	**0.000**
	Psychological job demands	0.766
	Decision authority	**0.000**
	Skill discretion	**0.158**
	Social support	0.698
	Conflicts at work	**0.003**
Health behaviour	**Smoking status**	**0.000**
	BMI	**0.026**
Health	**General SRH**	**0.000**
Employer characteristics	**Employer ownership**	**0.034**
	Employer size	**0.232**
Background variables	**Age**	**0.000**
	Gender	**0.000**

[a]Risk factors with P value < 0.25 boldfaced (selected for further analysis).

final step added SRH to the model containing work environment, health behaviour and employer characteristics. All three steps in the final modelling were controlled for age and gender. Finally, in order to evaluate the composite effect of several work environment exposures on high sickness absence, the method of Hosmer and Lemeshow was applied. The population was divided into 10 risk groups of equal size on the basis of the reduced work environment model [14]. The proportion of high sickness absence attributable to differences in work environment exposures—the aetiological fraction—was calculated on the basis of this model: the number of employees with absence days exceeding the number of absence days in the decile with the lowest prevalence of work environment factors was divided by the total number of employees with absence days.

The SAS procedure PROC LOGISTIC (SAS version 8.02) was used to perform the logistic regression analyses.

Results

Of the original sample of 5574, 4556 (82%) persons responded at follow-up. Of these, 684 (15%) were no longer employed and were excluded from the study. They included 347 (51%) receiving pension (73 disability pensioners and 274 old-age pensioners), 136 (20%) in education, 133 (19%) unemployed, 38 (6%) on leave and 30 (4%) engaged in 'other non-work'. Of the remaining 3872 (85%) still employed responders, 3792 persons (98%) answered the question on days of sickness absence.

The 3792 employees reported a total of 23 767 days of sickness absence during the year preceding follow-up (mean = 6.27, range 0–215 days). Of these, 20% of the population accounted for 80% of total days of sickness absence. A total of 1482 employees (39%) reported having 0 days of sickness absence.

Initial univariate analysis showed associations between almost all included risk factors and the outcome. All physical exposure scales and four of five psychosocial exposure scales were associated with the outcome; so were smoking, BMI, SRH, age, gender, employer size and employer ownership. Only psychological demands and social support did not meet the criteria for further analysis (Table 1).

High sickness absence was associated with the following baseline work environment exposures: work with arms lifted/hands twisted (OR = 1.3), extreme bending/stooping of the back/neck (OR = 1.45), repetitive monotonous work (OR = 1.23), low skill discretion (OR = 1.23) and low decision authority (OR = 1.23). In the initial modelling of work environment exposures, decision authority and skill discretion did not obtain statistical significance on a 95% level. However, removing them from the model caused the effect estimates for the physical exposures to change >10%, and decision authority and skill discretion were kept in the model for further analysis. The next step of analysis added health behaviour and employer characteristics. Analysis showed that high sickness absence was associated with both current (OR = 1.61) and former (OR = 1.32) smoking. Obesity—BMI > 30—also predicted high sickness absence (OR = 1.57). People employed by a public employer had an increased risk (OR = 1.26), whereas employer size had no significant relation. Adding these variables to the model only affected the work environment exposure estimates marginally.

In the last step, baseline SRH was added to the model. Poor SRH predicted high sickness absence (OR = 1.69) but had almost no effect on the risk estimates for work environment exposures and health behaviour, indicating that SRH was not an important mediator. The effect of repetitive monotonous work became insignificant at the 95% level, but this covered a change in OR from 1.25 to 1.23 (Table 2). Additional analysis of correlation showed low correlations between SRH and work environment exposures (Pearson correlation coefficients 0.05–0.07), whereas the correlations between the work environment variables were relatively higher (Pearson correlation coefficients 0.1–0.52) (not shown).

In the two extreme 10% composite risk groups, 33% of those exposed to the highest level of composite risk had high sickness absence, whereas the figure was 13% among those exposed to the lowest level of composite risk (Figure 1). The aetiological fraction attributable to poor work environment was calculated: 40% less employees would have high sickness absence, if the work environment was the same for everyone as among the decile of the population with the lowest composite risk.

Discussion

In this study, 20% of the population accounted for 80% of total amount of self-reported days of sickness absence from work. This is compatible with studies from Norway, yielding a similar, skewed 30/70 distribution [15]. The study showed associations between a number of primarily physical work environment exposures and high sickness absence. Two measures of work in uncomfortable positions increased the risk significantly; repetitive monotonous work was borderline significant, whereas skill discretion and decision authority did not reach statistical significance on a 95% level. However, these variables remained in the model, as removal affected the estimates for the other risk factors. The described associations persisted after adjustment for a number of other risk factors, such as age, gender, smoking, obesity and working for a public employer. The study found no effect of employer size, similar to the finding by Lund and Csonka [12]. Findings with regard to smoking are in

Table 2. Risk factors in 1995 for high sickness absence (above mean) in 2000 (n = 3792)*

Risk factor	n	Final model, step 1[a]		Final model, step 2		Final model, step 3	
		OR	95% CI	OR	95% CI	OR	95% CI
Work environment exposures							
Work with arms lifted, hands twisted							
Yes	2058	**1.35**	1.12–1.64	**1.31**	1.07–1.59	**1.3**	1.07–1.59
No	1734	1		1		1	
Extreme bending/twisting of neck/back							
Yes	2410	**1.53**	1.25–1.88	**1.48**	1.3–1.82	**1.45**	1.17–1.78
No	1382	1		1		1	
Repetitive monotonous work							
Yes	626	**1.24**	1.00–1.54	**1.25**	1.00–1.56	1.23	0.99–1.54
No	2776	1		1		1	
Skill discretion							
Lowest quartile	932	1.21	0.9–1.63	1.24	0.91–1.69	1.23	0.9–1.67
Third quartile	748	1.20	0.89–1.61	1.24	0.92–1.68	1.26	0.93–1.71
Second quartile	833	1.17	0.88–1.56	1.21	0.9–1.62	1.2	0.9–1.6
Highest quartile	894	1	1	1		1	
Decision authority							
Lowest quartile	895	1.23	0.96–1.56	1.27	0.99–1.63	1.23	0.96–1.58
Third quartile	883	1.07	0.83–1.37	1.11	0.85–1.43	1.09	0.84–1.4
Second quartile	1179	0.97	0.76–1.25	1.03	0.8–1.32	1.02	0.79–1.3
Highest quartile	450	1	1	1		1	
Health behaviour							
Smoking							
Current	1357			**1.63**	1.34–1.99	**1.61**	1.32–1.96
Former	721			**1.32**	1.04–1.69	**1.32**	1.03–1.68
Never	1329			1		1	
BMI							
Obesity	185			**1.69**	1.18–2.41	**1.57**	1.09–2.25
Overweight	938			1.02	0.83–1.25	1.01	0.82–1.24
Normal weight	2201			1		1	
Underweight	68			0.92	0.51–1.65	0.9	0.5–1.62
Employer characteristics							
Employer ownership							
Public	1371			**1.26**	1.04–1.53	**1.26**	1.04–1.53
Private	2031			1		1	
Employer size							
Decreasing size				1.02	0.97–1.07	1.02	0.97–1.07
Health							
General SRH							
Poor	372					**1.69**	1.29–2.19
Good	3392					1	
Background variables							
Gender							
Female	1672	**1.33**	1.12–1.57	**1.32**	1.09–1.59	**1.31**	1.08–1.59
Male	2120	1		1		1	
Age		**1.01**	1.00–1.02	**1.02**	1.01–1.03	**1.02**	1.01–1.03
1 year incremental steps							

[a]Work environment exposures excluded due to statistical insignificance in the basic work environment model: conflicts at work, working mostly standing/squatting.

*Significant results ($P < 0.05$) boldfaced.

accordance with other studies addressing similar outcomes [3,12,16]. The literature is ambiguous with regard to the effect of employer ownership on sickness absence. Some studies have found private employment to extend absence periods [17,18], whereas the opposite has been found in others [19]. The present study indicated a higher risk of high sickness absence when employed by a public employer. This difference in risk was not attributable to differences in work environment exposures, health behaviour, health status, compositions of sex or

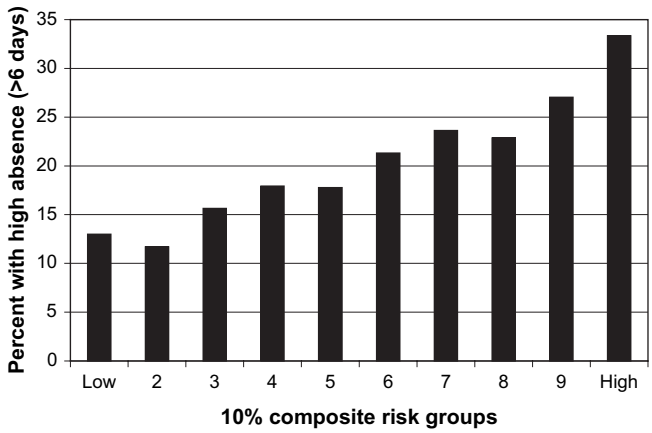

Figure 1. Combined effect of work with arms lifted/hands twisted, extreme bending/stooping of the back/neck, repetitive monotonous work, low skill discretion and low decision authority in 1995 for above mean level of self-reported days of sickness absence during the past 12 months of 2000 among the general working population, $n = 3792$.

age distribution between the two sectors, as this was controlled for in the analysis. Whether the results reflect a more stressful work environment in the public sector causing more sickness absence, differences in absence culture between the two sectors or whether they reflect a larger social responsibility among public employers in terms of retaining sick employees is unknown.

The analysis showed that poor SRH predicted high sickness absence, but the introduction of SRH in the final model did not affect the estimates of the other risk factors. The authors expected a change in the estimates for work environment exposures due to assumed causal relations between (poor) baseline work environment and (poor) baseline SRH [13]. The performed analysis of correlation showed weak correlations between SRH and work environment exposures. One interpretation could be that selection into specific work environments due to poor health and *vice versa* takes place over time, which would not be reflected in the baseline cross-section.

Another important note regarding effects of both work environment and health was that being employed both at baseline and follow-up were criteria for entering the study. This implies that those normally known to have the poorest SRH, poorest work environment and strong associations between work and health, namely receivers of permanent disability benefits or early retirement pension, were not included in this study. This introduces a couple of limitations into the study. It is likely that we underestimated the effects of the studied risk factors on sickness absence, as the most severe cases such as employees becoming disability pensioners during the study period were not included in the studied population. This could furthermore cause underestimation of days of sickness absence. Underestimation of days of sickness absence is discussed in more detail further in this section.

Another limitation derives from collecting the data at two points in time. We have no information on events taking place in the 5 years between baseline and follow-up that might affect the outcome under study. Also, baseline exposures were measured as point estimates, giving no information on duration of exposure.

The study also has important methodological strengths. Firstly, it is based on a large representative sample of Danish employees. Secondly, it covers a 5-year period allowing interpretation of causal relationships between baseline risk factors and outcome at follow-up. Finally, the study includes a broad array of validated scales assessing work environment exposures [12,13], as well as measures of health, health behaviour and employer characteristics.

Among the work environment exposure variables, only the physical exposures obtained statistical significance in the final model. However, removing the psychosocial exposures caused the estimates for the physical exposures to change significantly. One-to-one correspondence between specific occupational exposures and sickness absence is well-documented. Physical work environment exposures were found to be associated with sickness absence in previous studies [1,2] and psychosocial work environment exposures have been found to be associated with sickness absence [1,3–7]. Our result suggests a confounding effect of the psychosocial work environment exposures low skill discretion and low decision authority on the physical work environment exposures repetitive monotonous work, work with arms lifted/hands twisted and extreme bending/stooping of the back/neck.

The use of self-reported data on sickness absence to establish outcome deserves comment. To our knowledge, only a few studies feature comparisons of self-reported data on sickness absence and data from employer records [20–22]. Nearly all report a high specificity of a single question for detecting workers sickness absence. But at the same time, the results suggest not using a recall period of >2 months [21]. For retrospective measurement of sickness absence, there was little agreement on the duration of sickness absence episodes between questionnaire data and data from employer records. Based on these studies and considering the risk of missing values associated with use of questionnaires versus employer records, data on sickness absence gathered from employer records seem preferable as an outcome measure in a trial. This is, of course, dependent on the employer having a reliable registration system of sickness absence episodes. This is not always the case [22]. Also, there are several examples in the literature of studies featuring a recall period of 6 and up to 12 months [23–25].

In relation to the present study, it is noteworthy that the studies comparing self-reported and employer registered data are inconsistent when addressing the possibility of a systematic over- or underestimation of sickness absence using self-reported sickness absence data. It is therefore likely that the identification of the part of the

population contributing to 80% of the sickness absence in this study would have yielded similar results using register-based data.

Conclusions can be drawn on two levels: in relation to future research, this study indicates no confounding effect of SRH on work environment exposure variables, thus suggesting no reason for including global health measures as confounders of work environment effects on sickness absence in prospective cohort studies with a follow-up period as the present study.

In relation to sickness absence reduction, the study suggests a potential for reducing sickness absence through multifactorial interventions towards smoking, obesity, physical and psychosocial work environment exposures. The study showed that differences in physical and psychosocial work environment exposures account for 40% of the cases of high sickness absence.

Conflicts of interest

None declared.

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