Original research

Associations between physical and psychosocial work environment factors and sickness absence incidence depend on the lengths of the sickness absence episodes: a prospective study of 27 678 Danish employees

Sannie Vester Thorsen ![ORCID],[1] Mari-Ann Flyvholm ![ORCID],[1] Jacob Pedersen ![ORCID],[1] Ute Bültmann ![ORCID],[1,2] Lars L Andersen ![ORCID],[3] Jakob Bue Bjorner ![ORCID][1,4,5]

ABSTRACT

Objectives This study examined if the association between work environment factors and sickness absence (SA) depended on the inclusion or exclusion of short-term SA episodes.

Methods We linked the 'Work Environment and Health in Denmark' survey with the 'Danish Register of Work Absences' (n=27 678). Using covariate adjusted Cox regression, we examined the associations between work environment factors and SA by changing the cut-off points for the length of the SA episodes, for example, episodes ≥1 day, ≥6 days and ≥21 days. We examined three physical work environment factors: 'Back bend or twisted', 'Lifting or carrying', 'Wet hands' and three psychosocial work environment factors: 'Poor influence', 'Role conflicts' and 'Bullying'.

Results 'Back bend or twisted' and 'Lifting or carrying' had small significant HRs for SA episodes ≥1 day and large and highly significant HRs for SA episodes ≥6 days and ≥21 days. 'Wet hands' had small significant HRs for SA episodes ≥1 day for both sexes and large and highly significant HR for ≥6 days for women. HRs of all three psychosocial factors were highly significant for SA episodes ≥1 day and ≥6 days for both sexes, and 'Poor influence' and 'Role conflicts' were significant for SA episodes ≥21 days for women.

Conclusions The physical work factors had higher associations with SA when SA episodes of 1–5 days were excluded and focus was on SA episodes ≥6 days. The psychosocial work factors were strongly associated with SA both with and without SA episodes of 1–5 days included in the analyses.

Key messages

What is already known about this subject?
► Poor physical and poor psychosocial work environment factors are associated with long-term sickness absence from work.
► Short-term sickness absence (1–5 days) constitutes a considerable part of the total sickness absence from work.

What are the new findings?
► Physical work environment factors 'Back bend or twisted' and 'Carrying and lifting' were strongly associated with sickness absence of ≥6 days for both men and women, but the inclusion of short-term sickness absence episodes (1–5 days) deflated the association.
► The psychosocial work environment factors 'Role conflict' and 'Bullying' were strongly associated with sickness absence of ≥6 days for both men and women. Including short-term sickness absence episodes of 1–5 days only slightly deflated the association.

How might this impact on policy or clinical practice in the foreseeable future?
► Work environment interventions that reduce strenuous physical work may reduce sickness absence episodes of ≥6 days. Work environment interventions that improve different aspects of the psychosocial work environment may be important in the prevention of sickness absence of all lengths.

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BACKGROUND

In Denmark, 3.6% of all work hours are lost due to sickness absence (SA).[1] The expense of SA benefits alone exceeds 1.3 billion euro per year[2] not counting the additional cost of lost productivity and healthcare expenses. Knowledge about the association between work environment factors and SA is a prerequisite for reducing SA through preventive efforts.

Poor work environment is associated with long-term SA.[3] Psychosocial work environment factors such as low influence,[4 5] low decision authority,[6 7] role conflicts[3 5 8] and exposure to bullying[9] have been associated with long-term SA in several studies. Physical work environment factors such as excessive ergonomic exposures (bending and twisting of neck or back, lifting and carrying, squatting and kneeling, etc) and heavy physical workload have consistently been associated with long-term SA among men and women.[10–12] Exposure of the hands to wet work has been associated with long-term SA in women.[13]

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However, there is no consensus regarding the definition of long-term SA. Earlier, long-term SA has been defined as episodes exceeding 7 days,[14] 14 days,[15] 20 days[4], 30 days[16] or even 56 days[3]. In Denmark, it is estimated that episodes of 1–7 days account for 44% of all SA days.[1] While this percentage may be high, compared with other Nordic countries,[17 18] studies that exclude short-term SA from analyses ignore a large part of the total SA. If short-term SA is unrelated to the work environment, it would make sense to exclude it, since it would only add noise to a study. Most studies have excluded short-term SA, perhaps because data of short-term SA were lacking or perhaps because short-term SA episodes were considered to be caused by diseases that are not or to a lesser extent influenced by the work environment, for example, a influenza or a cold. However, given data on all SA are available, the question arises: should short-term SA be excluded? And if it should, how much of the short-term SA should be excluded? Episodes of 1 day? Episodes less than 7 days? Episodes less than 21 days?

Theoretically, several mechanisms may explain the associations between work environment factors and SA. Work may cause disease or worsen an existing disease. The disease may cause the employee to call in sick because of reduced work ability, required time for treatment or (for infectious diseases) the risk for coworkers or clients/customers. Moreover, for a given level of work ability, the work environment may affect the individual's decision to go to work or to call in sick. SA is a non-specific outcome, potentially influenced by many factors.

Using the Danish Register of Work Absences (RoWA),[19] which include SA of all lengths, the present study systematically examined the associations between work environment factors and SA where SA was defined respectively as SA episodes ≥1, ≥2, ≥4, ≥6, ≥8, ≥12, ≥16, ≥21 and ≥31 days. If short-term SA episodes are primarily related to infectious diseases and not influenced by the work environment, we expect inclusion of short-term episodes to add noise to the analyses and deflate the associations between work environment factors and SA. However, if short-term SA episodes are influenced by work environment factors, we expect strong associations between these work environment factors and SA when short-term SA episodes are included in the analyses.

The present study aims to answer two questions: (1) Do the associations between physical and psychosocial work environment factors and incidence of SA depend on the inclusion/exclusion of short-term SA? and (2) What is the optimal threshold for length of SA to be included in analyses for the highest associations? We examined the associations between work environment factors and SA for both men and women.

METHODS
Study design
We linked work environment data from the *W*ork *E*nvironment and *H*ealth in *D*enmark (WEHD) survey[20] with SA data from the Danish RoWA.[21] We followed the respondents for up to 18 months in RoWA.

WEHD survey
The Danish National Research Centre for the Working Environment conducted the WEHD survey biannually from 2012 to 2016 as part of an occupational health and safety surveillance. Eligible employees had to fulfil the following criteria: age 18–64 years, monthly income minimum Kr3000/€400 (average last 3 months), and minimum 8 weekly work hours (average last 3 months). Each survey year, eligible employees were drawn from

the Danish population using a stratified probability sample. The employees received a letter with an invitation to participate in a web-based survey. Non-respondents received a reminder by phone and later a reminder by letter with a paper-questionnaire.

Danish Register of Work Absences
Statistic Denmark have since 2007 registered SA data, irrespectively of episode length, in RoWA. RoWA is a combination of Statistics Denmark's 'Absence and Employment'-register (FRAN) and 'Periods of Absence'-register (FRPE). The RoWA contains start and end dates of the absence periods due to 'own sickness', 'child sickness', 'occupational injury' and 'maternity and adoption leave' from (1) all public institutions, (2) all private companies with more than 250 employees, and (3) a probability sample of private companies with 10–250 employees (a new sample drawn every year). Private companies with less than 10 employees are not included in RoWA.[21]

Study population
A total of 104 329 employees were invited to participate in the WEHD survey (a new sample each survey round, 2012: n=35 034, 2014: n=34 736, 2016: n=34 559), of which 51 552 (49%) responded to the questionnaire (respondents 2012: n=17 662 (50%), 2014: n=17 486 (50%), 2016: n=16 404 (47%)). As RoWA covers 100% of all public employees and about 37% of all private employees, 32 191 WEHD respondents could be linked to the RoWA. We excluded 2525 (8%) employees that had received SA benefit (due to long-term SA (≥31 days)) in 2 years preceding response date, and 1988 (7%) employees, with missing answers to main questions and main covariates, leaving n=27 678 employees (women n=16 356, men n=11 322). Of these, n=22 919 employees (women n=13 577, men n=9342) had complete questionnaire data on the secondary covariates chronic illness, smoking and exercise.

Physical and psychosocial work environment factors
This study used three physical and three psychosocial work environment factors from the WEHD survey: (1) 'Back twisted or bend', (2) 'Lifting or carrying burdens', (3) 'Wet hands', (4) 'Influence', (5) 'Role conflicts', and (6) 'Bullying'. All factors were measured with one question, except 'Influence' that was measured as the average of two questions. The questions, response categories, scoring and the answers' distribution are in online supplementary material. The questions have shown predictive validity in previous research, that is, 'Back twisted or bend', 'Lifting or carrying burdens', 'Role conflicts' ('Role conflicts' is formulated slightly different) have predicted long-term SA,[3] 'Wet hands' has predicted hand eczema[22] and bullying has predicted onset of depression.[23] We scored 'Back bend or twisted', 'Lifting or carrying', 'Wet hands' and 'Bullying' as yes/no variables, and 'Influence' and 'Role conflicts' with increasing values for each response-category, following scoring-methods from previous research.[10 24 25]

SA outcome
Outcome was 'own sickness' (all-cause SA) from RoWA. In different analyses, we used SA episodes of ≥1, ≥2, ≥4, ≥6, ≥8, ≥11, ≥16, ≥21, ≥26, and ≥31 days.

Covariates
We used the following covariates: age (in years), education (0=primary school or no record (n=137) of education, 1=upper secondary school, 2=apprentice/trainee, 3=short

higher education, 4=long higher education), sector (private or public, of which public is further divided into state, region and municipality), survey rounds (2012, 2014 and 2016), previous SA (any SA in the last 2 months up to baseline (yes/no)), smoking (0=never, 1=quit smoking, 2=smoke sometimes, 3=smoke daily), exercise (1=no exercise or at most 2 hours of light exercise per week, 2=more than 2 hours light exercise or/and at most 4 hours of medium exercise per week, 3=more than 4 hours a week of medium exercise or/and at most 2 hours hard exercise per week, 4=more than 2 hours per week of hard exercise), and receiving treatment in the last 12 months for chronic illnesses: depression (yes/no), back disease (yes/no), eczema (yes/no), other long standing illness (yes/no).

Sector and survey round were categorical variables; all other covariates were continuous variables. Sex, age, sector and previous SA were derived from RoWA, education from Statistics Denmark's 'education program' register (UDDF, the register has information about highest completed education); all other variables were from the WEHD questionnaires.

Statistical analysis

We used a Cox-regression model with recurrent events. Christensen *et al*[26] recommended the Cox model with recurrent events over Poisson regression for SA analyses, because Poisson regression had, for example, less statistical power. We used the statistical program SAS V.9.4 and the procedure Phreg.

Cox regression uses 'time to event', and 'event (yes/no)' in the analyses. We followed employees from the day they answered the questionnaire up until a SA-event happened. The Cox regression with recurrent events allows an employee, who has returned to work after a SA-event, to re-enter the model with a new entry date, 'time to event' and 'event (yes/no)'. To adjust for an employee may enter the model several times, the model uses the 'robust sandwich estimator' that takes into account the within subject correlation.[27] This adjustment will result in wider CI than if all 'time to event' and 'event (yes/no)' data had been from independent employees. We censored employees during periods of maternity leave or absences due to occupational injury. Employees were also censored, if they lost their job or if their workplace no longer were included in the register (n=4884). Average follow-up time was 14 months. The proportional hazard assumption of the Cox regression model was tested by visual inspection of cumulative hazard plots and Schoenfeld residuals.[27 28]

All analyses were stratified for sex and adjusted in two steps. In model 1, we adjusted for the following covariates: age, education, sector and survey rounds. In model 2, we additionally adjusted for: previous SA, smoking, exercise, chronic illnesses, and we adjusted physical work environment factors for psychosocial work environment, and psychosocial work environment factors for physical work environment. To avoid multicollinearity from closely related variables, we did not mutually adjust the three psychosocial work environment factors or mutually adjust the three physical work environment factors.[29]

To test if HRs were significantly different for men and women, we included an interaction term between sex and the particular work environment factor in analysis including data from both sexes. If the interaction term was significant, the HRs were significantly different.

We performed separate analyses with the above models where we systematically changed the definition of an SA event, including SA episodes of ≥1, ≥2, ≥4, ≥6, ≥8, ≥11, ≥16, ≥21, ≥26 and

Table 1 Sample characteristics of n=27 678 Danish employees in the study

	Women			Men		
	N	Per cent	Mean	N	Per cent	Mean
Age (years)	16 356		46.4	11 322		46.9
Follow-up time (months)	16 356		14.2	11 322		13.7
Sector						
Private sector	4752	29.1		6982	61.7	
Public sector	11 604	70.9		4340	38.4	
Education						
Primary school	1588	9.7		1477	13.0	
Upper secondary school	1088	6.7		798	7.0	
Apprentice/ trainee	4858	29.7		3804	33.6	
Short higher education	6500	39.7		3135	27.7	
Long higher education	2322	14.2		2108	18.6	
Chronic illnesses						
Depression	771	4.8		361	3.2	
Back disease	1423	8.9		1024	9.2	
Eczema	1489	9.3		821	7.4	
Other illness	3563	22.3		1923	17.3	
Smoking						
Never	8527	52.4		5763	51.2	
Quit	4725	29.1		3237	28.7	
Sometimes	849	5.2		643	5.7	
Daily	2159	13.3		1618	14.4	
Exercise						
Light exercise	1021	7.4		703	7.4	
Light-medium exercise	5141	37		2489	26.2	
Medium-hard exercise	7270	52.4		5582	58.7	
Hard exercise	447	3.2		742	7.8	
Employees with recurrent SA episodes						
No episodes	3810	23.3		4438	39.2	
1 episode	2984	18.3		2347	20.7	
2 or more episodes	9562	58.5		4537	40.1	

SA, sickness absence.

≥31 days, respectively, to examine if the HRs depended on the cut-off point for inclusion/exclusion of short-term SA.

RESULTS

Our final sample included a wide variety of Danish employees (see table 1), for example, both private and public sector, and both employees with short and long education. Women had 48 261 SA episodes and men had 21 150 SA episodes (table 2). A small subset of these (6038 episodes for women and 2293 episodes for men) lasted 6 days or longer, and only 2055 episodes for women and 622 episodes for men lasted 21 days or longer. Thus, short-term SA episodes were more frequent than long-term SA episodes.

Table 2 Number of sickness absence (SA) episodes for different cut-off points for the length of the SA episodes

	Women	Per cent	Men	Per cent
SA episodes ≥1 day	48 261	100	21 150	100
SA episodes ≥2 days	27 447	56.9	12 052	57
SA episodes ≥4 days	10 692	22.2	4541	21.5
SA episodes ≥6 days	6038	12.5	2293	10.8
SA episodes ≥8 days	4501	9.3	1677	7.9
SA episodes ≥12 days	3125	6.5	1086	5.1
SA episodes ≥16 days	2489	5.2	806	3.8
SA episodes ≥21 days	2055	4.3	622	2.9
SA episodes ≥26 days	1731	3.6	518	2.4
SA episodes ≥31 days	1465	3.0	434	2.1

Associations between work environment factors and SA episodes ≥1 day, episodes ≥6 days and episodes ≥21 days

HRs represent the increased risk for an SA episode at any given time, for example, an HR at 1.30 represents a 30% increased risk. Table 3 shows the HRs for SA episodes ≥1 day (lowest possible cut-off point), ≥6 days (cut-off point representing the strongest association for many predictors) and ≥21 days (highest cut-off point for which HR could be estimated for most scales). All CIs were smaller for analyses with SA episodes ≥1 day compared with analyses with SA episodes ≥6 days that again were smaller compared with analyses with SA episodes ≥21 days; hence, results were more precise the more SA episodes that were included in the analyses. Figures 1 and 2 show HRs for all cut-off points for the fully adjusted models. The proportional hazards assumption was fulfilled for all analyses with SA episodes ≥1 day and ≥6 days, but it could not be shown to be fulfilled for 'Bullying' at ≥21 days. Tables and figures only show analyses that fulfilled the proportional hazard assumption.

Physical work environment factors

In the fully adjusted model, 'Back bend or twisted', 'Lifting or carrying' and 'Wet hands' had small associations with SA episodes ≥1 day and large associations with SA episodes ≥6 days (see table 3); for example, for 'Back bend and twisted' for women, the HR at ≥1 day was 1.02 (1.00 to 1.04) and the HR at ≥6 days was 1.24 (1.17 to 1.32). The HRs at ≥6 days were considerably higher than the HRs at ≥1 day, that is, most 95% CIs did not overlap. For SA episodes of ≥21 days, the HRs of 'Back bend or twisted' and 'Lifting or carrying' were significant, HRs of 'Wet hands' were not significant.

The HRs of the physical work environment factors were higher for men than for women in most analyses. The HRs were significantly higher for 'Back bend or twisted' for SA episodes ≥1 day, 'Wet hands' for SA episodes ≥1 day, 'Lifting and carrying' for SA episodes ≥6 days and 'Lifting and carrying' for SA episodes ≥21 days. The p values for interaction were, respectively, p=0.003, p=0.024, p=0.001, p=0.011 (not shown in tables).

Psychosocial work environment factors

For women, the psychosocial work environment factors 'Poor influence', 'Role conflicts' and 'Bullying' were significantly associated with SA episodes ≥1 day, ≥6 days and ≥21 days in the fully adjusted model, for example, for 'Poor influence' the HRs were, respectively, 1.48 (1.41 to 1.57), 1.41 (1.21 to 1.63) and 1.49 (1.15 to 1.92). For 'Role conflicts' and 'Bullying', the HRs were considerably higher for ≥6 days than for ≥1 day, with almost no overlap of the CIs.

For men, the psychosocial work environment factors were significantly associated with SA episodes ≥1 day and ≥6 days, but not with ≥21 days in the fully adjusted model, for example, for 'Poor influence' the HRs were, respectively, 1.72 (1.59 to 1.85), 1.92 (1.53 to 2.42) and 1.32 (0.84 to 2.08). The HRs of the psychosocial work factors were higher for SA episodes ≥6 days than for ≥1 day; however, the CIs had large overlaps.

Men had significantly higher HRs for 'Poor influence' for ≥1 day and ≥6 days compared with women, that is, p values for interaction were <0.0001 and 0.013 (not shown in tables). All other HRs were higher, but not significantly higher, for women compared with men.

Sensitivity analyses

We performed sensitivity analyses, where (1) we weighted data with provided weights for representative population and (2) we split data up in public and private sector. The main result, that is, the HRs of the physical work environment were higher for SA episodes ≥6 days than ≥1 day, were repeated in all sensitivity analyses. See online supplementary material for details.

DISCUSSION

Our aims were to examine if the associations between physical and psychosocial work environment factors and SA depended on the inclusion/exclusion on short-term SA episodes, and to find the optimal cut-off point for which SA episodes to include/exclude in the analyses.

The physical work environment factors' association with SA was considerably higher if we focused on SA episodes ≥6 days compared with analyses with SA episodes ≥1 day. For 'Back bend or twisted' and 'Lifting or carrying', the magnitude of the associations was stable when we restricted analyses to even longer SA lengths (eg, ≥21 days), but the CIs became larger, that is, the precision of the estimates decreased. The association of 'Wet hands' with SA episode ≥21 days were non-significant for both men and women.

The psychosocial work environment factors, 'Role conflict' and 'Bullying' had higher associations with SA if we focused on SA episodes ≥6 days, but associations were also highly significant when 1–5 days SA episodes were included in the analyses, that is, analyses of SA episodes ≥1 day. The associations between 'Poor Influence' and SA were equally strong for SA episodes ≥1 day and ≥6 days.

Men had in general higher associations between physical work environment factors and SA than women. Women had in general higher associations between psychosocial work environment factors and SA than men, except 'Poor influence' where the associations with SA episodes ≥1 day and ≥6 days were significantly higher for men.

The deflation of the association between physical work environment factors and SA, when short-term SA episodes of 1–5 days were included in the analyses, could be explained if short-term SA is primarily associated with other factors. That is, if short-term SA is influenced by factors unrelated to the physical work environment, for example, a cold or a influenza. It is possible that poor physical work environment factors are mainly associated with severe illnesses, for example, chronic pain,[30] from which it is difficult to recover from in a few days, and therefore, the associations of physical work factors and

Table 3 HRs for physical and psychosocial work environment factors' association with sickness absence (SA) episodes ≥1 day, ≥6 days and episodes ≥21 days

Work environment	SA episodes ≥1 day			SA episodes ≥6 days			SA episodes ≥21 days		
	HR	CI	P value	HR	CI	P value	HR	CI	P value
Physical work environment									
Model 1 partly adjusted*									
Women n=16 356									
Back bend or twisted	1.11	(1.08 to 1.13)	<0.0001	1.4	(1.33 to 1.48)	<0.0001	1.31	(1.19 to 1.45)	<0.0001
Lifting or carrying	1.07	(1.05 to 1.09)	<0.0001	1.31	(1.24 to 1.39)	<0.0001	1.37	(1.24 to 1.51)	<0.0001
Wet hands	1.08	(1.06 to 1.10)	<0.0001	1.38	(1.31 to 1.47)	<0.0001	1.23	(1.11 to 1.36)	<0.0001
Men n=11 322									
Back bend or twisted	1.22	(1.18 to 1.27)	<0.0001	1.67	(1.52 to 1.83)	<0.0001	1.73	(1.45 to 2.07)	<0.0001
Lifting or carrying	1.18	(1.14 to 1.22)	<0.0001	1.67	(1.52 to 1.83)	<0.0001	1.75	(1.47 to 2.09)	<0.0001
Wet hands	1.22	(1.17 to 1.27)	<0.0001	1.48	(1.33 to 1.65)	<0.0001	1.30	(1.05 to 1.61)	0.018
Model 2 fully adjusted†									
Women n=13 577									
Back bend or twisted	1.02	(1.00 to 1.04)	0.095	1.24	(1.17 to 1.32)	<0.0001	1.16	(1.04 to 1.30)	0.008
Lifting or carrying	1.03	(1.01 to 1.06)	0.008	1.24	(1.16 to 1.33)	<0.0001	1.29	(1.15 to 1.44)	<0.0001
Wet hands	1.01	(0.99 to 1.04)	0.26	1.26	(1.19 to 1.35)	<0.0001	1.08	(0.96 to 1.21)	0.189
Men n=9342									
Back bend or twisted	1.06	(1.02 to 1.11)	0.002	1.36	(1.22 to 1.52)	<0.0001	1.32	(1.06 to 1.63)	0.012
Lifting or carrying	1.05	(1.01 to 1.09)	0.016	1.47	(1.32 to 1.64)	<0.0001	1.60	(1.30 to 1.96)	<0.0001
Wet hands	1.05	(1.00 to 1.10)	0.037	1.13	(0.99 to 1.28)	0.066	1.04	(0.81 to 1.35)	0.744
Psychosocial work environment									
Model 1 partly adjusted*									
Women n=16 357									
Poor influence	1.70	(1.63 to 1.79)	<0.0001	1.96	(1.72 to 2.23)	<0.0001	1.99	(1.59 to 2.50)	<0.0001
Role conflicts	1.29	(1.24 to 1.34)	<0.0001	1.66	(1.49 to 1.85)	<0.0001	1.96	(1.63 to 2.36)	<0.0001
Bullying‡	1.33	(1.30 to 1.37)	<0.0001	1.56	(1.46 to 1.66)	<0.0001	–		
Men n=11 322									
Poor influence	2.12	(1.98 to 2.26)	<0.0001	2.47	(2.03 to 3.01)	<0.0001	1.63	(1.10 to 2.42)	0.015
Role conflicts	1.16	(1.10 to 1.23)	<0.0001	1.30	(1.10 to 1.53)	0.002	1.14	(0.83 to 1.57)	0.417
Bullying‡	1.36	(1.30 to 1.41)	<0.0001	1.63	(1.46 to 1.82)	<0.0001	–		
Model 2 fully adjusted†									
Women n=13 577									
Poor influence	1.48	(1.41 to 1.57)	<0.0001	1.41	(1.21 to 1.63)	<0.0001	1.49	(1.15 to 1.92)	0.002
Role conflicts	1.17	(1.12 to 1.22)	<0.0001	1.38	(1.22 to 1.55)	<0.0001	1.67	(1.35 to 2.05)	<0.0001
Bullying‡	1.18	(1.15 to 1.22)	<0.0001	1.31	(1.21 to 1.42)	<0.0001	–		
Men n=9342									
Poor influence	1.72	(1.59 to 1.85)	<0.0001	1.92	(1.53 to 2.42)	<0.0001	1.32	(0.84 to 2.08)	0.229
Role conflicts	1.09	(1.03 to 1.16)	0.005	1.27	(1.05 to 1.53)	0.013	1.32	(0.92 to 1.89)	0.138
Bullying‡	1.17	(1.11 to 1.22)	<0.0001	1.29	(1.13 to 1.47)	<0.001	–		

*Adjusted for age, education, private/public sector, and survey round.

†Adjusted as previous model plus additionally adjusted for depression, eczema, back disease, other chronic illness, SA in 2 months up to baseline, smoking, exercise, plus physical work environment factors are adjusted for psychosocial work environment, and psychosocial work environment factors are adjusted for physical work environment.

‡'Bullying' did not fulfil the proportional hazard assumption in analyses with SA episodes ≥21 days and is therefore not shown.

SA are highest if we focus on SA episodes ≥6 days. A recent cohort study found that a reduction in physical workload was non-significantly associated with short-term SA episodes of 1–3 days, but significantly associated with SA of more than 14 days.[31]

The psychosocial work environment factors 'Role conflicts' and 'Bullying' had a trend towards higher HRs with SA episodes ≥6 days compared with SA episodes ≥1 day, but the trends were less pronounced than for the physical work environment factors. 'Poor influence' had similar HRs for SA episodes ≥1 day and ≥6 days. This suggest that the factors determining short-term SA may at least to some extent be influenced by psychosocial work environment. The psychosocial

work environment factors may be associated with short-term SA episodes due to psychological distress responses[32] and with long-term SA episodes, due to for example, depression.[33]

The HRs of the physical work environment factors were in general higher for men than for women. Some previous studies[34 35] has shown higher associations for men, in line with our study, but other studies have shown mixed results,[3 13] or higher associations for women.[36]

The HRs of the psychosocial work environment factors were in general higher for women, but some were significantly higher for men. Previous studies have also shown mixed results.[8 34 37] If there is a sex difference, it may be related to a gender-segregated labour market[38] with different physical

Physical work environment factors

Women: Hazard ratio for sickness absence

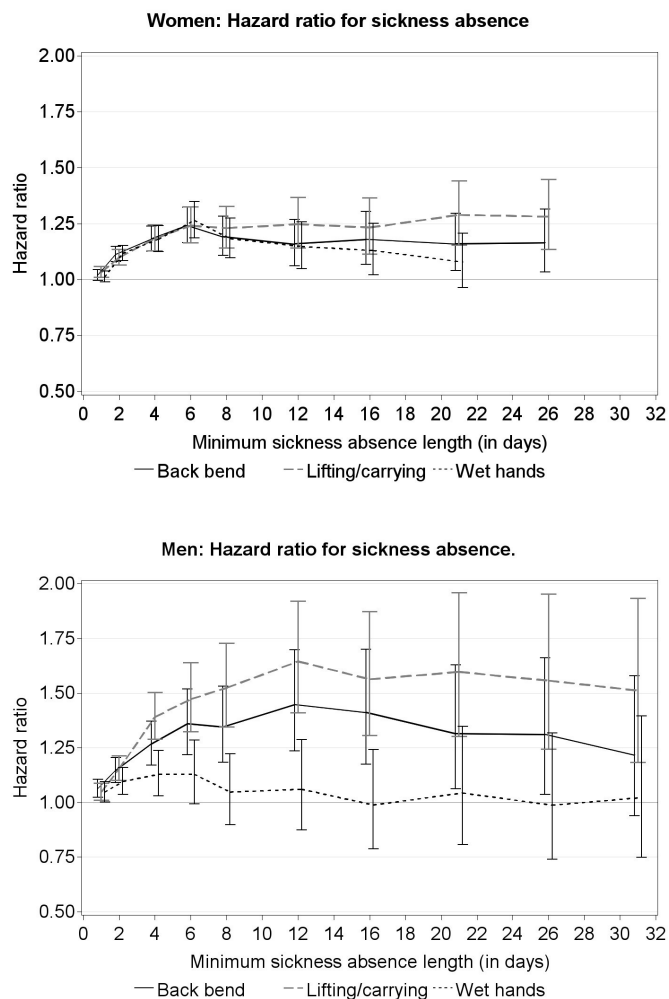### Men: Hazard ratio for sickness absence.

Figure 1 The HRs for different cut-off points for sickness absence (SA) episode length. Analyses of physical work environment adjusted for age, education, private/public sector, survey round, depression, eczema, back disease or other chronic illness, SA in 2 months up to baseline, smoking, exercise and psychosocial work environment. Analyses that did not fulfil the proportional hazard assumption are not shown in the figure.

and psychosocial exposures in male-dominated and female-dominated jobs such as the construction industry compared with cleaning, nursing and childcare. The differences could also be related to different home demands and expectations for men and women.

While our study has notable strengths, e.g. the large sample size and linkage with a national SA register, several limitations must be mentioned. First, the work environment measures were self-reported and the measures may be biased, for example, self-reported physical demands and self-reported wet work are imprecise compared to objective measurements.[24 39 40] Second, the response rate was 50% and only 63% of those could be linked to the register, that is, our data are not representative for the entire Danish workforce. Third, our study is an observational study and not a randomised controlled study; hence, it is difficult to show causality. We adjusted our analyses for important covariates, but we may both have adjusted too little or too much. For example, it may be an overadjustment to adjust analyses of 'Wet hands' for eczema, as wet hands may cause or exacerbate occupational

hand eczema.[22] Fourth, while the RoWA include SA of any length, it is possible that companies register SA exceeding 30 days more carefully, since companies can get compensation for salary expense to sick-listed employees, when the SA episodes exceed 30 days. However, a study comparing RoWA with self-reported SA found high correlations,[19] supporting the validity of RoWA. Fifth, our study is based on data from Denmark and may not be directly transferable to other countries. However, previous comparisons have found that the association between work environment and SA is similar in European countries.[41]

The results of the present study add to the understanding of the association between work environment factors and SA and it may guide researchers when designing SA studies. For example, according to our results, analyses of physical work environment factors should primarily focus on SA episodes ≥6 days. The psychosocial work environment factors 'Role conflict' and 'Bullying' may also have higher associations with SA when focus is on SA episodes≥6 days; however, for all three psychosocial work factors, the associations were highly

Psychosocial work environment factors

Women: Hazard ratio for sickness absence.

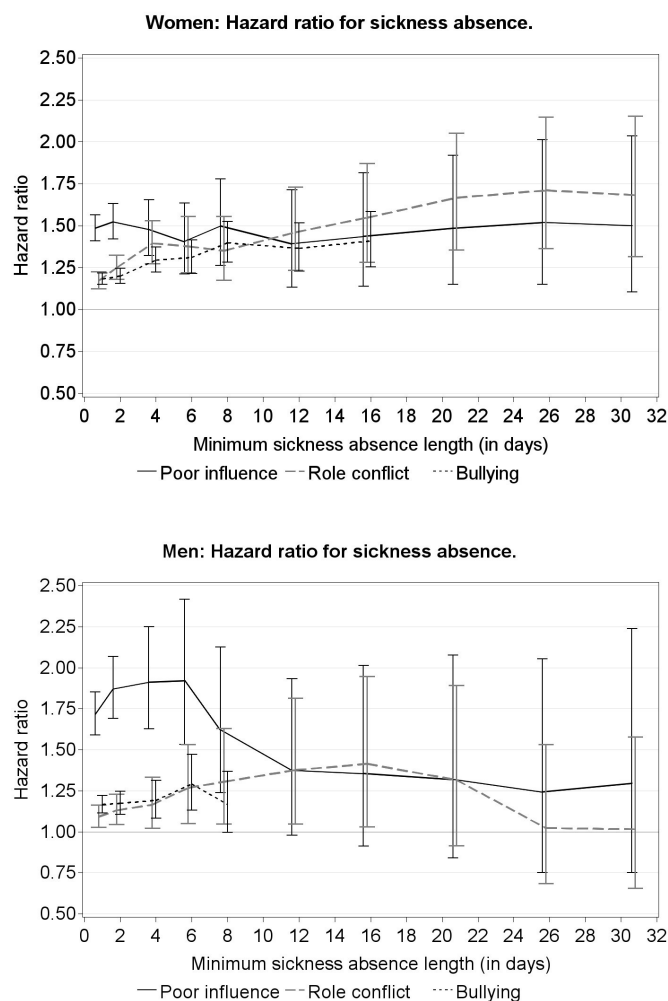### Men: Hazard ratio for sickness absence.

Figure 2 The HRs for different cut-off points for sickness absence (SA) episode length. Analyses for psychosocial work environment adjusted for age, education, private/public sector, survey round, depression, eczema, back disease or other chronic illness, SA in 2 months up to baseline, smoking, exercise and physical work environment. Analyses that did not fulfil the proportional hazard assumption are not shown in the figure.

significant when all SA episodes were included, that is, analyses of SA episodes ≥1 day.

The practical implications of our study are that reduction of strenuous physical work will probably not reduce short-term SA episodes of less than 5 days, but may reduce longer SA episodes. By contrast, improving certain aspects of the psychosocial work environment may be important in the prevention of SA of all lengths. Thus, improving different aspects of the work environment seem to be important to deal with SA in general.

CONCLUSION

For both men and women, the physical work environment factors 'Back bend or twisted' and 'Carrying and lifting' had larger and more significant associations with SA if analyses focused on SA episodes ≥6 days. The psychosocial work environment factors had highly significant associations with SA both when short-term SA was included and excluded, though 'Role conflict' and 'Bullying' may have slightly larger associations with SA if analyses focus on SA episodes ≥6 days.

ORCID iDs
Sannie Vester Thorsen http://orcid.org/0000-0002-8778-9053
Mari-Ann Flyvholm http://orcid.org/0000-0002-8942-754X
Jacob Pedersen http://orcid.org/0000-0003-4429-3485
Ute Bültmann http://orcid.org/0000-0001-9589-9220
Lars L Andersen http://orcid.org/0000-0003-2777-8085
Jakob Bue Bjorner http://orcid.org/0000-0001-7033-8224

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