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Occupational stress and incidence of sick leave in three sectors of activity of the Belgian workforce: the belstress study

by

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Abstract

Background: *The Karasek-Johnson "Demands-Control-Social support" (DCS) model is one of the most widely used job stress models. It has been largely used to predict a wide range of health outcomes and to a lesser extent absenteeism. Our aim is to test the predictive power of the model in relation with one year incidence of sick leave in three sectors of activity, taking into account a wide range of socio-demographic and behavioural variables.*

Methods: *The baseline survey of the BELSTRESS study was conducted in 25 companies of the secondary, tertiary and public sectors across Belgium between 1994 and 1998. A cohort of 15,557 males*

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(9621 from the secondary, 2640 from the tertiary and 3296 from the public sector) and 4906 females (1076 from the secondary, 1802 from the tertiary and 2028 from the public sector) were followed for absenteeism during a year. The relation of psychological job demands, job control (decision latitude), social support at work as well as the job strain concept (combination of high job demands and low control) and the iso-strain concept (job strain combined with high or low social support) was tested in relation with high annual sick leave incidence (total number of sick leave days above the percentile 75 of the distribution of total number of sick leave days), short (≤7 days) and long spells (>7days) of sick leave by univariate and multivariate logistic regression models.

Results: *Independent from major baseline confounding variables we observed a significant association between job characteristics and sick leave: thus, low job control was associated with short and long spells of sickness absence in both genders with OR of 1.17 (CI 95% 1.08-1.27) and 1.21 (CI 95% 1.09-1.34) in men respectively and 1.16 (CI 95% 1.00-1.33) and 1.27 (CI 95% 1.06-1.51) in women respectively. We also found an association between high strained jobs with low social support and long spells of sickness absence in both genders with odds ratios of 1.22 (CI 95% 1.05-1.41) in men and 1.35 (CI 95% 1.05-1.74) in women. Independently from a wide range of potential confounders, the public sector is also associated with a significant 24% increase of sickness absence incidence in men. Finally, we estimated the number of sickness absence days in men avoided if control would be increased above the median: from 529 days per 1000 workers per year (upper white collars of the tertiary sector) to 3797 days per 1000 workers per year (lower white collars of the public sector).*

Conclusions: *We have shown evidence that job stress is an independent risk factor of sick leave whatever the gender, the occupational class and the sector of activity. Moreover, we were able to identify within the Karasek model those job characteristics that play a major role in the relation between job stress and sick leave: job control and social support at work. Sick leave being an indicator of morbidity and productivity, the results of this study have implications in the domain of both public health and economy and should help to "re-think" the work and its organisation in Belgium.*

Keywords

Job characteristics, job stress, sick leave, stress models, demands-control-support model, sectors of activity.

Introduction

One of the most popular and influential stress models in the domain of job stress and employee health is the demands-control-social support (DCS) model proposed by Karasek and colleagues (1, 2).

In this model, job environment is considered to be the main determinant of stress (1, 3) and one postulates that psychological strain, and subsequent physiological illness, result from the interaction of two types of job characteristics: psychological demands of the work situation (stressors) and environmental moderators such as control or decision latitude and social support at work. Psychological job demands include several stressors affecting work and are felt to be the primary source of stress: perception of the workload, the work rhythm and possible conflicting demands. Job control or decision latitude includes control over use of skills, time allocations, and organisational decisions (1). Social support at work includes support received from colleagues and superiors. Jobs defined by high demands in combination with low control (high strained jobs) are considered stressful as they induce autonomic arousal leading to physical and psychological symptoms instead of enabling experiences of learning, stimulation and satisfaction ("strain hypothesis") (1). High strained jobs joined with a low social support at work ("iso-strain") constitute the worst combination in terms of adverse health consequences.

In that way, the model presents a clear prediction of the work conditions associated with stress (4) and provides starting points for improvement of employee health by way of job redesign (1, 5).

Many studies using the JDC model have demonstrated significant associations between job demands, decision latitude, strain and iso-strain on one hand and coronary heart disease (6-8), psychological disorder and health status and functioning on the other (9-11). A few studies tested the model (especially the expanded model) to predict sickness absence (12-19). Most of them are based on one branch (18) or sector (15, 16) of activity. Only one study was based on data from different companies belonging to different sectors of activity (17) but the sample size was insufficient to show statistical association within each sector.

In Belgium, all workers are entitled to medical insurance and in order to benefit from that, a certificate from a medical doctor is required for all spells of more than one day of absence. That way, medically certified absence is an important and a convenient measure of workers' health. However, as health has a social and psychological dimension, sick leave is also influenced by psychosocial circumstances.

Being also an indicator of productivity, sick leave is at the intersection of economy, clinical medicine, occupational medicine and public health.

To our knowledge, our study is one of the largest prospective studies that examines the relations between self-reported job characteristics and objective measures of sick leave in a large multi-occupational and multi-sectorial cohort of both genders, taking into account a large number of potential confounding variables.

Methods

As the design and methods of the study have been described in detail elsewhere (11, 20), we will summarise them here.

The field work in 25 large companies or public administrations across Belgium has been conducted in the period between 1994 and 1998. Of all those on the payroll, a total of 21,419 subjects aged 35-59 accepted to participate in this study, which represent 48% of all eligible subjects.

The main variables below were recorded by a self administered questionnaire:

Socio-demographic: age, sex, marital status, level of education (elementary; secondary technical or not; high school or university), mother tongue (French or Dutch) and country of origin.

Occupation: job title was classified using the International Standard Classification of Occupations (ISCO-88) 21 divided in 3 categories [ISCO 1, 2 = Occupational class I or upper white collars (managers, professionals), ISCO 3, 4, 5 = Occupational class II or lower white collars (technicians, clerks-service workers), ISCO 7, 8, 9 = Occupational class III or blue collars (craft & trade workers-machine operators and elementary occupations)].

Sector of activity: the companies were divided in three sectors: secondary (industrial companies), tertiary (services such as banks) and public service. The secondary sector was most represented with 11,159 subjects (52% of the total cohort) and the tertiary sector the least with 4726 subjects (22%).

Both level of education and occupation are used as proxy for the socio-economic status (22).

Presence of long-standing diseases: self-reported diabetes.

Health perception: The "Current Health Index" (CHI) is a score computed from the VOEG scale (Vragenlijst Over Ervaren Gezondheid) [Questionnaire on Experienced Health], a Dutch scale built up from 13 closed questions each having two outcomes (yes =1 / no = 0) and thus adding up to a scale between 0 and 13 (23). The scale was categorised in tertiles.

Smoking habits and alcohol consumption: the standardised questionnaire used in the MONICA study was applied (24).

Physical activity: the shortened and validated part of a MONICA substudy (MOSPA) was used (25).

Job characteristics: the Karasek questionnaire (26) with a total of 26 standardised items. Questions include 9 on psychological job demands, 9 questions on control or decision latitude and 8 on global social support at work. We used an algorithm to replace up to one missing value per scale: this missing value was given the mean score computed from the set of remaining valid scale-items for that particular respondent picking up 5% more valid cases at most (27). These scales proved to contain acceptable internal consistency (Cronbach's α between 0.66 and 0.87 in men and between 0.66 and 0.88 in women) and scale validity in the Belstress cohort (28). We dichotomised the different basic scales using gender specific medians. These medians were also used for the construction of the 2 scales "strain" and "iso-strain". Jobs with low demands and high control are referred to as "relaxed", those with low demands and low control as "passive", those with high demands and high control as "active" and finally those with high demands and low control as "strained". Jobs with high demands, low control and low social support are referred to as "high strained with low support". In addition to these scales, we used a scale of total physical demands at work (5 questions) categorised in tertiles, perception of globalisation of economy (3 questions) categorised in tertiles, and job insecurity (4 questions) dichotomised using gender specific medians (29).

"Job satisfaction" is assessed by one question with 5 response categories. We recategorised later in 3 categories: "not satisfied"; "neutral" and "satisfied".

Depression: The Iowa short version (11 items) of the original CES-D scale (30) developed by Kohout et al. was used. This short version has been validated in elderly subjects (31) and in women (32).This variable has been categorised in tertiles.

Anxiety: The "anxiety" sub-scale of the PSI was used (33, 34).

Locus of control: the personality characteristic "external locus of control" (LOC) indicating lack of mastery or self-esteem was measured with 2 questions derived from Pearlin and Schooler's short scale of mastery orientation (35). Two groups are defined, "internal LOC" (scores 2-5) and "external LOC" (scores 6-8), based on their scoring on the additive scale.

Social support outside work: the standardised questionnaire of Berkman and Syme (social contacts with relatives and friends and satisfaction concerning the practical help received; number of children under 5 years old, responsibility towards sick or elderly persons) (36).

Type of coping: scales of the 3 main type of coping with stress described by Amirkhan were used (37): problem solving coping, social support coping and avoidance coping.

Variables listed below were recorded during a clinical examination. For more details, see Coetsier et al. 1996 (38).

- **Anthropometric data:** height, weight from which body mass index (BMI) (Kg/m^2) was computed.
- **Blood pressure elevation** (yes/no): hypertension was defined as having a systolic blood pressure above 140 and/or a diastolic blood pressure above 90 with or without treatment.
- **Biology:** total cholesterol dichotomised (≤5.0 mmol/l and above), HDL cholesterol dichotomised (≤1.0 mmol/l and above) and fibrinogen in gender specific tertiles.
- **Electrocardiogram:** the CHD prevalence at baseline was assessed using the Minnesota code (39). Subjects having a code $I_{1,2,3}$ or/and IV $_{1,2,3}$ or/and $V_{1,2}$ or VII $_1$ were considered as possible or probable "ischaemic ECG" at baseline.

Follow-up

All workers who participated at the baseline examination agreed to be screened for sick leave. Computerised sickness absence records were obtained from 24 out of 25 companies during 12 months following the baseline examination. All the workers with a follow-up less than 1 year (deceased persons, (pre)-retirement, dismissals, resignation, lost to follow-up) as well as workers on maternal leave were excluded from the analyses. Finally a total of 20,463 workers (15,557 males and 4,906 females) were screened for sick leave during a complete year. Percentile

75 (P75) of the distribution of the total annual sickness days was used as cut-off to classify the workers with a high one year incidence rate of sick leave. The P75 for men and women was 10 and 15 days respectively. As different types of sick leave are related to different problems (15, 40, 41), we defined more specific end-points such as short spells (at least 1 short spell [≤ 7 days] per year) and long spells (at least 1 long spells [> 7 days] per year). In men and women, short spells of sickness absence represented 65.8% and 65.2% of the total number of spells of sickness absence respectively.

Statistics

For the comparisons of means of sickness absence days between sectors, we used the Kruskall-Wallis test. Age adjusted ORs and their 95% confidence intervals were calculated for men and women separately using logistic regression. Multiple logistic regression was relied upon to select predictive factors of high sick leave incidence, short and long spells using a backward procedure based on the likelihood ratio. Criteria for variable removal and entry were set to 0.10 and 0.05 respectively. The variables initially entered in the logistic regression equation are socio-demographic variables (age, mother tongue, country of origin, level of education, occupation, marital status, social support outside work [number of social contacts; satisfaction concerning the practical help received], number of children under 5 years old, responsibility towards ill or elderly persons), job characteristics (psychological demands, control at work, social support at work, physical demands at work, perception of job insecurity, perception of globalisation of economy, work satisfaction, sector of activity), psychological characteristics (type of coping [problem solving, social support and avoidance], locus of control), psychological stress response (score of depression, score of anxiety), lifestyles (physical activity, smoking habits and alcohol consumption) and health indicators (diabetes and prevalence of coronary heart disease assessed either by ECG and/or symptoms of angina, other CHD risk factors such as body mass index, hypertension, high serum cholesterol, low HDL-cholesterol and high fibrinogen). The selected variables are listed in tables 7-9.

The attributable fraction amongst exposed male subjects was calculated using the formula: (1-OR)/OR. The workers having job control under the median were considered at risk. The attributable fraction amongst the entire male population (exposed and non exposed) was obtained by multiplying the attributable fraction amongst exposed male subjects by the prevalence of men at risk. This percentage was multiplied by the total number of sick leave days above the P75 to obtain an

estimation of the number of sick leave days avoided by increasing job control above the median.

The "Hosmer and Lemeshow" test has been used to test the fitting of the models (42). All analyses were done using SPSS 10.0 for Windows.

The study has been approved by the medical ethics committee of the faculty of medicine of the Université Libre de Bruxelles.

Results

Sectors of activity and sick leave

Table 1 gives the annual average number of sickness absence in different sectors of activity according to the gender and the occupational class. Whatever the gender, absenteeism is systematically higher in the public sector. Thus in male blue collars, the annual average number of sickness absence days is 13.2 in the secondary and 11.3 in the tertiary sector whereas nearly 20 days in the public sector. Table 2 gives the relative risks of absenteeism in the tertiary and the public sectors compared to the secondary sector in men and women after adjustments for age and occupational class have been made. In both genders, the risk is most important in the public sector whatever the end-point used with OR ranging in men from 1.41 (95% CI 1.28-1.56) for long spells to 1.84 (95% CI 1.69-2.01) for short spells and in women from 1.19 (95% CI 1.02-1.39) for short spells to 1.36 (95% CI 1.14-1.62) for high sick leave incidence.

TABLE 1
Annual average number of sickness absence days per subject and per year

MEN Occupational class	Sectors Secondary (n = 9299)	 Tertiary (n = 2593)	 Public (n = 3184)	 p (sign.)
Upper white collars (n = 2682)	**4.0**	**5.4**	**9.2**	*<0.0001*
Lower white collars (n = 6411)	**9.7**	**9.6**	**15.5**	*<0.0001*
Blue collars (n = 5983)	**13.2**	**11.3**	**19.8**	*<0.0001*
p (sign.)	*<0.0001*	*<0.0001*	*<0.0001*	
WOMEN	(n = 1052)	(n = 1755)	(n = 1979)	
Upper white collars (n = 481)	**6.9**	**9.5**	**10.2**	*NS*
Lower white collars (n = 3225)	**11.2**	**13.2**	**17.1**	*<0.0001*
Blue collars (n = 1080)	**16.5**	**10.4**	**20.4**	*NS*
p (sign.)	*0.002*	*NS*	*0.004*	

Job characteristics and sick leave

We examined the association between psychosocial work environment and high sick leave incidence after stratifying by occupational class and sector. After adjustments for age, education level, consumption of alcohol and smoking habits, we found a clear association between work characteristics and high sick leave incidence (Tables 3-5). For example, in the upper white collars working in the secondary sector, men who reported low levels of control at work, have a 1.60 (95% CI 1.25-2.05) fold increase (or 60%) in the risk of having high sick leave incidence (≥P75) compared to those who reported high levels of control (Table 3). The odds ratios range from 1.19 (95% CI 1.03-1.37) for blue collars of the secondary sector to 1.61 (95% CI 1.28-2.04) for lower white collars in the public sector. Although not statistically significant in all strata, lack of social support at work is consistently positively associated with absenteeism: odds ratios ranged from 1.14 (95% CI 0.95-1.36) for lower white collars of the secondary sector to 1.31 (95% CI 1.02-1.67) for lower white collars of the tertiary sector. However, when using the combined scales (strain and iso-strain), the associations are stronger and usually statistically significant. Thus, as compared to all other jobs combined, high strained jobs with low levels of social support at work are associated with a significant increase of sick leave with ranging odds ratios from 1.34 (95% CI 1.10-1.63) in blue collars of the secondary sector to 1.77 (95% CI 1.22-2.58) in upper white collars of the secondary sector. Passive jobs with low social support are also associated with sick leave especially in higher occupational classes. For women, in strata where the analyses were possible, the same patterns were observed although not always statistically significant (results not shown).

Table 6 shows the results of the multivariate analyses in both genders for high sick leave incidence (annual number of sick days above P75). In general, the same associations as those found in the stratified analysis are observed. Thus, men who reported low levels of control at work, have a 1.19 (95% CI 1.08-1.32) fold increase in the risk of having high rate of sickness absence (≥P75) compared to those who reported high levels of control. This association was found in short and long spells as well (results not shown). Social support at work was furthermore negatively associated with high sick leave incidence with an OR of 1.12 (95% CI 1.02-1.24). This association was also observed in long spells of sick leave (results not shown). In women, only short and long spells of sick leave are associated with job characteristics (results not shown).

When combining the primary scales (tables 7-9), we observed a positive association between strained jobs with low social support and high

TABLE 2
Sector of activity in relation with sick leave adjusted for age and occupation class

PREDICTORS MEN		**High sick leave incidence** (n° of sick leave days ≥P75)	p	OR (95% CI) **Short spells (≤7 days)** (>1/year)	p	**Long spells (>7 days)** (>1/year)	p
Sector of activity	n						
Secondary	9299	1		1		1	
Tertiary	2593	1.07 (0.95-1.21)		1.12 (1.02-1.24)	0,018	1.00 (0.88-1.15)	
Public	3184	1.75 (1.59-1.92)	< 0,0001	1.84 (1.69-2.01)	< 0,0001	1.41 (1.28-1.56)	< 0.0001
WOMEN							
Sector of activity							
Secondary	1052	1		1		1	
Tertiary	1755	0.98 (0.80-1.18)		1.01 (0.85-1.18)		1.06 (0.88-1.27)	
Public	1979	1.36 (1.14-1.62)	0,001	1.19 (1.02-1.39)	0,024	1.24 (1.05-1.48)	0.012

TABLE 3

Job characteristics in relation with high incidence of sick leave in Men (≥P 75) by sector in occupational class I (upper white collars)

MEN	OR (95% CI) adjusted for various factors°		
JOB CHARACTERISTICS	**Sectors**		
	Secondary (n = 1358) (398 cases)	Tertiary (n = 1019) (276 cases)	Public
Job demands			
Low	1	1	
High	0.93 (0.73-1.19)	0.99 (0.74-1.32)	
Job control			
Low	1.60 (1.25-2.05)****	1.28 (0.95-1.73)	
High	1	1	
Social support			
Low	1.26 (0.99-1.62)	1.20 (0.89-1.61)	
High	1	1	
Iso-strain			
All other jobs	1	1	
Passive jobs with L.S.S.	1.94 (1.38-2.72)****	1.49 (1.01-2.20)*	
Strained jobs with L.S.S.	1.77 (1.22-2.58)****	1.76 (1.19-2.58)**	

° Adjustment for age, education level, alcohol consumption, smoking.

* p≤0.05 ** p≤0.01 *** p≤0.001 **** p≤0.0001.

TABLE 4
Job characteristics and high incidence of sick leave in men (≥P 75) by sector in occupational class II (lower white collars)

MEN	OR (95% CI) adjusted for various factors°		
JOB CHARACTERISTICS	**Sectors**		
	Secondary (n = 2747) (686 cases)	Tertiary (n = 1364) (378 cases)	Public (n = 1822) (460 cases)
Job demands			
Low	1	1	1
High	1.02 (0.85-1.23)	1.16 (0.90-1.48)	1.15 (0.92-1.43)
Job control			
Low	1.37 (1.13-1.65)***	1.46 (1.14-1.88)**	1.61 (1.28-2.04)****
High	1	1	1
Social support			
Low	1.14 (0.95-1.36)	1.31 (1.02-1.67)*	1.23 (0.98-1.54)
High	1	1	1
Iso-strain			
All other jobs	1	1	1
Passive jobs with L.S.S.	1.32 (1.03-1.70)	1.30 (0.89-1.89)	1.45 (1.06-1.98)*
Strained jobs with L.S.S.	1.38 (1.05-1.81)	1.69 (1.20-2.37)**	1.73 (1.29-2.33)****

° Adjustment for age, education level, alcohol consumption, smoking.
* $p \leq 0.05$ ** $p \leq 0.01$ *** $p \leq 0.001$ **** $p \leq 0.0001$.

TABLE 5

Job characteristics in relation with high incidence of sick leave in men (≥P 75) by sector in occupational class III (blue collars)

MEN	OR (95% CI) adjusted for various factors°		
JOB CHARACTERISTICS	**Sectors**		
	Secondary (n = 4432) (1131 cases)	Tertiary	Public (n = 844) (212 cases)
Job demands			
Low	1		1
High	1.06 (0.92-1.22)		1.29 (0.93-1.79)
Job control			
Low	1.19 (1.03-1.37)*	TOO	1.22 (0.87-1.70)
High	1		1
		SMALL	
Social support			
Low	1.15 (1.00-1.33)*		1.27 (0.91-1.78)
High	1	STRATUM	1
Iso-strain			
All other jobs	1		1
Passive jobs with L.S.S.	1.18 (0.97-1.43)		1.28 (0.81-2.02)
Strained jobs with L.S.S.	1.34 (1.10-1.63)**		1.64 (1.06-2.52)**

° Adjustment for age, education level, alcohol consumption, smoking.

* p≤0.05 ** p≤0.01 *** p≤0.001 **** p≤0.0001.

TABLE 6
High sick leave incidence in relation with job characteristics, occupational class and sector of activity adjusted for various factors

JOB CHARACTERISTICS	MEN° (n = 11,903)	p	WOMEN°° (n = 3,559)	p
JOB DEMANDS				
Low	1		1	
High	0.93 (0.85-1.02)	ns	0.98 (0.83-1.16)	ns
JOB CONTROL				
Low	1.19 (1.08-1.32)	****	1.16 (0.97-1.38)	ns
High	1		1	
SOCIAL SUPPORT				
Low	1.12 (1.02-1.24)	*	1.13 (0.95-1.34)	ns
High	1		1	
OCCUPATIONAL CLASS				
Upper white collars	1			
Lower white collars	1.47 (1.24-1.75)	****		
Blue collars	1.63 (1.34-1.98)	****		
SECTOR OF ACTIVITY				
Secondary	1			
Tertiary	1.01 (0.87-1.16)	ns		
Public	1.22 (1.08-1.38)	***		

° Adjustments for variables selected by backward procedure: age, mother tongue, level of education, locus of control, smoking, alcohol consumption, other job characteristics (physical demands, job insecurity), job satisfaction, depression, health perception, BMI, fibrinogen and coronary heart disease assessed by ECG.

°° Adjustments for variables selected by backward procedure: age, education level, responsibility toward sick or elderly persons, smoking, BMI, health perception, HDL cholesterol, physical demands, job satisfaction, coping of avoidance, coping of social support.

TABLE 7

Short spells of sick leave in relation with job characteristics,occupational status and sector of activity adjusted for various factors

JOB CHARACTERISTICS	MEN° (n = 12,472)	p	WOMEN°° (n = 3,832)	p
ISOSTRAIN				
Other jobs	1		1	
Passive jobs with low social support	1.21 (1.07-1.36)	****	1.25 (1.02-1.53)	*
Strained jobs with low social support	1.03 (0.91-1.17)	ns	1.19 (0.96-1.47)	ns
OCCUPATIONAL STATUS				
Upper white collars	1		1	
Lower white collars	1.27 (1.14-1.41)	****	1.23 (1.00-1.52)	ns
Blue collars	1.11 (0.98-1.25)	ns	0.70 (0.54-0.90)	****
SECTOR OF ACTIVITY				
Secondary	1			
Tertiary	1.29 (1.16-1.45)	****		
Public	1.76 (1.59-1.95)	****		

° Adjustments for variables selected by backward procedure: age, mother tongue, country of origin, smoking, number of chilfren under 5 years old, physical demands, job satisfaction, health perception and coronary heart disease assessed by ECG.

°° Adjustments for variables selected by backward procedure: age, marital status, mother tongue, contry of origin, health perception.

TABLE 8

Long spells of sick leave in relation with job characteristics,occupational status and sector of activity adjusted for various factors

JOB CHARACTERISTICS	MEN° (n = 12,123)	p	WOMEN°° (n = 3,249)	p
ISOSTRAIN				
Other jobs	1		1	
Passive jobs with low social support	1.18 (1.03-1.35)	*	1.04 (0.81-1.34)	ns
Strained jobs with low social support	1.22 (1.05-1.41)	**	1.35 (1.05-1.74)	*
OCCUPATIONAL STATUS				
Upper white collars	1			
Lower white collars	1.43 (1.19-1.71)	****		
Blue collars	1.59 (1.30-1.95)	****		
SECTOR OF ACTIVITY				
Secondary				
Tertiary				
Public				

° Adjustments for variables selected by backward procedure: age, level of education, smoking, country of origin, alcohol consumption, other job characteristics (physical demands, job insecurity), job satisfaction, depression, health perception, BMI, fibrinogen, hypertension and coronary heart disease assessed by ECG.

°° Adjustments for variables selected by backward procedure: age, level of education, alcohol consumption, number of children under 5 years old, health perception, HDL cholesterol, fibrinogen, physical demands, job satisfaction, coping of avoidance, coping of social support.

TABLE 9

High sick leave incidence in relation with job characteristics,occupational status and sector of activity adjusted for various factors

JOB CHARACTERISTICS	MEN° (n = 11,903)	p	WOMEN°° (n = 3,513)	p
ISOSTRAIN				
Other jobs	1		1	
Passive jobs with low social support	1.19 (1.05-1.36)	**	1.14 (0.89-1.46)	ns
Strained jobs with low social support	1.20 (1.04-1.38)	*	1.19 (0.93-1.53)	ns
OCCUPATIONAL STATUS				
Upper white collars	1		1	
Lower white collars	1.51 (1.27-1.78)	****	0.75 (0.49-1.13)	ns
Blue collars	1.69 (1.39-2.05)	****	1.11 (0.87-1.41)	ns
SECTOR OF ACTIVITY				
Secondary	1			
Tertiary	1.01 (0.88-1.17)	ns		
Public	1.25 (1.11-1.41)	****		

° Adjustments for variables selected by backward procedure: age, mother tongue, level of education, locus of control, smoking, alcohol consumption, other job characteristics (physical demands, job insecurity), job satisfaction, depression, health perception, BMI, fibrinogen and coronary heart disease assessed by ECG.

°° Adjustments for variables selected by backward procedure: age, level of education, responsibility toward sick or elderly persons, smoking, BMI, health perception, HDL cholesterol, physical demands, job satisfaction, coping of avoidance, coping by social support.

TABLE 10
Estimated impact of increasing control in working population by sector and occupational class in men

SECTOR/OCCUPATION MEN	Attributable fraction amongst exposed (%)[1]	At risk worker[2] (%)	Attributable fraction population (%)	Number of sickness absence days avoided per 1000 subject (days)
SECONDARY				
Upper white collars	37.5	54.4	20.4	580
Lower white collars	27.0	47.6	12.9	1088
Blue collars	16.0	52.1	8.3	997
TERTIARY				
Upper white collars	21.9	56.0	12.3	529
Lower white collars	31.5	53.4	16.8	1405
Blue collars[3]	–	–	–	–
PUBLIC				
Upper white collars[3]				
Lower white collars	37.9	70.4	26.7	3797
Blue collars	18.0	63.4	11.4	2115

[1] The attributable fraction amongst exposed is obtained by calculating the formula: (1-OR)/OR: the OR's are obtained by logistic regression adjusting for age, demands, social support at work, education level, alcohol consumption and smoking.
[2] Workers at risk are those with low control at work (under the median).
[3] Number of subject insufficient.
* OR obtained by logistic regression adjusting for demands, social support and age.

sick leave incidence or long spells of sickness absence in men with ORs of 1.20 (95% CI 1.04-1.38) and 1.22 (95% CI 1.05-1.41) respectively. Passive jobs with low social support were also significantly associated with high sick leave incidence, short and long spells of sickness absence in men with ORs of 1.19 (95% CI 1.05-1.36), 1.21 (95% CI 1.07-1.36) and 1.18 (95% CI 1.03-1.35) respectively. In women, strained jobs with low social support were associated with long spells whereas passive jobs with low social support were associated to short spells of sickness absence. It is important to note that in the multivariate analyses, sector of employment was never a predictor of sick leave in women whereas in men, it was a predictor of high sick leave incidence and especially of short spells. Thus as compared to the secondary sector, the public sector is associated with an increased risk of short spells of sickness absence and high sick leave incidence with ORs of 1.76 (95% CI 1.59-1.95) and 1.25 (95% CI 1.11-1.41) respectively.

Finally, from the ORs obtained in the multivariate analyses and the prevalence of low job control defined as under the median in the different sectors, we estimated the percentage of sick leave that could be avoided in each sector and each occupational class by increasing control at work above the median (population attributable fraction). In the second column, we calculated the attributable fraction among exposed workers using the formula (1-OR)/ OR. The third column is the percentage of workers at risk (subjects with a control under the median) whereas the fourth column is obtained by multiplying the second column by the third one (attributable fraction population). The last column gives an estimate of sickness absence days per 1000 subjects that could be avoided. For example, in male upper white collars of the secondary sector, sick leave incidence (number of sick days above P75) could be reduced by 20.4% [(1.60-1.00)/1.60 x 54.4%] if control was increased above the median that is to say 581 days per year and per 1000 workers. The percentage of sick leave that could be avoided ranges from 8.3% in blue collars of the secondary sector to 26.7% in the lower white collars of the public sector.

Discussion

Reliability and validity of the study

This study was prospective, relying on external and objective sources for collecting standardised sick leave data. Our study population is definitely not representative of the Belgian workforce but as recalled by Kristensen (43) it is the variation of exposure that matters in analytical

studies and not representativity. As all the selected occupations come from the secondary (industrial), tertiary (private services) and fourth sectors (public services), they represent different positions in the demand-control-support model leading to a large variance.

As recommended by Liberatos et al. (22), all the analyses were performed using two measures of socio-economic status (education and occupation). In contrast to other studies, we were able to control for many confounding factors.

In a cohort study, selection bias due to low participation rate is unlikely to occur as exposure is ascertained before the development of the outcome. However, due to privacy matters, it was not possible to make the distinction between absenteeism due to sickness and to work accident in some companies. For companies where it was possible to do so, work accidents accounted only for 2.9% of the total number of days which is likely not to influence the results.

Risk factors specific to the work (indispensability at work), informal norms about acceptable levels of absence among colleagues (18), family situation due to the individual or work-home interference and risk factors at group level may be important and should be considered when interpreting our findings.

Discussion of the results

Job characteristics and sick leave

Previous studies on absenteeism are difficult to compare to our study due to differences in the way job characteristics such as demands were reported: in a subjective (12-15, 17, 18) or objective way (16). Moreover sick leave was either self-reported (12, 13, 18) or not (14-17), the point in time of sick leave measurement was either before (12) or after job stress measurement (13-18), the type of the study was cross-sectional (12, 13, 18) or prospective (14-17) and eventually other measured covariables were different from one study to another. Nevertheless, our results are consistent with reports of previous studies of higher rates of sick leave among male and female workers involved in jobs with low level of control (12-17). But contrary to those studies, we also observed a significant negative association between social support at work and sick leave in both genders even after adjustments for a wide range of confounders. Although being felt the primary source of stress, demands are not associated with sick leave in our study. For most occupations today, demands within the workplace rarely exceed the physical and

intellectual capabilities of most workers. Thus the source of stress is to be found in work that simultaneously combines high demands and low control or low social support (4). This is suggested by our results showing the combination of the three primary scales (iso-strain) to be more strongly associated with sick leave than used separately. Another explanation is that the demands scale does not capture all the constraints and should be better conceptualised and expanded.

To our knowledge, until this day no study has examined the effect of job stress in different occupational classes of the different sectors of activity on males and females. In each sector of activity we found consistent and, most of the time, significant associations between job characteristics and sick leave whatever the occupational class even after controlling for education, smoking and alcohol. The weakest associations are usually observed in blue collars of the secondary sector and the strongest in lower white collars of the public sector. These differences can partially be explained by the fact that the Job Content Questionnaire is composed of very general questions that may not capture the subtleties or specificities of demands and control within a particular job title or workplace (7).

In the multivariate analyses, these associations remained significant even after adjustment for mediators like objective health variable, health perception, depression and job satisfaction. It is important to note that in these models, the estimates of the size of the association between job characteristics and absenteeism obtained are conservative. Actually, if health, perceived health or job satisfaction are partial mediators between job stressors and sick leave, adjusting for them is likely to underestimate the association. The true association is probably between the unadjusted and the health/job satisfaction-adjusted odds ratio.

It is interesting to note that in both genders “passive jobs with low social support” is an independent predictor of short spells of sickness absence whereas “high strained jobs with low social support” is an independent predictor of long spells of sickness absence. Long spells of sickness absence being a better indicator of morbidity (40) than short spells, these findings are consistent with Karasek’s hypothesis (1) that “passive work” is associated only with an average level of psychological strain and illness risk.

Sector of employment and sick leave

To our knowledge, the effect of the sector of employment on sick leave incidence has not yet been examined. In univariate analysis, we

found in both genders differences in the risk of sickness absence between the three sectors of activity but in women they disappeared after adjustment for the variables selected by the backward procedure, showing that the variables introduced in the model could explain in our sample the differences between sectors observed in univariate analysis. Therefore we can refute at least in women the idea that workers in the public sector, conscious of their job security, are more prone to take a day off. However, in men, working in the public sector is associated with a high sick leave incidence and an increased risk of having short spells of sickness absence even after adjustment for a wide range of potential confounders whereas it does not predict long spells of sickness absence, a probable indicator of morbidity. Thus, we suggest that the association between sector of activity and sick leave is not mediated by health. Anyway, we were able to estimate in most sectors and occupational classes among men the number of days of sickness absence that could be avoided if control was increased in the working population. As we did not take into account demands and social support in these estimates, it is probable that they are underestimated.

Conclusions

First, this study was able to show the robustness of the Karasek model. We have shown evidence that job stress is an independent risk factor of sick leave whatever the sex, the occupational class and the sector of activity. Moreover, the use of this model permitted to identify the job characteristics that play a major role in the relation between stress and sick leave, that is to say job control and social support at work. Thus it gives important clues on what should be changed in the workplace and its organisation to reduce stress and its consequences. Sick leave being an indicator of morbidity and productivity, the results of this study have implications in the domains of both public health and economy and should help to "re-think" the work and its organisation in Belgium. We have also shown that in men absenteeism is more important in the public sector than in the other sectors. We are not able to fully explain these differences.

The next step should be to implement a controlled intervention study or job redesign, affecting favourably decision latitude and social support at work. The impact of these modifications on incidence of sick leave could be analysed and the causal relationship between job characteristics and sick leave could be strengthened.

References

1. Karasek R, Theorell T. Healthy work – stress, productivity and the reconstruction of working life. Harper Collins, 1990; 1-38.
2. Johnson J, Hall E, Theorell T. Combined effects of job strain and social isolation on cardiovascular disease morbidity and mortality in a random sample of the Swedish male working population. Scand J Work Environ Health 1989; 15: 271-9.
3. Siegrist J. Adverse health effects of high-effort/low-reward conditions. J Occup Health Psychol 1996; 1: 27-41.
4. Baker D. The study of stress at work. Annu Rev Public Health 1985; 6: 367-81.
5. Theorell T. How to deal with stress in organizations?--a health perspective on theory and practice. Scand J Work Environ Health 1999; 25: 616-24.
6. Kristensen T. Job stress and cardiovascular disease: a theoretic critical review. J Occup Health Psychol 1996; 1: 246-60.
7. Schnall P, Landsbergis P, Baker D. Job strain and cardiovascular disease. Annu Rev Public Health 1994; 15: 381-411.
8. Johnson J, Stewart W, Hall E, Fredlund P, Theorell T. Long-term psychosocial work environment and cardiovascular mortality among Swedish men. Am J Public Health 1996; 86: 324-31.
9. Johnson J, Hall E, Ford D, et al. The psychosocial work environment of physicians. The impact of demands and resources on job dissatisfaction and psychiatric distress in a longitudinal study of Johns Hopkins Medical School graduates. J Occup Environ Med 1995; 37: 1151-9.
10. Lerner D, Levine S, Malspeis S, D'Agostino R. Job strain and health-related quality of life in a national sample. Am J Public Health 1994; 84: 1580-5.
11. Pelfrene E, Vlerick P, Kittel F, Mak R, De Backer G, Kornitzer M. Psychosocial work environment and psychological well-being: assessment of the buffering effects in the job demand-control(-support) model in Belstress. Stress and Health 2002; 18: 43-56.
12. Houtman I, Bongers P, Smulders P, Kompier M. Psychosocial stressors at work and musculoskeletal problems. Scand J Work Environ Health 1994; 20: 139-45.
13. Karasek R, Gardell B, Lindell J. Work and non work correlates of illness and behaviour in male and female Swedish white collar workers. Journal of Organisational behavior 1987; 8: 187-207.
14. North F, Syme S, Feeney A, Head J, Shipley M, Marmot M. Explaining socioeconomic differences in sickness absence: the Whitehall II Study. BMJ 1993; 306: 361-6.
15. North F, Syme S, Feeney A, Shipley M, Marmot M. Psychosocial work environment and sickness absence among British civil servants: the Whitehall II study. Am J Public Health 1996; 86: 332-40.
16. Vahtera J, Pentti J, Uutela A. The effect of objective job demands on registered sickness absence spells; do personal, social and job-related resources act as moderators? Work Stress 1996; 10: 286-308.
17. de Jonge J, Reuvers M, Houtman I, Bongers P, Kompier M. Linear and nonlinear relations between psychosocial job characteristics, subjective outcomes, and sickness absence: baseline results from SMASH. Study on Musculoskeletal Disorders, Absenteeism, Stress, and Health. J Occup Health Psychol 2000; 5: 256-68.
18. Kristensen T. Sickness absence and work strain among Danish slaughterhouse workers: an analysis of absence from work regarded as coping behaviour. Soc Sci Med 1991; 32: 15-27.
19. Theorell T, Harms-Ringdahl K, Ahlberg-Hulten G, Westin B. Psychosocial job factors and symptoms from the locomotor system--a multicausal analysis. Scand J Rehabil Med 1991; 23: 165-73.

20. Coetsier P, De Backer G, De Corte W, et al. Etude belge du stress au travail: aperçu du modèle de recherche et des outils d'investigation.[Belgian study of work stress: outline of research model and research tools] Psychologie & Psychométrie 1996; 17: 17-35.
21. International Standard Classification of Occupations: ISCO-88. Geneva: 1990.
22. Liberatos P, Link B, Kelsey J. The measurement of social class in epidemiology. Epidemiol Rev 1988; 10: 87-121.
23. Dirken JM. Arbeid and gezondheid. Groningen: Wolters-Noordhoff, 1969.
24. Monica Manual. Geneva: World Health Organisation, 1990.
25. Jones Deborah. The MONICA Optional Study of Physical Activity (revised manual of operations). 1994.
26. Karasek R, Baker D, Marxer F, Ahlbom A, Theorell T. Job decision latitude, job demands, and cardiovascular disease: a prospective study of Swedish men. Am J Public Health 1981; 71: 694-705.
27. Bosma H, Marmot M, Hemingway H, Nicholson A, Brunner E, Stansfeld S. Low job control and risk of coronary heart disease in Whitehall II (prospective cohort) study. BMJ 1997; 314: 558-65.
28. Pelfrene E, Vlerick P, Mak R, De smet P, Kornitzer M, De Backer G. Scale reliability and validity of the Karasek "Job Demand-Control-Support" model in the Belstress study. Work and Stress 2001; 15: 297-313.
29. Karasek R. Job Content questionnaire. Department of Industrial and Systems Engineering. Los Angeles: University of California, 1985.
30. Radlof L. The CES-D Scale: a self-report depression scale for research in the general population. Appl Psychol Meas 1977; 1: 385-401.
31. Kohout F, Berkman L, Evans D, Cornoni-Huntley J. Two shorter forms of the CES-D Depression Symptoms Index. Journal of aging and health 1993; 5: 179-93.
32. Carpenter J, Andrykowski M, Wilson J, et al. Psychometrics for two short forms of the Center for Epidemiologic Studies-Depression scale. Issues Ment Health Nurs 1998; 19: 481-94.
33. Preville M, Boyer R, Potvin L, Perrault C, Légaré G. La detresse psychologique: détermination de la fiabilité et de la fiabilité de la mesure utilisée dans l'enquête Santé Québec. [Psychological distress: reliability and measure reliability determination used in Quebec Health survey] Cahiers de recherche n° 7. Québec: Gouvernement du Québec, Ministère de la santé et des services sociaux, Direction des communications, 1992.
34. Ilfeld F. Further validation of a psychiatric Symptom Index in a Normal population. Psychological Report 1976; 39: 1215-28.
35. Pearlin L, Schooler C. The structure of coping. J Health Soc Behav 1978; 19: 2-21.
36. Berkman L, Syme S. Social networks, host resistance, and mortality: a nine-year follow-up study of Alameda County residents. Am J Epidemiol 1979; 109: 186-204.
37. Amirkhan J, K. A factor analytical derived measure of coping: the coping strategy indicator. J Pers Soc Psychol 1990; 5: 1066-74.
38. Coetsier P, De Backer G, De Corte W, et al. Onderzoeksdesign en instrumentarium van het belgish jobstress onderzoek – Modele de recherche et manuel de travail de l'étude Belge du stress au travail.[Research model and work manual of the Belgian study of work stress] Theoretishe en toegepaste Psychologie 1996; n° 6.
39. The "Minnesota Code" for ECG classification. Adaptation to CR leads and modification of the code for ECGs recorded during and after exercise by the Scandinavian Committee on ECG Classification. Acta Med Scand Suppl 1967; 481: 1-26.

40. Marmot M, Feeney A, Shipley M, North F, Syme S. Sickness absence as a measure of health status and functioning: from the UK Whitehall II study. J Epidemiol Community Health 1995; 49: 124-30.
41. Szubert Z, Szeszenia-Dabrowska N. [Diagnosis and the reasons for absenteeism among workers with frequent and long-term diseases], N. Med Pr 1990; 41: 264-9 (Abstract).
42. Hosmer D, Lemeshow S. Applied logistic regression. New York, Chichester, Brisbane, Toronto, Singapore: John Wiley & sons, 1989.
43. Kristensen T. The demand-control-support model: methodological challenges for future research. Stress medicine 1995; 11: 17-26.