Belgian predictive models of absenteeism for sickness or accident.

Foreword

The Belgian study on job stress, in abbreviated form BELSTRESS is a multidisciplinary and longitudinal study realised as part of the program of scientific support to the protection of the worker. This programme started end 1994 ; it is co-ordinated and financed by the services of the Prime minister – "Services Fédéraux des Affaires Scientifiques, Techniques et Culturelles" (SSTC) as well as by the "Fond de la Recherche scientifique Médicale (FNRS)". In this study, we used the most important job stress model : "Demand / Control / Social support" (JDCS) developped by R.Karasek, T.Theorell and J.Johnsson. Two reports [1,2] have been realised beginning 1999 and allowed us to determine the distribution of the scales of this model from data collected in companies from different sectors of industry. In these reports, we showed that job stress perception vary according to the occupation and this independently from the age and the level of education in both genders. We showed also in men that independently from age and the level of education, the scales of perceived job stress are varying for the same occupation according to the sectors of activity. We showed also that JCQS scales are associated with depression, consumption of psychotropic drugs, scale of complaints (health perception) as well as the exhaustion scale. This has been the subject of publications in international scientific journals [3,4]. Concerning the relation between job stress and sick leave, only a sub-cohort of 12.708 subject was analysed giving only preliminary results.

In order to perform extensive research on these data, a new project called "Belgian predictive model of absenteeism for sickness absence or accident" started end 2000 thank to the support of the SSTC as part of the program of pluriannual research concerning existing problems as regards social cohesion.

Introduction

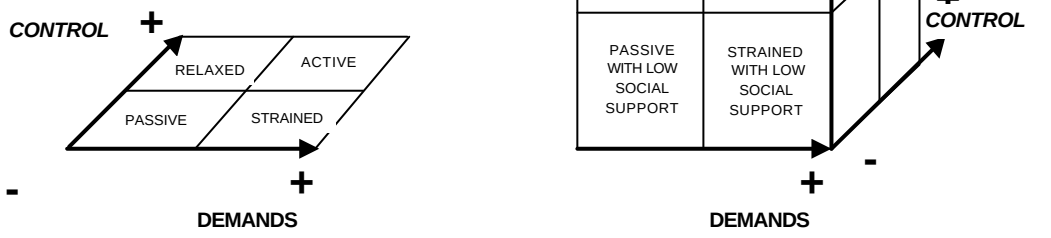
It is increasingly admitted that job stress has negative consequences on the worker's health. Thus, some studies have suggested that occupational stress is related to ill health and could induce absenteeism for sickness or accident [5-11]. However most of these studies have important limitations such as a cross-sectional design[4] , a self-reported sick leave or don't control for some important variables.

In 1978, R.Karasek proposed a new job stress model (" Job Demands-Control" model or JDC) that states that the very origin of stress lies within the job environment and clearly described job characteristics associated with stress [12-15] (fig 1). This JDC model postulates that psychological strain, and subsequent illness, result from the interaction of two types of job characteristics: psychological demands of the work situation (stressors) and environmental moderators or 'buffers' such as job control (decision latitude). Psychological job demands include several potentially stressors affecting work: perception of the workload, the work rhythm and possible conflicting demands. Job control or decision latitude on the other hand includes control over use of skills, time allocations, and organisational decisions[12-14]. Very quickly, a third scale, social support at work has been developed by Johnson and Hall[16-21] and has been added to the first model (JDCS model). Social support includes support received from colleagues and superiors and could serve as buffering the combination of high demands and low control or decision latitude.

The main hypothesis of the JDCS model states that occupations with high psychological demands and low control on these demands are stressful. In the last model (JDCS), the worst combination, iso-strain –high demands, low control and low support-, would have the most adverse health consequences (fig 1).

Some studies used the JDCS model to study coronary heart disease [14,22-30] as well as psychological disorder, health status and functioning [3,31-35]. However, few studies tested the model (specially the complete model) to study absenteeism for sickness or accidents[36-43].

Figure 1 : MODEL OFKARASEK



MODELE OF KARASEK WITH 2 DIMENSIONS

MODEL OF KARASEK WITH 3 DIMENSIONS

In order to clarify the text, we will from now on use the term of absenteeism, meaning absenteeism for sickness or accidents. Actually, as in Belgium every spell of sickness absence require a medical certification, absenteeism is an important measure of worker's health.

[4] It means studies in which stress and health problems are measured at the same time. In longitudinal studies, stress is measured before health problems.

Methods

Participants

The fieldwork in 25 large companies or public administrations across Belgium has been conducted in the period between 1994 and 1998. Data collection has been co-ordinated by the department of epidemiology of the School of Public Health of the "Université Libre de Bruxelles (ULB)" and the "Vakgroep Maatschappelijke Gezondheidkundige, Universiteit Gent (UG)". A total of 21,419 subjects aged 35-59 years accepted to participate to this study, which represent 48% of the group of subjects who were asked to participate.

Main independent variables

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

Job characteristics

Scales of job demands, control and social support at work

The Karasek's questionnaire [25] has been used. On a total of 26 questions, 9 are dealing with psychological job demands, 9 questions with control or decision latitude and 8 with global social support at work (colleagues and superiors). The questionnaire has been translated into French, back translated into English and validated by R.Karasek. A Dutch version has been also translated and tested in a pilot study. These scales proved to contain acceptable internal consistency (a between 0.66 and 0.87 in men and between 0.66 and 0.88 in women) and scale validity in the Belstress cohort [4].
The combination of the 2 scales –demands and control- allowed us to define 4 categories of jobs (fig 1):

'passive': combination of low demands and low control or decision latitude

'relax': combination of low demands and high control or decision latitude

'**active**': combination of high demands and high control or decision latitude

'strained': combination of high demands and low control or decision latitude

This scale was categorised later in 'high strained' and 'low strained'.

The scale 'iso-strain' has been developed from the 3 scales –demands, control and social support- defining eight job categories (the same than for the 'strain' scale each time divided in high or low social support at work). The scale has been categorised later in 4 ("strained with low social support" versus "strained with high social support" versus " not strained with low social support" versus "not strained with high social support") and later 2 categories ("strained with low social support" versus "other types of job").

Scale of perception of the globalisation of the economy

Scale proposed by Karasek and developed from 3 questions [44].

Socio-demographic variables

Age, sex, marital status and standardised question on the level of education (elementary, secondary and university).
Occupation: job title was classified using the International Office of work , the ISCO-88 classification [45]. A new 3 categories variable was created from the 9 original categories [ISCO 1-2 (upper-white collars), 3-5 (white collars) and 7-9 (blue collars)].
Sector of activity: companies were categorised in 3 sectors: secondary (industrial ex. Cockerill, Glaverbel), tertiary (services ex. Dexia, AG) and public (ex. Public administration).
Social support outside the work: we used the standardised questionnaire from Berkman and Syme (number of social contacts with family and friends) [46].

Health variables

Health symptoms and presence of long-standing diseases: presence of angina, respiratory problems based on the Rose et al. questionnaire [47] ; history of diabetes based on the questionnaire MONICA[48].
Health perception: The 'Current Health Index' (CHI) is a score computed from the VOEG scale (Vragenlijst Over Ervaren Gezondheid) [questionnaire on health perception], a Dutch scale built up from 13 closed questions [49].
Depression: The Iowa short version (11 items) of the original CES-D scale [50] developed by Kohout et al. was used.
Personal psychological characteristics
Type of coping: scales of the 3 main type of coping with stress described by Amirkhan were used [51]: problem solving coping, social support coping and avoidance coping.
Lifestyles
Smoking habits and alcohol consumption: the standardised questionnaire from the MONICA study was used[48].
Physical activity: we used a shortened version of a validated sub-study of MONICA (MOSPA)[52].

Clinical and biological variables

- Anthropometric data: height, weight from which body mass index was computed (BMI). We used also in some analyses the waist circumference as an indicator of abdominal obesity.
- 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 and HDL cholesterol.
- Electrocardiogram: the CHD prevalence at baseline was assessed using the Minnesota code [53].

Dependant variable

The dependant variable is absenteeism for sick leave or accident.
All workers who participated in the baseline examination agreed to be followed for sick leave. Computerised sickness absence records were obtained from 24 out of the 25 companies. A second year of follow-up has been obtained for 11 of them. All the workers with a follow-up less than 1 year (deceased persons, (pre)-retirement, dismissals, resignation, lost to follow-up) were excluded from the analyses. We excluded also absenteeism due maternal leave. Finally a total of 20,463 workers (15,557 males and 4,906 females) were followed for sick leave during a complete year.
We used the percentile 75[5] (P75) of the distribution of the total annual sickness days as cut-off to classify the workers with a high one-year incidence rate of sick leave. Percentile 75 has been calculated in each occupational grade separately in men and women. The other end-points were short spells (at least 1 short spell [<= 7 days] per year), medium spells (at least 1 medium spell [8-27 days] per year), long spells (at least 1 long spells [>=28 days] per year) and repetitive spells of sick leave (at least 3 spells per year whatever the duration).

Statistics

For descriptive and univariate analyses, we used the t-test as well as the χ^2, the Mann-Whitney and the Kruskall-Wallis tests.
The odds ratios (OR) adjusted for age and their 95% confidence intervals were calculated using logistic regression.
In the multivariate analyses, we used also logistic regression. Different models have been worked out and will be explained later. The results are also expressed in OR and confidence intervals were calculated using a = 0,05 meaning that we have 95% of chance that the true OR is between these two boundary marks. As it is a longitudinal study, all OR can be interpreted as risk ratio (RR), meaning the ratio between the risk of observing a case (having sickness absence) when the risk factor is present (being under strain) and the risk of observing this case (having sickness absence) when the risk factor is not present (no strain). In our example, a RR of 1 means that the risk of having sickness absence being under strain is equal to the risk of having sickness absence when there is no strain.

[5] The percentile 75 of the distribution of the total annual sickness days is the total number of sickness absence above which we find 25% of the workers. The percentile 75 in men is 10 days and 15 days in women. Workers having more than 10 annual sickness days (15 for women) are considered as having a high sickness absence incidence.

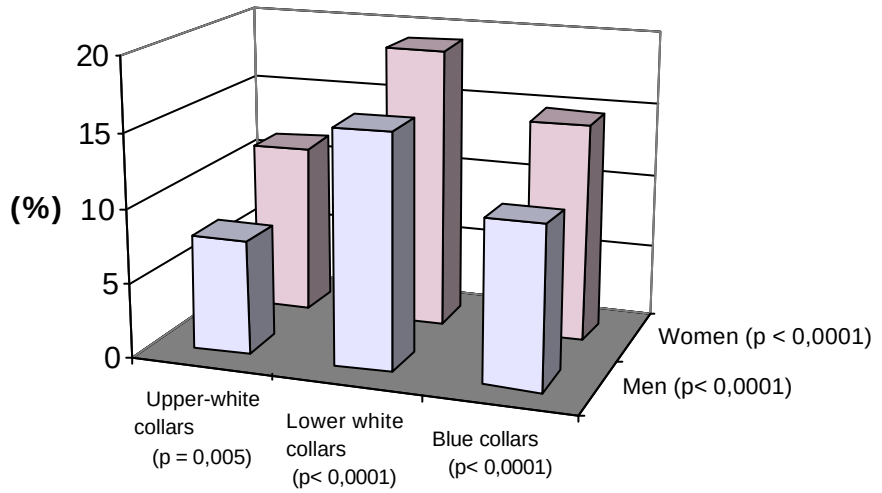
A RR of 2 means that the risk of having sickness absence being under strain is twice the risk of having sickness absence when there is no strain. To clarify the text, we always used the term risk ratio (RR).
For the demands scale, the first quartile [6] has always been used as a reference. For the control and social support scale, the last quartile [7] or tertile [8] was used as a reference.
The "Hosmer and Lemeshow" test has been used to test the fitting of the models [54]. Sick leave data processing has been done with SAS version 6. All analyses were done in SPSS 10.0 for Windows.
The study has been approved by the medical ethics committee of the faculty of medicine of the Brussels Free University.

Results-Comments

DESCRIPTIVE DATA

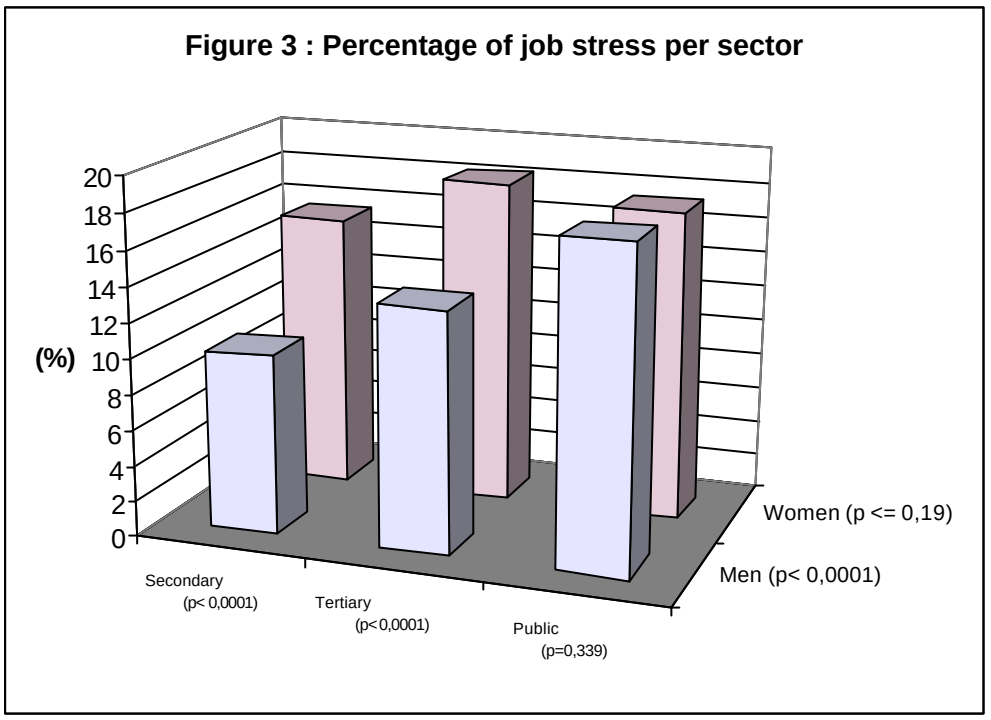
- Using as definition of strained jobs all jobs combining high psychological demands, low control and low social support, the percentage of these jobs is higher in women than in men (17.3% versus 12.3%). After stratifying by occupation or by sector, we observed the same difference excepted for the public sector (fig 2 & 3).
  In both genders, the percentage of strained jobs is the highest in white collars and the lowest in upper-white collars.
  In men, the percentage of strained jobs is the highest in the public sector whereas there is no statistical difference between the sectors in women.

Figure 2 : Percentage of job stress per occupational grade



- We observed that the mean of the total number of sick leave as well as medium and long absences increase when the occupational grade decrease (ISO-88 1 digit). On the other hand, short absences are more frequent amongst lower white collars than in higher white collars and blue collars.
- Women have always more sick leave than men whatever the duration of sick leave.
- In both genders, blue collars have spells of longer duration than upper-white and white collars (figure 3).

[6] Meaning 25% of subjects having the lowest psychological demands.
[7] Meaning 25% of subjects having the highest control.
[8] Meaning 25% of subjects having the highest social support.



- Whatever the occupational grade in men, sick leave incidence is quite similar in the secondary and tertiary sectors and clearly less prevalent than in the public sector. We observed the same in women.

To summarise, we can say that sick leave percentages in the secondary and tertiary sector are quite similar but is clearly less important than in the public sector whatever the gender, the occupational grade and the duration of the spell.

ASSOCIATION JOB STRESS –SICK LEAVE

- ***HYPOTHESE 1***

  - **"A complex multivariate model of sick leave can be worked out from job environmental variables, behavioural variables, personality characteristics variables and finally from bioclinical variables."**

Univariate analyses

We observed a clear association between job characteristics and high sick leave incidence (>= P75) whatever the gender and the occupational grade. Thus, sick leave significantly decrease when the control or social support increase whatever the gender and the occupational grade. On the other hand, we didn't observe any association between the psychological demands and high sick leave incidence excepted in female blue collars.
When combining the 2 scales –psychological demands and control-, we observed also an association between sick leave and job 'strain', the most important percentage of high incidence of sick leave being observed amongst those having a 'high strained' job.
When combining the 3 basic scales, the most important percentage of high incidence of sick leave is observed amongst those having a 'high strained' job with low social support.

Bivariate analyses[9]

After adjustment for age, we observed always in men that a lack of control and social support go together with an excess of absenteeism whatever the gender and the occupational grade. Thus, male upper-white collars who reported low level of control (quartile 1) have a 2.29 fold increase in the age adjusted risk of having high rate of sick leave (>= P 75)

[9] Analyses taking into account one variable (co-variable) besides the dependant variable (sick leave) and the independant variable (strain).

compared to those who reported high levels of control (quartile 4) [RR 2.29 (1.80-2.92)]. For lower-white collars and blue collars, we observed RR of 2.15 and 1.61 respectively. We observed also that males upper-white collars who reported low social support at work (tertile 1) have a 1.40 fold increase (40% increase) in the age adjusted[10] risk of having high rate of sick leave (>= P 75) compared to those who reported high levels of social support (tertile 3) . For lower-white collars and blue collars, we observed RR of 1.62 and 1.32 respectively.
In women, a lack of control and social support go also together with an excess of absenteeism in the 3 occupational grades. However, these associations are only significant in lower-white collars. Thus, female lower-white collars having a job with low control (being in the quartile 1) have a 1.52 fold increase (52% increase) in the age adjusted risk of having high rate of sick leave (>= P 75) compared to those who reported high levels of control (quartile 4).
When combining the 2 first primary scales –control and demands-, we observed an important association between the different type of jobs and high sick leave incidence. Thus, in men, upper-white collars having a 'high strained' job have a 1.62 fold increase (62% increase) in the risk of having a high annual sick leave incidence compared to those having a 'relax' job. For lower-white and blue collars, the RR are 1.76 (76% increase) and 1.58 (58% increase) respectively.
In women, we observed very similar results. Thus in upper-white collars, 'high strained jobs' are associated with a 39% increase of the risk of having a high annual sick leave incidence compared to 'relaxed' jobs.
When combining the 3 first primary scales, we observed in both gender that 'high strained jobs' with low social support are associated with a higher risk of high annual incidence of sick leave than other kind of jobs.

Multivariate analyses[11]

All the associations observed in uni and bivariate analyses are observed in the different multivariate models but they are less pronounced.

In summary, these results allow us to confirm our primary hypothesis: in our study, sick leave is influenced by job stress, or by one or more components such as control or social support. Actually, even after adjustment[12] for many confounding variables (socio-economic and biomedical variables), we observed in almost all occupational grades and in both sex a significant association between job characteristics and sick leave.

Table 1
High annual incidence of sick leave (>= P75) in relation with job characteristics stratified by gender and occupational grades, adjusted for different factors*

MEN		UPPER-WHITE COLLARS >= P75	LOWER-WHITE COLLARS >= P75	BLUE COLLARS >= P75
Job characteristics		RR	RR	RR
Psychological demands		(n=2339;637 cases)	(n=5285;1329 cases)	(n=4599;1132 cases)
Low (Quartile 1)		1	1	1
High (Quartile 4)		0.80	0.75	0.92
	p	Ns	0.03	Ns
Control				
Low (Quartile 1)		2.12	1.69	1.27
High (Quartile 4)		1	1	1
	p	< 0.0001	< 0.0001	0.07
Support Social at work				
Low (Quartile 1)		1.10	1.24	1.16
High (Quartile 4)		1	1	1
	p	Ns	0.03	Ns

[10] Meaning taking into account age
[11] Analyses taking into account other variables (co-variable) besides the dependant variable (sick leave) and the independant variable (strain).
[12] Meaning taking into account many other variables

Table 1 (con't)
High annual incidence of sick leave (>= P75) in relation with job characteristics stratified by gender and occupational grades, adjusted for different factors*

Job 'Strain'				
Relax		1	1	1
Active		0.75	0.88	0.74
Passive		1.49	1.45	1.00
High strained		1.30	1.27	1.11
	p	< 0.0001	< 0.0001	0.002
'Strain' at work				
Not strained		1	1	1
High Strained		1.14	1.09	1.20
	p	Ns	Ns	0.03
'Iso-strain' at work				
Other types of jobs		1	1	1
High strained jobs with low social support		1.39	1.23	1.30
	p	0.03	0.03	0.006

* Adjusted for age, marital status, blood pressure hypertension, total cholesterol, body mass index, smoking, presence of chronic diseases (diabetes by questionnaire and coronary diseases assessed by EKG), physical activity outside the work, sector of activity, health perception and depression.

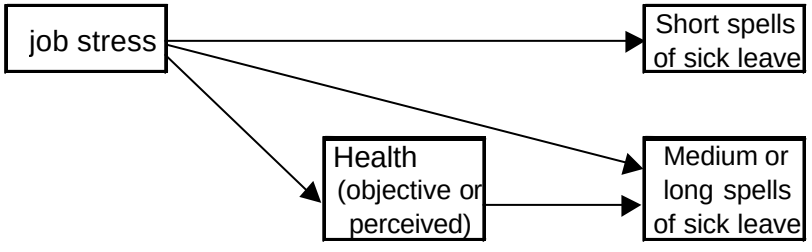
Other predictive variables: Upper-white collars: smoking, sector, health perception and social support outside the work.
Lower-white collars: age, smoking, diabetes, sector, health perception and depression.
Blue collars: body mass index, smoking, sector and health perception.

❖ ***HYPOTHESIS 2***

❑ **"Predictive multivariate model of sick leave could be different for short spells of sick leave (1-7 days and 8-27 days) and long spells of sick leave (>= 28 days)".**

Whatever the duration of spells studied, we observed an association between sick leave and job stress according to the Karasek's model ('strain' and 'iso-strain') as well as 2 of his components, control and social support at work. However, job stress influence in a different way short, medium or long spells of sick leave. Job stress (or his components) predict in a **direct** way short spells of sick leave without involvement of health or health perception in the causal pathway. On the other hand, for medium and long spells of sick leave, health and health perception are involved in the causal pathway between sick leave and job stress. This has already been described in the U.K.[55].
Sick leave could be considered "as a conscious coping behaviour seen in the light of a person's wish to keep his/her health and working capacity" [42].

Figure 4 : Stress, health and sick leave



❖ ***HYPOTHESIS 3***

❑ **"The predictive model of sick leave will be applied to men and women, private companies as well as civil servants (public services) as well as subjects of different occupational grade (ISCO 88)"**.

The results of these analyses allow us to conclude that job characteristics are associated with sick leave whatever the sector of activity and the occupational grade: lack of control and social support as well as 'high strained' and 'high strained jobs with low social support' ('iso-strain') is associated with a higher risk of sick leave. The RR are varying a little from one sector to another. Although sick leave vary from one sector to another, workers "react" in the some way to high strained job environments.

❖ ***HYPOTHESIS 4***

❑ **"A model will be also proposed for repetitive spells of sick leave".**

The results of these analyses allow us to conclude that job characteristics are associated with 'repetitive' spells of sick leave whatever the sex and the occupational grade: lack of control and social support as well as 'high strained' and 'high strained jobs with low social support' ('iso-strain') is associated with a higher risk of repetitive spells of sick leave even after adjusting for a wide range of potential. In table 2 (model 1), we adjusted for the 3 job stress scales, age as well as for marital status and the sector. The associations observed in the previous analyses are found again but a little less pronounced. In males, lack of control is the most associated with sick leave with RR from 1.45 to 2.92.

In females, it was not possible to perform the analyses in the upper-white collars because of insufficient cases observed. Contrary to men, the combination of the primary scales ('iso-stress') is predicting better sick leave than the primary scales used separately with RR from 1.64 to 1.85.

Table 2

« At least 3 spells of sickness absence per year in relation with job characteristics, stratified by sex and occupational grade, adjusted for socio-demographic variables (Modèle 1).

MEN		UPPER-WHITE COLLARS >= 3 spells	LOWER-WHITE COLLARS >= 3 spells	BLUE COLLARS >= 3 spells
Job characteristics		OR (CI 95%)	OR (CI 95%)	OR (CI 95%)
Control		(n=2569 – 213 cases)	(n=6024 – 986 cases)	(n=5530 – 762 cases)
Low (Quartile 1)		2.92	1.59	1.45
High (Quartile 4)		1	1	1
	p	< 0.0001	< 0.0001	0.001
Support Social at work				
Low (Quartile 1)		1.38	1.50	1.26
High (Quartile 4)		1	1	1
	p	Ns	< 0.0001	0.056
Job 'Strain'				
Relax		1	1	1
Active		1.04	0.90	1.07
Passive		2.01	1.35	1.12
High strained		1.70	1.53	1.59
	p	0.001	< 0.0001	< 0.0001
'Strain' at work				
Not strained		1	1	1
High Strained		1.13	1.33	1.48
	p	Ns	0.001	< 0.0001
'Iso-strain' at work				
Other types of jobs		1	1	1
High strained jobs with low social support		1.31	1.65	1.55
	p	ns	< 0.0001	< 0.0001

WOMEN			
Control	(n=449 – 73 cases)	(n=2927 – 746 cases)	(n=841 – 170 cases)
Low (Quartile 1)		1.59	0.88
High (Quartile 4)	Not enough	1	1
p		0.001	Ns
Support Social at work			
Low (Quartile 1)	cases	1.26	1.80
High (Quartile 4)		1	1
p		0.07	0.028
Job 'Strain'			
Relax	Not enough	1	1
Active		0.98	0.87
Passive	cases	1.23	0.69
High strained		1.42	1.11
p		0.011	Ns
'Strain' at work	Not enough		
Not strained		1	1
High Strained	cases	1.31	1.33
p		0.01	ns
'Iso-strain' at work	Not enough		
Other types of jobs		1	1
High strained jobs with low social support	cases	1.64	1.85
p		< 0.0001	0.006

Adjusted for psychological demands at work, social support at work, age, marital status and the sector.
Other predictive co-variables (M) : Upper-white-collars : sector.
Lower-white collars: age and sector.
Blue collars: sector and marital status.
Other predictive co-variables (F) : Lower-white collars: sector.
Blue collars: sector

Generally, we observe in both gender a homogeneity of the results across the 3 occupational grade for job control, social support at work, strain as well as 'iso-strain'.

❖ ***HYPOTHESIS 5***

❑ **"The model will take into account interactions between variables (variables with modificator effect)"**

The effect of job stress on sick leave could be different according the occupational grade, the sector or personal characteristics such as the "locus of control", the coping style, the problem management, the language (French/Dutch), the marital status or according to the family situation such as the presence of children less than 5 years old in the family and finally the responsibility towards sick or elderly persons. One could imagine that the effect of job stress on sick leave could be more important on isolated persons than for married persons (meaning that the variable "marital status" has a modificator effect on the influence of job stress on sick leave).
In fact, none of the studied variables showed a modificator effect on the relation between job characteristics and sick leave. It seems that in front of stress, there is no differences of reacting in term of sick leave between subjects coming from different sectors, having different occupational grade or personal psychological characteristics or different cultural background or a different familial situation.

❖ ***HYPOTHESIS 6***

❑ **"High perception of helplessness resulting from an economical globalisation increases short spells as well as repetitive spells of sickness absence".**

The results of these analyses allow us to reject this hypothesis. Although in univariate analysis we observed a significant association between sick leave and the perception of the globalisation of the economy, it disappeared after adjustments for the sector of activity and the stress scales. Therefore, the perception of the influence of the globalisation in the work is not an independent predictor of sick leave. Moreover, the hypothesis predicted an increase of sick leave along with an increase of the perception of globalisation of the economy. Further analyses should be realised in order to better understand the effect of this variable on sick leave in the different sectors.

❖ ***HYPOTHESIS 7***

❑ **"In order to study the robustness of the model, a second year of follow-up of sick leave will be asked from the companies who sent sick leave data during the first year."**

We observe in our study that stress models keep their predictivity of sick leave during the second year of follow-up in both genders: lack of control or social support at work as well as 'high strained' jobs and 'high strained' jobs with low social support ('iso-strain') are predicting a higher number of spells of sick leave. Thus men who reported low job control (quartile 1) have a 59% increased risk of having at least one absence per year (RR 1.59) during the first year of follow-up and a 33% increased risk (RR 1.33) during the second year. We can observe the same for social support : men who reported low job control (quartile 1) have a 39% increased risk of having at least one absence per year (RR 1.39) during the first year of follow-up and a 35% increased risk (RR 1.35) during the second year. The association between job strain and sick leave is no more significant but the tendency of more spells of sick leave in case of strain persists. The association between 'iso-strain' at work and sick leave remains significant and tends even to increase (1.31 for the first year and 1.38 for the second).
In women, the association between job control and sick leave is decreasing a little during the second year. However, we observe again an excess of sick leave in case of lack of control. Thus, women who reported low job control (quartile 1) have a 42% increased risk of having at least one absence per year (RR 1.42) during the first year of follow-up and a 34% increased risk (RR 1.34) during the second year. On the opposite, the association between social support and sick leave is increasing a little . For 'High strained jobs with low social support', the association becomes stronger and significant (RR are 1.37 for the first year and 1.70 for the second).
These variations can be explained amongst others by changes of risks factors occurred during the second year of follow-up. (job characteristics, economic and situation).

Table 3
"At least one spell of sick leave per year" in relation with job characteristics (1st and 2nd years of follow-up) adjusted for various factors* in men.

		Year 1 RR (4077 cases)	Year 2 RR (4029 cases)
Psychological demands			
Low (Quartile 1)		1	1
High (Quartile 4)		0.95	0.97
	p	Ns	Ns
Job control			
Low (Quartile 1)		1.59	1.33
High (Quartile 4)		1	1
	p	< 0.0001	0.001
Social support at work			
Low (Quartile 1)		1.39	1.35
High (Quartile 4)		1	1
	p	< 0.0001	< 0.0001
'Strain' at work			
No strain (n=6003)		1	1
Strain (n=1347)		1.19	1.12
	p	0.008	0.08
'Iso-strain' at work			
Other type of work (n=6552)		1	1
Strain with low support (n=798)		1.31	1.38
	p	0.001	< 0.0001

* Adjusted for age, occupational grade, level of instruction, marital status, social support outside work, sector, body mass index, smoking and alcohol consumption.
* p<=0.05 ** p<= 0.01 *** p<= 0.001 *** p<= 0.0001

Table 4 "At least one spell of sick leave per year" in relation with job characteristics (1st and 2nd years of follow-up) adjusted for various factors* in women.

		Year 1 RR (1432 cases)	Year 2 RR (1462 cases)
Psychological demands			
Low (Quartile 1)		1	1
High (Quartile 4)		1.02	1.32
	p	Ns	Ns
Job control			
Low (Quartile 1)		1.42	1.34
High (Quartile 4)		1	1
	p	0.016	Ns
Social support at work			
Low (Quartile 1)		1.32	1.53
High (Quartile 4)		1	1
	p	0.005	0.005
'Strain' at work			
No strain (n=6003)		1	1
Strain (n=1347)		1.22	1.26
	p	Ns	0.09
'Iso-strain' at work			
Other type of work (n=6552)		1	1
Strain with low support (n=798)		1.37	1.70
	p	0.053	0.002

* Adjusted for age, occupational grade, level of instruction, marital status, social support outside work, sector, body mass index, smoking and alcohol consumption.
* p<=0.05 ** p<= 0.01 *** p<= 0.001 *** p<= 0.0001

❖ ***INTERVENTION ON JOB STRESS AND INFLUENCE ON SICK LEAVE***

As we can see, job control and social support are the most significantly inversely associated with sick leave. Therefore, in a program of reduction of job stress, we will operate on these job characteristics. Therefore, we will estimate the percentage of avoided sick leave by increasing job control and social support using the prevalence of jobs with low control and a low social support as well as the RR obtained in multivariate analyses for these characteristics. We made these estimation first separately for men and women (table 5). In the first column, we indicated the RR obtained by logistic regression. These are adjusted for age, language (french / dutch), sector, occupational grade, level of education, psychological and physical demands, smoking, alcohol consumption and BMI (body mass Index).

Table 5
Estimation of the impact of measures increasing job control and social support in men and women.

	RR	Attributable fraction amongst exposed° (%)	At risk subjects°° (%)	Attributable fraction in the population°°° (%)	Number of sickness absence days avoided per 1000 subjects
HIGH SICK LEAVE INCIDENCE					
JOB CONTROL					
Men	1.30	23.1	44.6	10.3	814
Women	1.28	21.9	45.1	9.9	923
SUPPORT SOCIAL					
Men	1.25	20.0	40.8	8.2	648
Women	1.28	21.9	42.3	9.3	867
MEDIUM SPELLS					
JOB CONTROL					
Men	1.24	19.4	44.6	8.7	-
Women	1.35	26.0	45.1	11.7	-
SOCIAL SUPPORT					
Men	1.25	20.0	40.8	8.2	-
Women	1.22	18.0	42.3	7.6	-
LONG SPELLS					
JOB CONTROL					
Men	1.54	35.1	44.6	15.7	-
Women	1.40	28.6	45.1	12.9	-
SOCIAL SUPPORT					
Men	1.20	16.7	40.8	6.8	-
Women	ns	-	42.3	-	-
REPETITIVE SPELLS					
JOB CONTROL					
Men	1.31	23.7	44.6	10.6	-
Women	1.35	26.0	45.1	11.7	-
SOCIAL SUPPORT					
Men	1.31	23.7	40.8	9.7	-
Women	1.38	27.5	42.3	11.6	-

° The attributable fraction amongst exposed was calculated by the formula: (1 – OR)/OR: OR's were obtained by logistic regression adjusting for age, language, sector, occupational grade, level of education, psychological and physical demands, body mass index, smoking and alcohol consumption.
°° At risk subjects are those reporting a job control or a social support under the median.
°°° The attributable fraction in the population is obtained by multiplying the attributable fraction amongst exposed by the prevalence of at risk subjects.

In the second column, we calculated the attributable fraction among exposed workers using the formula (1 – RR)/RR. The third column is the percentage of people at risk (prevalence of exposition to low control or low social support). The results of the fourth column were obtained by multiplying the second column by the third (it is the attributable fraction in men and women meaning the percentage of sick leave that could be avoided for in the total population) (strained or not). The last column gives an estimation in days that could be avoided for 1000 people. Thus, increasing the level of job control in men could reduce high sick leave incidence of 10.3% [(1.30-1.00)/1.30 x 44.6%] that is to say 814 days per 1000 subjects. We have similar results in women. In general, increasing job control or social support could reduce globally sick leave of 10% with a minimum of 6.8% and a maximum of 15.7%.

❖ ***OTHER HYPOTHESIS***

❖ *Body mass index – waist circumference in relation with sick leave*

Whatever the gender and sick leave end-points used, body mass index was never selected in none of the logistic regression models as a predictor of sick leave. Waist circumference is the only independent predictor of sick leave. Compared to those having a waist circumference under 94 cm, male subjects having a waist circumference above 102 cm have a 22% increase in the risk of having high sick leave incidence and a 19% increase in the risk of having long spells of sick leave. In women, we have similar results. Compared to those having a waist circumference under 80 cm, female subjects having a waist circumference above 88 cm have a 59% increase in the risk of having high sick leave incidence.

❖ *Smoking in relation with sick leave*

Whatever the gender, we found a positive association between smoking and sick leave whatever the definition used. In men, age-adjusted OR range from 1.26 for short spells to 1.65 for long spells. In women, the results are similar.

In the multivariate analysis, smoking is positively associated in men with sick leave whatever the definition used. The risk of sick leave is multiplied by 1.15 for short spells and by 1.26 for long spells.

In women, only high sick leave incidence is associated with smoking with an OR of 1.36.

❖ ***GENERAL CONCLUSIONS***

In this study, we showed that the percentage of job stress (jobs combining high psychological demands, low control and low social support) was more important in women than in men excepted in the public sector where the percentage is similar in both gender. This percentage is the highest in lower-white collars and the lowest in upper-white collars. It is also higher in the public sector in men although in women, we didn't observe any significant differences between the sectors.

We showed also that sick leave was more important in women than in men whatever the occupational grade and the sector of activity. We found also that in general sick leave increases when qualifications decrease. We found also that sick leave in the public sector is more important than in the 2 other sectors specially in men and for short or repetitive spells of sickness absence.

Concerning the relation between job stress and sick leave, we found the Karasek'model to be very robust. According to the results of this study, we can conclude that perceived job stress is an independent risk factor of sick leave on a period of 2 years whatever the gender, the occupational grade or the sector of activity.

Moreover, using this model allowed us to identify job characteristics playing a major role in the relation between stress and sick leave that is to say a **perception of low job control** as well as a **perception of low social support at work**. It gives precious clues on what should be changed in work and its organisation to reduce stress and its consequences.

On the other hand, we didn't observe any association between high psychological demands and sick leave. These seem to be harmful only in combination of a lack of control and/or social support.

According to our results, measures intending to increase job control and social support at work in a population of worker could reduce sick leave of 10 to 15 %.

We didn't find any variables with a modificator effect. It suggests that perceived job stress influence sick leave in the same way whatever the occupational grade, the sector, the familial situation and the personal psychological characteristics.

In both genders, perception of globalisation of the economy is not significantly associated with neither repetitive nor short spells of sickness absence. Contrary to our initial hypothesis, a high perception of globalisation of the economy is associated with a reduction of sick leave.

Bibliography

1 De Backer G, Kornitzer M, Karnas G, Coetsier P, De Corte W. Etude sur le stress au travail: scores normatifs, étude des déterminants et recherche prospective sur la relation avec l'absentéisme et avec l'incidence des maladies cardio-vasculaires. 1999;1-100.

2 Kornitzer M, Kittel F, Karnas G, Swysen M. Etude de la relation de la tension au travail avec l'absentéisme et l'incidence des affections cardio-vasculaires, dans la communauté française. 1999;FRSM n°: 3.4504.94F.

3 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.

4 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.

5 Wardwell W, Hyman M, Bahnson C. Stress and coronary heart disease in three field studies. *J chron dis* 1964;**17**:73-84.

6 Psychological microbes. *JAMA* 1969;**209**:1082.

7 Chevrolle J. [Comparison of the frequency and duration of absenteeism of employees working normal hours and in 2 X 8 shifts]. *Arch Mal Prof* 1969;**30**:348-351.

8 Hackman J, Lawler III E. Employee reactions to job characteristics. *Journal of Applied Psychology monograph* 1971;**55**:259-286.

9 Pocock S, Sergean R, Taylor P. Absence of continuous three-shift workers: a comparaison of traditional and rapidly rotating systems. *Occupational psychology* 1972;**46**:7-13.

10 Cooper C. Occupational source of stress : a review of the literature relating to coronary heart disease and mental ill health. *J Occupational Psychology* 1976;**49**:11-28.

11 Cobb S, Rose R. Hypertension, peptic ulcer, and diabetes in air traffic controllers. *JAMA* 1973;**224**:489-492.

12 Otten F, Bosma H, Swinkels H. Job stress and smoking in the Dutch labour force. *Eur Journal of Public Health* 1999;**9**:58-61.

13 Karasek R, Theorell T. *Healthy work - stress, productivity and the reconstruction of working life*. Harper Collins, 1990;1-381

14 Karasek R, Theorell T, Schwartz J, Pieper C, Alfredsson L. Job, psychological factors and coronary heart disease. Swedish prospective findings and US prevalence findings using a new occupational inference method. *Adv Cardiol* 1982;**29**:62-67.

15 Baker D. The study of stress at work. *Annu Rev Public Health* 1985;**6**:367-381.

16 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**:271-279.

17 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**:324-331.

18 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**:1151-1159.

19 Stansfeld S, Rael E, Head J, Shipley M, Marmot M. Social support and psychiatric sickness absence: a prospective study of British civil servants. *Psychol Med* 1997;**27**:35-48.

20 Sargent L. The moderating role of social support in Karasek's.... *WORK & STRESS* 2000;**14**:245-261.

21 Unden A. Social support at work and its relationship to absenteeism. *WORK & STRESS* 1996;**10**:46-61.

22 Marmot M, Bosma H, Hemingway H, Brunner E, Stansfeld S. Contribution of job control and other risk factors to social variations in coronary heart disease incidence. *Lancet* 1997;**350**:235-239.

23 Steenland K, Johnson J, Nowlin S. A follow-up study of job strain and heart disease among males in the NHANES1 population. *Am J Ind Med* 1997;**31**:256-260.

24 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**:558-565.

25 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.

26 Karasek R, Theorell T, Schwartz J, Schnall P, Pieper C, Michela J. Job characteristics in relation to the prevalence of myocardial infarction in the US Health Examination Survey (HES) and the Health and Nutrition Examination Survey (HANES). *Am J Public Health* 1988;**78**:910-918.

27 Alfredsson L, Karasek R, Theorell T. Myocardial infarction risk and psychosocial work environment: an analysis of the male Swedish working force. *Soc Sci Med* 1982;**16**:463-467.

28 Theorell T, Tsutsumi A, Hallquist J, et al. Decision latitude, job strain, and myocardial infarction: a study of working men in Stockholm. The SHEEP Study Group. Stockholm Heart epidemiology Program. *Am J Public Health* 1998;**88**:382-388.

29 Theorell T, Hamsten A, de Faire U, Orth-Gomer K, Perski A. Psychosocial work conditions before myocardial infarction in young men. *Int J Cardiol* 1987;**15**:33-46.

30 Kristensen T. Job stress and cardiovascular disease: a theoretic critical review. *J Occup Health Psychol* 1996;**1**:246-260.

31 Hellerstedt W, Jeffery R. The association of job strain and health behaviours in men and women. *Int J Epidemiol* 1997;**26**:575-583.

32 Stansfeld S, Bosma H, Hemingway H, Marmot M. Psychosocial work characteristics and social support as predictors of SF-36 health functioning: the Whitehall II study. *Psychosom Med* 1998;**60**:247-255.

33 Stansfeld S, Fuhrer R, Shipley M, Marmot M. Work characteristics predict psychiatric disorder: prospective results from the Whitehall II Study. *Occup Environ Med* 1999;**56**:302-307.

34 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**:1580-1585.

35 Mausner-Dorsch H, Eaton W. Psychosocial work environment and depression: epidemiologic assessment of the demand-control model. *Am J Public Health 2000 Nov;90(11):1765-70* .

36 Houtman I, Bongers P, Smulders P, Kompier M. Psychosocial stressors at work and musculoskeletal problems. *Scand J Work Environ Health* 1994;**20**:139-145.

37 Karasek R, Gardell B, Lindell J. Work and non work correlates of illness and behaviour in male and female Swedish white collars workers. *Journal of Organisational behavior* 1987;**8**:187-207.

38 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**:361-366.

39 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**:332-340.

40 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.

41 de Jonge J, Reuvers M, Hout man 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 Apr;5(2):256-68* 2000;**5**:256-268.

42 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.

43 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**:165-173.

44 Karasek R. Job Content questionnaire. *Department of Industrial and Systems Engineering University of California, Los Angeles* 1985.

45 *International Standard Classification of Occupations : ISCO-88.* Geneva: 1990.

46 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.

47 Rose G, Blackburn H, Gillum R, Prineas R. *Cardiovascular survey methods*. Geneva: World Health Organisation, 1982;

48 *Monica Manual*. Geneva: World Health Organisation, 1990.

49 Dirken JM. Arbeid and gezondheid. Groningen: 1969.

50 Radlof L. The CES-D Scale : a self-report depression scale for research in the general population. Applied Psychological Measurement 1977;1:385-401.

51 Amirkhan J, K. A factor analytical derived measure of coping: the coping strategy indicator. *Journal of personality and social psychology* 1990;**5**:1066-1074.

52 Jones Deborah. *The MONICA Optional Study of Physical Activity (revised manual of operations)*. 1994.

53 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**.**

54 Hosmer D, Lemeshow S. *Applied logistic regression*. New York, Chichester, Brisbane, Toronto, Singapore: John Wiley & sons, 1989.

55 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**:124-130.