Gender and regional differences in perceived job stress across Europe

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Background: Over the last 20 years stress at work has been found to be predictive of several conditions such as coronary heart disease, high blood pressure and non-specific sick leave. The Karasek demand/control/strain concept has been the most widely used in prospective epidemiological studies. **Objectives:** To describe distribution in Karasek's demand/control (DC) dimensions as well as prevalence of strain in samples from different parts of Europe grouped into three regions (South, Middle, Sweden), adjusting for occupation. To describe gender differences in Karasek's DC dimensions along with strain prevalence and assess the regional stability of those differences in different occupational groups. Design: The Job stress, Absenteeism and Coronary heart disease in Europe (JACE) study, a Concerted Action (Biomed I) of the European Union, is a multicentre prospective cohort epidemiological study: 38,019 subjects at work aged 35–59 years were surveyed at baseline. Standardised techniques were used for occupation coding (International Standardised Classification of Occupations) and for the DC model (Karasek scale): five items for the psychological demand and nine items for the control or decision latitude dimensions, respectively. **Results:** A total of 34,972 subjects had a complete data set. There were important regional differences in the Karasek scales and in prevalence of strain even after adjustment for occupational class. Mean demand and control were higher in the Swedish centres when compared to two centres in Milano and Barcelona (Southern region) and values observed in four centres (Ghent, Brussels, Lille and Hoofddorp) in Middle Europe were closer to those observed in the Southern cities than to those obtained in the Swedish cities. Clerks (ISCO 4) and, more specifically, office clerks (ISCO 41) exhibited the smallest regional variation. In a multivariate model, the factor 'region' explained a small fraction of total variance. In the two Southern centres as well as in the four Middle European centres, men perceived marginally less job-demand as compared to women whereas the reverse was observed in the two Swedish centres. Differences were larger for control: men appeared to perceive more control at work than did women. In a multivariate model, gender explained a small fraction whereas occupational level explained a large fraction of the variance. **Conclusions:** In this standardised multicentre European study Karasek's DC model showed large gender and occupational differences whereas geographic region explained a small fraction of the total DC variance, notwithstanding large differences in labour market and working conditions as pointed out by the European Commission as recently as 2000.

Keywords: gender, job stress, occupation, regional differences

S tress has been an object of biomedical research for many decades and has resulted in both psycho-social models (1) as well as patho-physiological models (2–4). In the last two decades a more narrow concept of stress in terms of situation, namely stress at the workplace or 'job-stress' has been the object of a large variety of research both applied and fundamental in nature.

One of the leading theoretical models in the job-stress literature is the 'Demand/Control' (DC) model developed by Karasek and Theorell (5) and initially involving two major dimensions of job stress: psychological demands and decision latitude at work. The association of high demand and low decision latitude leading to a highly-strained situation is proposed to be the cause of adverse health outcomes (6–17). In terms of Karasek and Theorell's model this defines the high-strain group, as opposed to the no-strain or less-strained situations, a combination of passive jobs (low demand/low control), active jobs (high demand/high control) and relaxed jobs (low demand/high control).

Geographical differences in labour market and working conditions have been observed. Higher rates of long duration unemployment as well as overall lower activity rates are observed in the South of Europe when compared to the North (18) with, as a consequence, a higher dependency ratio in the South (19). Moreover, voluntary part-time employment (18), extra payment for special working hours (night, weekends) (20) and contractual and voluntary social security contributions by the employer (21) were more frequently observed in Sweden when compared to the South. Geographical differences in working conditions

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leading to differences in job satisfaction and perception of exposure to health and safety hazards have been described (20). Hence, our hypothesis that some or all of these European differences in working conditions could be related to differences in prevalence of job strain across Europe as well as differences in distribution of DC scales with a possible North/South gradient. Although the study of the mechanisms through which diversity of working conditions might influence differences in job strain is the domain of occupational psychology and sociology, they can be empirically tested by epidemiology in a very large European data set such as the multicentre, prospective JACE study (Job stress, Absenteeism and Coronary Heart Disease in Europe). The primary objectives and design of the JACE study have been described elsewhere (22).

The aim of this paper is to report on potential geographic differences in the scales of the Karasek model as well as on gender differences, taking into account the occupational level in samples from different parts of Europe.

Materials and methods

Samples

Samples were supplied by eight centres across six countries: Belgium (Ghent and Brussels), Italy (Milano), France (Lille), Spain (Barcelona), Sweden (Malmö and Göteborg) and The Netherlands (Hoofddorp). Centres were regrouped into three European regions: Southern Europe, Middle Europe and Sweden.

Table 1 shows the contribution of each centre. A total of 38,019 subjects were screened. 1140 subjects were excluded from the analysis due to missing job title and/or missing education level, whereas 1907 subjects were excluded for incomplete job stress scales. Overall loss for missing data amounted to 8%. In total 34,972 subjects aged 35–59 years (23,553 men and 11,419 women) were available for analysis.

Barcelona, Göteborg and Malmö supplied random samples of the general population, while the rest supplied occupational samples from a wide variety of administrations and industries. All subjects on the payroll working full- or part-time, were invited to participate. Fields of activity included manufacturing, power supply, car assembly, municipal employees, health care, postal service, insurance and banking, chemical industry, among others.

For the three population samples all randomly selected subjects were invited to participate, but only those employed at the time of the screening were retained. The participation rate varied across centres from a low, 38% in Malmö and 45% in Brussels, to a high, 87% in Hoofddorp and 73% in Barcelona and Milano

Table 1 Number of subjects by centre

Centre	Men	Women	Total	No. of companies
Brussels	6533	2593	9126	13
Ghent	8642	1989	10631	12
Lille	1755	342	2097	8
Barcelona	921	498	1419	a
Milano	1420	2048	3468	1
Hoofddorp	637	193	830	34
Malmö	2478	3278	5756	a
Göteborg	1167	478	1645	a
Total	23553	11419	34972	

a: Population sample

with intermediate figures in other centres (64% in Göteborg and 65% in Ghent).

Questionnaires were self-administered except in Barcelona where they were administered by an interviewer due to literacy problems.

Job stress questionnaire

Two key scales were available in every centre, namely, 'psychological demands' (five questions) and 'decision latitude' (nine questions) enabling allocation of subjects to each of the four quadrants defined by the combination of those two dimensions (5). Only two groups were considered: subjects under strain (i.e. scoring above median for demand and below median for control) versus every other combinations. The Malmö centre questionnaire had different answer options for the same questions; a calibration study in a subsample using the two questionnaires allowed scores to be converted (23).

The questionnaire was translated from English-American to Swedish, Dutch, French, Italian and Spanish and then back-translated to English to assess the semantic equivalence of the different versions. Validity and reliability of the scales were studied for the Dutch and French versions of the questionnaire (24,25).

Missing value replacement: whenever (at most) one item happened to be missing per scale (i.e. 1/5 for demand and/or 1/9 for control) this item was attributed the mean value of other items for that dimension in the same individual (13).

For the purpose of geographical comparisons, all centres were combined and computed medians were occupation and gender specific, whereas for gender comparisons, medians were ccupation and centre specific.

Job title

Occupations were coded in each centre using the ISCO-88 classification (26). For practical reasons, however, full precision coding (four digits) could not be attained in every centre, thus two-digit coding was considered as the lowest common denominator. Between-centre quality control was assessed by comparing ISCO-88 codes assigned to a sample of 20 occupations. Kappa agreement between eight centres was 79.6% (precision: two digits).

A subset of ISCO-88 occupation codes with sufficient numbers was specifically analysed across the eight centres: ISCOs 4, 5, 7, 8 and 9 in men and 4, 5 and 9 in women. Secondary analyses were also performed with tighter control for job title, on the following occupational subgroups: 12, 41, 71, 72, 91 in men and 41, 51 and 91 in women.

Finally, levels of education were standardised across the eight centres using the MONICA (MONItoring of trends and determinants in Cardiovascular Disease) questions (27).

Statistical analysis

To analyse psychological demand and decision latitude scores, multiple linear regression was applied. In a first step, a block of chosen variables, including the variables under study (region or gender), and potential confounders were entered in the model.

All categorical variables were transformed into dummies before being introduced in the models. In a second step, interaction terms between variables under study and other factors were tested using partial F-tests (28). If an interaction proved to be significant, separate models were fitted in the categories of the factor that caused the interaction. Multiple logistic regression was used to analyse strain (dichotomous variable). The same strategy of model building as that described for linear regression was applied. For the purpose of geographical analysis, besides region (reference category: South), education (two categories), ISCO-88 (reference: first category, lowest level) and

age (continuous) were included in the regression equations. The analysis was conducted separately in men and women. In all analyses, the interaction OCCUPATION × REGION was highly significant ($P < 0.001$). Therefore, new models were established after stratification for job title.

For the purpose of gender analysis, confounders introduced in the multivariable models were job title (reference category: lowest level), age and education. Occupational classes retained for analysis when controlling for ISCO-88 with one digit of precision were ISCO 4, 5 and 9. When controlling for job-title with two digits of precision we selected ISCO-88 41 and 91. These ISCO categories were selected as they formed sufficiently large groups in both men and women and across clusters of centres.

The GENDER × REGION interaction was highly significant for demand and control, but not for strain. Hence, all gender comparisons were conducted separately for the three region groups (South Europe, Middle Europe, Sweden).

The dichotomous strain indicator (high strain quadrant versus others) was designed, controlling for centre and job title.

Results

Univariate analyses

Tables 2a and 2b show, separately for men and women, relationships between the three outcome variables (demand, control, strain) and age, education, region and occupational groups.

Age

Whereas mean job control score increased with age, mean job demand remained stable, resulting in higher strain prevalence in the younger. Men showed higher average job control and lower job demand scores when compared to women ($P < 0.001$ for comparisons in all sub-groups). Job strain prevalences are slightly higher in women.

Education

Job control increased faster with education than job demand resulting, in both genders, in a lower strain prevalence in the more educated.

Table 2A Sample description: demand, control and strain in men and women according to age, education, region and occupation

	Men				Women			
	n	D Mean (SD)	C Mean (SD)	S %	*n*	D Mean (SD)	C Mean (SD)	S %
Age				***				
35–44	9008	31.1 (6.0)	69.3 (12.2)	21.3 ***	4610	31.6 (5.8)	64.9 (12.4)	22.4
45–59	14545	31.3 (6.4)	70.9 (12.4)	18.9 ***	6809	31.8 (6.6)	66.2 (13.4)	20.6
35–59	23553	31.2 (6.2)	70.3 (12.3)	19.8 ***	11419	31.7 (6.3)	65.7 (13.0)	21.4
P		ns	***	***		ns	***	*
Education				***				
Elementary* Junior high	10908	30.3 (6.2)	66.9 (12.3)	22.0 ***	5880	31.2 (6.3)	62.4 (12.9)	22.6
High school* Some college	7246	31.1 (6.1)	70.8 (11.5)	18.4 ***	3559	31.8 (6.1)	67.3 (11.9)	20.9
college* graduate school	5399	33.2 (6.2)	76.4 (10.8)	17.3 ***	1980	33.0 (6.4)	72.9 (12.1)	18.4
P		***	***	***		***	***	***
Region[a]								
Southern European centres	2341	30.2 (5.2)	66.6 (11.3)	20.5	2546	30.7 (5.2)	62.6 (12.5)	22.3
Middle European centres	17567	30.8 (6.2)	69.6 (12.1)	20.3	5117	31.7 (6.2)	64.0 (12.3)	22.8
Swedish centres	3645	33.6 (6.7)	75.9 (12.4)	17.0	3756	32.5 (7.0)	70.1 (13.3)	18.8
P		***	***	***		***	***	***

a: Southern European centres, Milano, Barcelona; Middle European Centres, Lille, Ghent, Hoofddorp, Brussels; Swedish centres, Göteborg, Malmö
D, demand; C, control; S, Strain; ns, not significant
***$P < 0.001$; **$P < 0.01$; *$P < 0.05$

Table 2B Sample description: demand, control and strain in men and women according to occupation

Occupational group (ISCO 88)	Men				Women			
	n	D Mean (SD)	C Mean (SD)	S%	*n*	D Mean (SD)	C Mean (SD)	S%
1. Legislators, senior officials and managers	1585	34.6 (5.9)	80.3 (9.5)	16.0	24	34.7 (7.0)	77.1 (11.5)	15.6
2. Professionals	2851	33.6 (6.2)	77.6 (10.1)	17.2	1847	32.5 (6.0)	75.6 (9.6)	19.4
3. Technicians and associated professionals	3619	32.1 (16.2)	74.3 (10.6)	17.2	1839	32.4 (6.4)	69.7 (11.4)	19.8
4. Clerks	4120	30.9 (6.0)	66.9 (11.5)	22.7	3390	31.3 (6.4)	63.6 (12.1)	20.0
5. Service workers, shop and market sales workers	1649	31.1 (5.9)	68.0 (11.1)	18.1	1267	31.9 (6.4)	67.3 (12.0)	25.3
6. Skilled agricultural and fishery workers	232	28.1 (6.3)	67.8 (12.4)	17.7	22	28.5 (4.4)	65.5 (13.2)	18.2
7. Craft and related trades workers	4162	29.9 (5.9)	70.3 (11.0)	20.3	285	31.7 (6.3)	61.1 (12.9)	24.9
8. Plant and machine operators and assemblers	3733	29.7 (5.9)	65.2 (12.0)	23.0	344	31.5 (6.0)	58.0 (11.6)	24.1
9. Elementary occupations	1602	30.0 (6.2)	61.5 (12.7)	20.2	2214	30.8 (6.0)	57.2 (11.6)	23.8
P		***	***	***		***	***	***

D, demand; C, control; S, strain
***$P < 0.001$; **$P < 0.01$; *$P < 0.05$

Region

In both genders the Swedish centres showed higher values in mean job demand and control and lower values in strain prevalence as compared to the two other regions.

Occupation

Mean demand and control scores were lower and job strain was more prevalent in less qualified occupational groups.

When stratifying for occupation, mean control scores were, in general, higher in men as compared to women. The reverse situation was observed for job demand. Prevalence of strain was higher in men in the occupations of 'legislators, senior officials and managers' and in 'clerks'. The other seven occupational groups showed a higher prevalence of strain in women reaching statistical significance in 'skilled agricultural and fishery workers' and 'elementary occupations' ($P < 0.05$).

Multivariate analyses

Region

Table 3A gives age and education adjusted standardised regression coefficients for demand and control in men, by region, stratifying for occupation. Odds ratios (ORs) are given for strain.

Both for job demand and job control, differences appeared to be more marked between the Swedish and the Southern centres than between the Middle and the Southern centres. All coefficients for Swedish versus South centres were positive and all but one were significant at the 0.001 level whereas, for Middle versus Southern centres, in some occupational groups, we observed negative coefficients only statistically significant for control.

Regional differences appeared to be much smaller for clerks than for the other occupational groups.

Table 3A also shows adjusted coefficients for specific occupations (two digit ISCO codes). The same patterns emerged, i.e significant positive coefficients for demand and control in the Swedish compared with the Southern centres.

For strain, in two out of five occupational groups a decreasing gradient in the ORs from South Europe to Sweden was observed. In more specific occupations the same is observed from Southern to the Swedish centres in three out of five groups, reaching statistical significance for corporate managers (ISCO 12) and sales and services in elementary occupations (ISCO 91). However, the association between strain and region was quite

different for services and sales workers in which prevalence of strain was significantly higher in the Swedish and Middle as compared to the Southern European centres (ISCO 5).

Results in women were similar to those in men, although a restricted set of occupations was studied due to smaller numbers (table 3B). Differences between the Swedish and the Southern centres outweighed differences between the Middle and the Southern centres, coefficients for the Swedish versus the Southern centres were always positive, some coefficients for the Middle versus the South being negative. Regional differences for clerks and office clerks were smaller than for other occupations, especially for demand.

When looking at the association between strain and region, the decreasing Southern–Swedish trend observed in ISCO 4, 9 and 41, 91 parallels that observed for the same occupational groups in men, although the 5% level of significance was reached only for ISCO groups 4 and 91.

The percentages of variance explained by the factor region, in men, were small, averaging 3.8% for job demand and 1.9% for job control. These percentages were somewhat higher when considering more specific occupations: 6.1% on average for demand and 5.2% for control. Percentages of variance explained by region in women were consistently smaller than in men in every comparable occupation class.

Sensitivity study

We reran the previous analyses excluding data from the Malmö centre in Sweden due to the calibration performed on the job content scales of that centre and observed (strain in men) no material differences in the pattern of relationship. Two examples of ORs excluding Malmö; Swedish centres against Southern centres: ISCO 4, OR 0.59 (with Malmö: 0.73), ISCO 8, OR 1.10 (with Malmö: 1.28). No differences with respect to the main analysis were observed and the pattern of the relationship remained similar.

In summary, regional differences in reported job strain were observed in both genders, independent of age and education, although those differences varied across occupational groups without homogeneous patterns.

They explained only a small fraction of the variance of demand and control in both men and women.

Gender

Gender comparisons were repeated separately in each centre cluster (Southern, Middle, Swedish).

Table 3A Standardised regression coefficients (demand, control) and odds ratio (strain) by region and occupation (adjusted for age and education) for men

Occupation[a]	Demand				Control				Strain		
	South[b]	Middle[b]	Swedish[b]	ΔR²(%)[c]	South	Middle	Swedish	ΔR²(%)[c]	South	Middle	Swedish
4. Clerks	0	−0.0019	0.0681	0.4	0	−0.0471	0.0593	0.8	1.0	0.99	0.73
CI 95%		(−0.0369;0.0331)	(0.0330;0.1032)			(−0.0819;−0.0123)	(0.0244;0.0942)			(0.82;1.20)	(0.50;1.08)
5. Service workers, shop and market sales workers	0	0.0671	0.2471	3.9	0	−0.0922	0.1260	3.2	1.0	2.09	2.02
CI 95%		(0.0107;0.1235)	(0.1861;0.3081)			(−0.1486;−0.0359)	(0.0651;0.1869)			(1.49;2.93)	(1.25;3.27)
7. Craft and related trades workers	0	0.0086	0.3188	8.1	0	0.0693	0.1767	1.4	1.0	0.85	1.14
CI 95%		(−0.0399;0.0571)	(0.2690;0.3686)			(0.0192;0.1194)	(0.1252;0.2282)			(0.64;1.13)	(0.83;1.58)
8. Plant and machine operators and assemblers	0	−0.0146	0.1630	2.7	0	−0.0006	0.0010	0.0	1.0	0.84	1.28
CI 95%		(−0.0637;0.0345)	(0.1135;0.2125)			(−0.0503;0.0491)	(−0.0491;0.0511)			(0.61;1.16)	(0.86;1.90)
9. Elementary occupations	0	−0.0380	0.1941	4.1	0	0.1489	0.2542	4.2	1.0	0.77	0.67
CI 95%		(−0.0948;0.0188)	(0.1339;0.2543)			(0.0927;0.2051)	(0.1947;0.3137)			(0.57;1.03)	(0.42;1.09)
	OCCUPATION × CENTRE		F 8.15249 = 6.67 (***)		OCCUPATION × CENTRE		F 8.15249 = 14.8 (***)		OCCUPATION × CENTRE		ns
12. Corporate managers	0	0.1177	0.2417	2.5	0	0.2872	0.4917	9.3	1.0	0.89	0.46
CI 95%		(0.0132;0.2222)	(0.1507;0.3327)			(0.1871;0.3873)	(0.4045;0.5789)			(0.50;1.57)	(0.25;0.84)
41. Office clerks	0	−0.0050	0.0632	0.4	0	0.0604	0.0583	0.9	1.0	1.00	0.76
CI 95%		(−0.0417;0.0317)	(0.0299;0.0965)			(0.0241;0.0967)	(0.0219;0.0947)			(0.82;1.22)	(0.51;1.15)
71. Extraction and building trade workers	0	0.0486	0.4462	14.3	0	−0.0028	0.2038	3.6	1.0	1.06	1.19
CI 95%		(−0.0362;0.1334)	(0.3594;0.5330)			(−0.0932;0.0876)	(0.1113;0.2963)			(0.65;1.75)	(0.67;2.09)
72. Metal, machinery and related	0	0.0117	0.2711	5.9	0	0.0505	0.1130	0.5	1.0	1.01	1.55
CI 95%		(−0.0573;0.0807)	(0.2011;0.3411)			(−0.0201;0.1211)	(0.0414;0.1846)			(0.63;1.61)	(0.93;2.59)
91. Sales and services elementary occupations	0	−0.2378	0.0893	7.5	0	0.2241	0.3922	11.8	1.0	0.43	0.26
CI 95%		(−0.3203;−0.1553)	(0.0016;0.1770)			(0.1462;0.3020)	(0.3094;0.4750)			(0.28;0.67)	(0.12;0.57)
	OCCUPATION × CENTRE		F 8.9504 = 14.9***		OCCUPATION × CENTRE		F 8.9504 = 17.1***		OCCUPATION × CENTRE		***

a: Occupations divided into one and two digits
b: See Table 2A for location of centres
c: ΔR²: proportion of additional explained variance when the factor is entered in the model
CI, confidence interval
***$P < 0.001$; **$P < 0.01$; *$P < 0.05$

Table 3B Standardised regression coefficients (demand, control) and odds ratio (strain) by region and occupation (adjusted for age and education) for women

Occupation[a]	Demand				Control				Strain		
	South[b]	Middle[b]	Swedish[b]	ΔR² (%)[c]	South	Middle	Swedish	ΔR² (%)[c]	South	Middle	Swedish
4. Clerks	0	−0.0374	0.188	0.2	0	−0.0478	0.1984	1.6	1.0	0.78	0.64
CI 95%		(−0.0965;0.0817)	(−0.0475;0.0851)			(−0.1062;0.0106)	(0.1328;0.2640)			(0.59;1.04)	(0.45;0.90)
5. Service workers, shop and market sales workers	0	0.2148	0.3086	3.1	0	−0.1668	0.1799	6.4	1.0	2.47	1.48
CI 95%		(0.1276;0.3020)	(0.2138;0.4034)			(−0.2525;−0.0811)	(0.0867;0.2731)			(1.49;4.11)	(0.89;2.49)
9. Elementary occupations	0	0.0252	0.0985	0.7	0	0.0787	0.1141	1.2	1.0	0.98	0.74
CI 95%		(−0.0189;0.0693)	(0.0514;0.1456)			(0.0350;0.1224)	(0.0674;0.1608)			(0.79;1.22)	(0.51;1.07)
OCCUPATION × CENTRE		F 4.6860 = 7.14***				F 4.6860 = 6.47***				OCCUPATION × CENTRE ***	
41. Office clerks	0	0.0008	0.0535	0.2	0	−0.0062	0.1773	2.1	1.0	1.10	0.85
CI 95%		(−0.0647;0.0663)	(−0.0199;0.1269)			(−0.0708;0.0584)	(0.1048;0.2498)			(0.80;1.52)	(0.57;1.25)
51. Personal and protective service workers	0	0.2016	0.2637	1.8	0	−0.1338	0.2501	8.0	1.0	1.90	0.97
CI 95%		(0.0847;0.3185)	(0.1361;0.3913)			(−0.2461;0.0215)	(0.1275;0.3727)			(1.04;3.45)	(0.52;1.83)
91. Sales and services elementary occupations	0	−0.0142	0.0880	0.7	0	0.0951	0.1585	2.4	1.0	0.85	0.52
CI 95%		(−0.0600;0.0316)	(0.0399;0.1361)			(0.0503;0.1399)	(0.1114;0.2056)			(0.67;1.07)	(0.33;0.82)
OCCUPATION × CENTRE		F 4.5767 = 3.49***				F 4.5767 = 6.23***				OCCUPATION × CENTRE ***	

a: Occupations divided into one and two digits
b: See Table 2A for location of centres
c: ΔR²: proportion of additional explained variance when the factor is entered in the model
CI, confidence interval
***$P < 0.001$; **$P < 0.01$; *$P < 0.05$

Table 4 Standardised regression coefficients (demand, control) and odds ratio (strain) by gender after stratification for region (adjusted for age and education)

Centre	Demand				Control				Strain	
	Women	Men	ΔR^2 (%)		Women	Men	ΔR^2 (%)		Women	Men
Occupation categories 4, 5, 9										
Southern European Centres	0	−0.0181	0.0		0	0.1183	1.0		1.0	0.75
CI 95%		(−0.0583;0.0221)				(0.0819;0.1547)				(0.63;0.90)
Middle European Centres	0	−0.0471	0.2		0	0.1495	2.2		1.0	0.65
CI 95%		(−0.0686;0.0256)				(0.1286;0.1704)				(0.59;0.72)
Swedish Centres	0	0.0655	0.4		0	0.1627	2.5		1.0	0.70
CI 95%		(0.0267;0.1043)				(0.1248;0.2006)				(0.56;0.87)
		GENDER × CENTRE				GENDER × CENTRE			GENDER × CENTRE	
		F 2.14232 = 16.1***				F 2.14232 = 4.39***			ns	
Occupation categories 41, 91										
Southern European Centres	0	−0.0181	0.0		0	0.0969	0.7		1.0	0.78
CI 95%		(−0.0647;0.0285)				(0.0543;0.1395)				(0.63;0.97)
Middle European Centres	0	−0.0524	0.2		0	0.1660	2.5		1.0	0.66
CI 95%		(−0.0801;−0.0247)				(0.1391;0.1929)				(0.58;0.75)
Swedish Centres	0	0.0255	0.1		0	0.1792	3.1		1.0	0.57
CI 95%		(−0.0285;0.0795)				(0.1259;0.2325)				(0.40;0.80)
		GENDER × CENTRE				GENDER × CENTRE			GENDER × CENTRE	
		F 2.9200 = 3.05*				F 2.9200 = 3.60***			ns	

CI, confidence interval
***$P < 0.001$; **$P < 0.01$; *$P < 0.05$

Analyses were performed on subjects belonging to ISCO 4, 5, 9 and ISCO 41, 91.

Table 4 gives standardised regression coefficients for demand and control scales (men versus women) along with ORs for strain (men/women).

Job demand

Southern and Middle European groups showed a lower value in mean demand in men when compared to women. The situation is reversed in the Swedish centres where mean demand was higher in men. Percentages of additional variance explained when introducing factor gender in the models were quite low (<1%).

Job control

Mean value for control was significantly higher in men (versus women) in all ISCO subgroups (independent of age and education).

Regression indicates that gender explained more variance for control than it did for demand: percentages range from close to 0.7% (South, ISCO 41+91) to 3.1% (North, ISCO 41, 91).

Variance explained by the factor gender is higher in the Swedish centres.

The gender differential in job-control is higher in the Swedish centres as compared to the Middle and Southern European centres (interaction term GENDER × CENTRE significant).

Strain

Independent of age and level of education:

- in all ISCO groups retained, job strain prevalence was significantly higher in women and similar in all regions;

- women perceived less control than men did. The relation appeared less consistent as far as demand was considered. These unequal differences on the DC scales materialised further in substantial differences in proportion of strained women when compared to men (in the selected occupational classes);

- gender effect appeared stable across occupational groups but could differ according to the geographical provenance of the data (in selected occupational classes).

It is worth noting that the geographical gradient observed for gender, in a restricted set of occupational classes (4, 5, 9 and 41, 91), was amplified when we introduced the factor 'occupation class' in the model.

Discussion

There are few published studies comparing DC scales between countries and/or continents and, when available, the comparisons are performed for the whole working population without taking into account differences in workforce structure between countries. This is the case for the publication by Karasek *et al.* (29) the only other study focusing on the relation of cultural and gender differences across six large databases from the USA, Canada, The Netherlands and Japan.

This study is, to our knowledge, the first European multicentre study that has been able to study potential regional and gender differences in the Karasek model (psychological demands, control and job-strain), independent of age and education, in selected occupational classes, across some parts of Europe using standardised occupational groups (ISCO 88).

Regional differences

In both men and women, mean job demand and control were higher in the two Swedish centres as compared to the two Southern centres with adjusted values in Middle European centres closer to those observed in the South than to those observed in Sweden.

Job strain was less prevalent in the Swedish than in the Southern centres in two out of five occupational groups (i.e. clerks, more specifically office clerks, elementary occupations, more specifically sales and services elementary occupations), whereas it was lower in the South in services workers.

Overall, the regional factor appeared to be a weak independent predictor of perceived stress at work.

An analysis of covariance performed on pooled data (with respect to job titles) indicated that the proportion of variance explained by job title defined at the two digit level, was by far larger than the variance explained by the factor region (data not shown).

Few studies have compared perceived stress at work across countries or regions, and a large section of those that have are rather qualitative and performed on a limited number of subjects and/or occupations. The present study was carried out using a quantitative instrument administered in a standardised way using a common coding instrument (ISCO-88) to a large sample of employed subjects and to a reasonably large set of occupations in six countries of the European Union, therefore providing an improvement with respect to the scope previous studies.

Nevertheless, our study also has limitations: its external validity is limited by the fact that the whole workforce was not represented. For instance, in Belgium and France only large companies were included. Although the mixture of population with occupational samples could be criticised, we believe that in this particular study it is an advantage and does not introduce significant selection bias because occupational samples were derived from a wide variety of companies, administrations and industries. At the same time, employed subjects enrolled from the population samples contributed with a larger variety of jobs than would be possible with occupational samples alone, thus encompassing almost all occupational strata. The most important fact is the representativeness of all occupational strata in the three European regions, although it should be acknowledged that the term 'regions' refers only to the location of the eight centres and does not in any way reflect the representativeness of the total workforce of these cities and even less so for the three regions. Some selection bias due to differences in response rates across centres cannot be excluded.

The stress measurement instrument being rather task-oriented was perhaps not best suited to capture cultural or organisational differences in working conditions. Despite the size of this survey, comparisons across centres could only be performed between some occupational classes defined at a one or two digits precision level of the ISCO classification. A residual confounding effect cannot be ruled out. Regional or occupational level heterogeneity in the DC model could reflect different interpretation of scale items due to socio-cultural background. This holds true for all standardised questionnaires translated in different languages or even administered in the same language to subjects from different professional levels. In our study the Karasek questionnaire was translated and back-translated to English, in order to be relatively sure that questions had the same meaning in the six languages used (in Barcelona, two languages, Spanish and Catalan and in Belgium both French and Dutch were used).

Among the reviewed studies, which used methodologies quite different from ours, all concluded that there were differences in stress perception according to the national/cultural membership of the groups compared. Using a qualitative approach, differences were found between French and Italian school teachers (30), as well as between air traffic controllers from Canada, New-Zealand and Singapore (31), whereas a quantitative approach showed differences between assembly workers in Sweden and in Indonesia (32) and between British and German managers (33).

Still closer to our design, was a study comparing broad samples of working populations from different countries/continents (29). Using the DC Karasek scales the authors reported no important variations in mean and standard deviation of the scales between the USA, Canada, The Netherlands and Japan, although without adjustment for heterogeneity in occupation distribution. We are aware that, in Europe, there are heterogeneities in labour force structure between countries/regions (for instance more manufacturing orientated in the South, more service orientated in the North) and, further, that DC scales are correlated with occupations (25). Thus, the new information supplied by our study is that country/region-based differences in stress perception exist but with different magnitudes according to occupational class. One common finding between our study and Karasek's is that the observed percentage of variance explained by the factor region was low.

Proposed explanations for these regional differences in stress perception are culture, economic environment and work organisation with unavoidable interactions between these factors.

Culture could determine stress perception-related dimensions such as coping strategies (34) or social support (31); economic environment could confer variable social status to a given occupation (32) triggering under or over-reporting of stress. It is most probable that the Southern Europe/Swedish gradient in economic development has not completely disappeared, GDP, unemployment, activity rate and dependency ratio being less favourable in the South as compared to the North (19).

Work organisation is also quoted by Pedrabissi et al. (30) and Kirkcaldy and Cooper (33).

The smaller regional difference observed in clerks or office clerks could be attributed to the widespread diffusion of computer-based work. Should this be an indication of international homogenisation of specific production processes, with some occupations leading the movement, only a future study within 5–10 years could confirm this hypothesis.

Gender differences

Our study showed that, adjusting for age, education and occupational groups, men perceived less psychological job demand than women did (although marginal). This was true for the Southern and Middle European centres, the relation being reversed in the Swedish centres.

Gender-based differences appeared to be larger for job control, with men perceiving higher control at work than women.

The deficit of job control in females, however, increased towards less qualified occupations (univariate). Percentage of variance explained by the factor gender was also larger for control than for demand. Gender was a weak predictor of DC dimensions in our study. Heterogeneity in gender-based DC differentials seemed to exist between regions, the gender effect being larger in the Swedish as compared to the Southern centres.

Job strain was less prevalent in men than in women, without apparent regional heterogeneity. However, a tighter control for occupation could reveal a Southern Europe–Swedish gradient.

Other DC models also showed lower perceived job control in women (35), or that women tended to report more stress symptoms than men, both in univariate and multivariate analysis (36). With respect to the demand dimension, no gender differences were found by either Brisson et al. (37) or Sorensen et al. (38). Our results are thus in agreement with others.

Most of the studies using the DC model showed a female disadvantage in perceived control at work: without (5) and with adjustment for occupation (6,37).

Netterstrom et al. (39), using the DC model, showed that women were more likely to experience strain than men, which is also in agreement with our results.

Martocchio and O'Leary (40) suggested that it may be too simplistic to try to investigate gender-related differences using simply gender membership as the exposure variable. Situational factors associated with gender could explain this gender effect. Thus, Nelson and Quick (41) and Baruch et al. (42) quoted factors such as marriage/work interface, social isolation, discrimination and stereotyping or parental status. Davidson and Cooper (43) added the need for women to prove themselves. Goh et al. (44) also suggested that women were less able to release tension and leave work problems at work.

Guppy and Rick (35) suggested that the gender differential could be explained by grade inequalities, which were not accounted for in our study.

We could also hypothesise, having used a task-orientated instrument, that some work/production procedures in industry or administration have been designed by men without paying much attention to the adaptation to women with regard, for instance, to ergonomy. It could also be reasonable to think that home–work interface, discrimination (difference in upward mobility, for instance) or social support are explanatory factors that could exhibit cross-regional (cultural) variations.

The original contribution of our work is to suggest the potential existence of a regional disparity in the gender differentials of the demand/control/strain model even after standardisation for level of occupation. In summary, it has been claimed that the advent of the global economy has led to the homogenisation of working conditions (29). One possible consequence of this homogenisation is an increased comparability of work stress data across countries and regions. Our study suggests that, though using a rather task-orientated instrument for measuring demand and control, gender-based inequalities appeared inconsistent between regions of Europe, but regional contrasts emerged when controlling for occupation. This of course does not preclude the existence of differences in perceived job stress associated with a truly different cultural attitude towards work at a higher than task level.

Acknowledgement

Key points

- Job stress scale distribution and gender differentials in perceived job stress across 3 regions of Europe after adjustment for occupation were studied.
- Regional differences emerged and appeared heterogeneous across occupational classes.
- The gender differential also appeared heterogeneous across regions even after control for occupation.
- Job stress has been showed to be associated with a variety of health problems.
- A 'regional' component could play a role in perceived job stress independently from gender, age, education and occupation.
- Contextual elements should be kept in mind when interpreting comparisons in job stress measurements across populations.
- Efforts in job stress management could take this dimension into consideration.

References

1 French J, Caplan R, Van Harrison R. *The mechanisms of job stress and strain.* New York: Wiley & Sons, 1982.

2 Cannon W. *Bodily changes in pain, hunger, fear and rage.* Boston: C.T. Branford, 1929.

3 Selye H. *Stress.* Montreal: Acta Inc., 1950.

4 Selye H. *Stress without distress.* New York: Lippincott, 1974.

5 Karasek RA, Theorell T. *Healthy work.* New York: Basic Books, 1990.

6 Johnson J, Hall E. Job strain, workplace social support and cardiovascular disease: a cross-sectional study of a random sample of the Swedish working population. *Am J Public Health* 1988;78:1336–42.

7 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.

8 Alfredsson L, Spetz C, Theorell T. Type of occupation and near-future hospitalization for myocardial infarction and some other diagnoses. *Int J Epidemiol* 1985;14:378–88.

9 Karasek R, Theorell T. Job characteristics in relation to the prevalence of myocardial infarction in the US Health and Nutrition Examination Survey (HANES).*Am J Public Health* 1988;78:910–8.

10 Kristensen T. Cardiovascular disease and the work environment. *Scand J Work Environ Health* 1989;15:245–64.

11 Schnall P, Landsbergis P, Baker D. Job strain and cardiovascular disease. *Ann Rev Public Health* 1994;15:381–411.

12 Theorell T, Karasek R. Current issues relating to psychosocial job strain and cardiovascular disease research. *J Occup Health Psychol* 1996;1:9–26.

13 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. *Br Med J* 1997;314:558–65.

14 Theorell T, Tsutsumi A, Hallquist J et al. Decision latitude, job strain, and myocardial infarction: a study of working men in Stockholm. *Am J Public Health* 1998;88:382–8.

15 Cooper C, Marshall J. Occupational sources of stress: a review of the literature relating to coronary heart disease and mental ill-health. *J Occup Psychol* 1976;49:11–28.

16 Karasek R. Job demands, job decision latitude and mental strain: implications for job redesign. *Admin Sci Q* 1979;24:285–307.

17 Schechter J, Green L, Olsen L, Kruse K, Cargo M. Application of Karasek's Demand/control model in a canadian occupational setting including shift workers during a period of reorganization and downsizing. *Am J Health Promotion* 1997;11:394–9.

18 European Commission. Statistiques sociales europeennes. Resultats de l'enquete sur les forces de travail 1999. Luxembourg: Office des publications officielles des Communautes europeennes, 2000.

19 de Jong A, Broekman R for the European Commission. National and regional trends in the labour force in the European Union 1985–2050. Luxembourg: Office des publications officielles des Communautes europeennes, 2000.

20 Paoli P for the European foundation for the improvement of living and working conditions. Second European survey on working conditions. Luxembourg: Office des publications officielles des Communautes europeennes, 1997.

21 European Commission. European social statistics. Series 1988–1999. Theme 3. Population and social conditions. Labour costs. Luxembourg: Office des publications officielles des Communautes europeennes, 2001.

22 Houtman I, Kornitzer M, de Smet P et al. Job stress, absenteeism and coronary heart diseases European Cooperative study (the JACE study). Design of a multicentre prospective study. *Eur J Public Health* 1999;9:52–7.

23 Ostergren, P.O. Personal communication.

24 Hellemans C, Karnas G. Epreuve de validation du modele de Karasek aupres des travailleurs du secteur tertiaire. Relations du modele avec les tensions mentales. *Rev Eur Psychologie Appliquee* 1999;49:215–24.

25 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 Stress* 2001;15:297–313.

26 ILO. *ISCO-88: International Standard Classification of Occupations.* Geneva: ILO, 1990.

27 WHO MONICA Project. *Monica Manual*, revised edition. Geneva: Cardiovascular Disease Unit, WHO, 1990.

28 Kleinbaum D, Kupper L, Muller K, Nizam A. *Applied regression analysis and other multivariable analysis.* Pacific Grove: Duxbury Press, 1998.

29 Karasek R, Brisson C, Kawakami N, Houtman I, Bongers P, Amick B. The Job Content Questionnaire (JCQ): an instrument for internationally comparative assessments of psychosocial job characteristics. *J Occup Health Psychol* 1998;3:322–55.

30 Pedrabissi L, Rolland JP, Santinello M. Stress and burnout among teachers in Italy and France. *J Psychol* 1991;127:529–35.

31 Shouksmith G, Taylor J. The interaction of culture with general job stressors in air traffic controllers. *Int J Aviation Psychol* 1997;7:343–52.

32 Waluyo L, Ekberg K, Eklund J. Assembly work in Indonesia and in Sweden—ergonomics, health and satisfaction. *Ergonomics* 1996;39: 199–212.

33 Kirkcaldy B, Cooper C. Cross-cultural differences in occupational stress among British and German managers. *Work Stress* 1992;6:177–90.

34 Chiu R, Kosinski F. Chinese cultural collectivism and work-related stress: implication for employment counselors. *J Employment Counsel* 1995;32:98–110.

35 Guppy A, Rick J. The influences of gender and grade on perceived work stress and job satisfaction in white collar employees. *Work Stress* 1996;10:154–64.

36 Sorensen G, Pirie P, Folsom A, Luepker R, Jacobs D, Gillum R. Sex Differences in the relationship between work and health: The Minnesota Heart Survey. *J Health Social Behav* 1985;26: 379–94.

37 Brisson C, Blanchette C, Guimont C et al. Reliability and validity of the French version of the 18-item Karasek Job Content Questionnaire. *Work Stress* 1998;12:322–36.

38 Sorensen G, Lewis B, Bishop R. Gender, job factors, and coronary heart disease risk. *Am J Health Behav* 1996;20:3–13.

39 Netterstrom B, Kristensen T, Damsgaard M, Olsen O, Sjol A. Job strain and cardiovascular risk factors: a cross sectional study of employed Danish men and women. *Br J Ind Med* 1991;48:684–9.

40 Martocchio J, O'Leary A. Sex differences in occupational stress: a meta-analytic review. *J Appl Psychol* 1989;74:495–501.

41 Nelson D, Quick J. Professional women: are distress and disease inevitable? *Acad Managem Rev* 1985;10:206–13.

42 Baruch G, Biener L, Barnett R. Women and gender in research on work and family stress. *Am Psychol* 1987;42:130–6.

43 Davidson M, Cooper C. *Stress and the woman manager.* Oxford: Martin Robertson & Cy Ltd, 1983.

44 Goh T, Koh HC, Low CK. Gender effects on the job satisfaction of accountants in Singapore. *Work Stress* 1991;5:341–8.