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Large variation between European countries in the prevalence of back and neck/upper-limb pain may be attributable in part to socioeconomic differences between countries, with higher prevalence where there is less poverty and more social support. Future studies should explore this possibility further, perhaps by comparing trends over time in countries where socioeconomic circumstances have changed differentially.

Affiliation: Occupational Health Unit, University of Bologna, Sant'Orsola Malpighi Hospital, via Palagi 9, IT-40138 Bologna, Italy. francesco.violante@unibo.it

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Key terms: back pain; cross-sectional study; Europe; European Working Conditions Survey; EWCS; musculoskeletal disease; musculoskeletal pain; neck pain; occupational risk factor; personal risk factor; population characteristic; social risk factor; upper-limb pain

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Original article

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Musculoskeletal pain in Europe: the role of personal, occupational, and social risk factors

by Andrea Farioli, MD,[1] Stefano Mattioli, MD,[1] Anna Quaglieri, BSta,[1] Stefania Curti, PhD,[1] Francesco S Violante, MD,[1] David Coggon, DM[2]

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Objectives The prevalence of musculoskeletal pain in European countries varies considerably. We analyzed data from the fifth European Working Conditions Survey (EWCS) to explore the role of personal, occupational, and social risk factors in determining the national prevalence of musculoskeletal pain.

Methods Over the course of 2010, 43 816 subjects from 34 countries were interviewed. We analyzed the one-year prevalence of back and neck/upper-limb pain. Individual-level risk factors studied included: sex; age; educational level; socioeconomic status; housework or cooking; gardening and repairs; somatizing tendency; job demand–control; six physical occupational exposures; and occupational group. Data on national socioeconomic variables were obtained from Eurostat and were available for 28 countries. We fitted Poisson regression models with random intercept by country.

Results The main analysis comprised 35 550 workers. Among individual-level risk factors, somatizing tendency was the strongest predictor of the symptoms. Major differences were observed by country with back pain more than twice as common in Portugal (63.8%) than Ireland (25.7%), and prevalence rates of neck/upper-limb pain ranging from 26.6% in Ireland to 67.7% in Finland. Adjustment for individual-level risk factors slightly reduced the large variation in prevalence between countries. For back pain, the rates were more homogenous after adjustment for national socioeconomic variables.

Conclusions Our analysis indicates substantial variation between European countries in the prevalence of back and neck/upper-limb pain. This variation is unexplained by established individual risk factors. It may be attributable in part to socioeconomic differences between countries, with higher prevalence where there is less risk of poverty or social exclusion.

Key terms back pain; cross-sectional study; European Working Conditions Survey; EWCS; musculoskeletal disease; neck pain; occupational exposure; population characteristic; upper-limb pain.

In western countries, painful disorders of the back, neck and upper limb are major causes of work disability (1). Most early studies on causes of musculoskeletal pain focused on physical exposures, such as manual material handling, repetitive movements, awkward postures, and vibration (2). More recently, important psychological risk factors – in particular low mood and somatizing tendency – have also been demonstrated (3–6). In addition, the role of work-related psychosocial factors has been explored (7), often using Karasek's job demand–control model (8), although with less consistent results.

It seems unlikely, however, that these individual-level risk factors can fully explain the variation in occurrence of musculoskeletal pain and associated disability that has been observed between countries and within countries over the time (9–11). This raises the possibility of a contribution also from socioeconomic factors operating at a population-level, such as provision of healthcare and social security, and attention to occupational health and safety.

To explore the variation in common musculoskeletal symptoms between European countries, and the extent to which it might be explained by individual-level risk factors and national socioeconomic circumstances, we analyzed data from the fifth European Working Conditions Survey (EWCS) and from Eurostat (12, 13).

1 Department of Medical and Surgical Sciences, University of Bologna, Bologna, Italy.
2 Medical Research Council Lifecourse Epidemiology Unit, University of Southampton, Southampton, UK.

Correspondence to: Prof Francesco S Violante, Director, Occupational Health Unit, University of Bologna, Sant'Orsola Malpighi Hospital, via Palagi 9, IT-40138 Bologna, Italy. [E-mail: francesco.violante@unibo.it]

Methods

Study population and setting

The European Foundation for the Improvement of Living and Working Conditions conducted the fifth EWCS in 2010. Carried out every five years, the survey uses a harmonized approach to investigate the working conditions of employees and the self-employed across Europe. A detailed description of the methods has been published elsewhere (14). Briefly, the survey was carried out in the 27 Member States of the European Union (EU), and also in Norway, Republic of Macedonia, Croatia, Turkey, Albania, Kosovo, and Montenegro. A standardized questionnaire (14) was administered at interview to random samples, stratified by sex and age, of all persons aged ≥15 years (≥16 in Spain, the UK and Norway), who resided in specified regions of the participating countries and were thought to have been in employment during the previous week. Interviews were conducted among 43 816 respondents in their homes, giving an overall response rate of 59.6%.

Health outcomes

Among other items, the questionnaire asked whether the participant had suffered from back or neck/upper-limb pain during the past year. These two outcomes were related to individual-level risk factors derived from the questionnaire and also to various socioeconomic risk factors defined by country.

Individual-level risk factors

The individual-level risk factors studied were: sex; age; educational level; socioeconomic status; time spent on housework or cooking; time spent on gardening and repairs; somatizing tendency; job demand–control; frequency of six physical exposures at work; and occupational group.

Age was classified in five ten-year categories. A three-level variable was created for education (primary or lower; secondary; tertiary) by collapsing the seven levels of the International Standard Classification of Education (15). The full method of the European Socioeconomic Classification (16) was used to assign subjects to three socioeconomic classes (salariat, intermediate, and working class) according to their job title [classified according to the 1988 version of the International Standard Classification of Occupations (ISCO-88)], employment status (employer, self-employed, or employee), and the size of the organization in which they worked. Time spent on housework or cooking and on gardening and repairs was graded to three levels by aggregating categories from a six-level scale that had been used in the questionnaire. This aggregation was based on observed frequencies, and was carried out before associations with health outcomes were examined. Somatizing tendency was graded according to how many symptoms from a total of four (stomach ache, respiratory difficulties, overall fatigue, and headaches/eyestrain) the participant reported in the past year.

Classification of job demand–control was based on Karasek's model (8). Three scales where created from the EWCS questionnaire: job demand (7 items), job skill discretion (6 items), and job decision-making authority (3 items). Job decision-latitude, representing job control, was calculated as the sum of job skill discretion and job decision-making authority, weighting for the number of items in each scale. Scores for job demand and job decision-latitude were then dichotomized using their median values, and four categories of job demand–control were defined: low-strain jobs (low demand, high decision-latitude); passive jobs (low demand, low decision-latitude); active jobs (high demand, high decision-latitude); and high-strain jobs (high demand, low decision-latitude). A more detailed description of the methods by which job demand–control was specified is presented online in Appendix 1 (www.sjweh.fi/data_repository.php).

The occupational physical exposures analyzed were frequency of: carrying or moving loads; lifting or moving people; standing; exposure to vibrations; repetitive hand or arm movements; and working with computers. The questionnaire asked about the proportion of working time that was occupied by these activities, with seven possible answers collapsed to four categories: never, sometimes (including "almost never" and "around ¼ of the time"), often (including "around ½ of the time" and "around ¾ of the time"), and always ("almost all of the time" or "all of the time").

National socioeconomic risk factors

Data on potentially relevant socioeconomic variables defined at the national level were obtained from Eurostat (13) and available for all but six countries (Albania, Croatia, Former Yugoslav Republic of Macedonia, Kosovo, Montenegro, and Turkey). When complete information on a variable was available for 2010, this was used; otherwise, data were taken from the most recent year for which they were complete. To enhance comparability, all variables were standardized to have mean 0, standard deviation (SD) 1. The following statistics were examined: (i) people at risk of poverty or social exclusion (2010); (ii) in-work at-risk-of-poverty rate (2010); (iii) gross domestic product per capita in purchasing power standards (2010); (iv) material deprivation rate (2010); (v) distribution of income measured with Gini Index (2010); (vi) hospital beds per 100 000 inhabitants (2007); (vii) school expectancy (expected years of education over a lifetime)

(2010); (viii) public expenditure on labor market policies, category 1 (publicly funded services for job-seekers) (2007); (ix) public expenditure on labor market policies, categories 2–7 (training, supported employment and job creation) (2007); (x) public expenditure on labor market policies, categories 8–9 (unemployment and early retirement benefits) (2007); (xi) public expenditure on education (2005); (xii) expenditure on social protection (2008); (xiii) fatal accidents at work: incidence rate (2005); (xiv) fatal accidents at work: trend (2006 compared to 1998); (xv) healthy life expectancy at birth (2010); (xvi) self-reported unmet need for medical examination or treatment (2010); and (xvii) unemployment rate (2010).

A detailed description of these variables is provided online in Appendix 2 (www.sjweh.fi/data_repository.php).

Statistical analysis

Statistical analysis was carried out using Stata 11.2 SE (Stata Corp, College Station, TX, USA). Associations of pain outcomes with risk factors were characterized by prevalence ratios (PR) and associated 95% confidence intervals (95% CI), estimated by fitting Poisson regression models with robust estimates of variance (17, 18). To account for clustering within the study sample, we allowed for random effects (ie, intercepts) by country. Supplementary analyses were carried out with random intercepts for region as well as country to ensure there was no important additional clustering by region. Subjects with missing information on one or more of the variables in an analysis were excluded from that analysis.

Multilevel methods were used to study country-level risk factors in the same models as individual-level risk factors (19). In view of the large sample size, all of the individual-level risk factors were included in the final multivariate models. However, the number of socioeconomic risk factors defined at national level was large compared with the number of countries. Therefore, to develop a suitably parsimonious model, we applied forward selection based on the Wald test, adding variables that produced a significant ($P<0.05$) improvement in fit. To avoid problems associated with colinearity, national attributes that were strongly interrelated (Pearson's $r>0.70$) were never included together in the same model. A matrix setting out Pearson's correlation coefficients for pairs of country-level risk factors is presented in Appendix 2. Subjects from countries with missing data on socioeconomic variables at national level were excluded from the analysis of country-level risk factors.

Adjusted prevalence rates by country were estimated by summing the fixed and the random effects from logistic regression models with random effects (ie, intercepts) by country such that:

Prevalence = 1/(1+exp(-1*(linear prediction for the fixed effect + linear prediction for the random effect))).

Prevalence rates by occupation were estimated as average marginal effects from the fixed effects portion of the models. Coefficients of variation in prevalence rates were calculated as the ratio of SD to mean.

The overall spatial autocorrelation of prevalence rates between neighboring countries was studied with Moran's I (20), ranging from -1 (perfect dispersion) to 1 (perfect correlation), with a value of 0 meaning no spatial autocorrelation.

Results

From the original sample of 43 816 subjects, we excluded 1926 who did not confirm having been at work (as an employee or employer/self-employed) during the past week (984 aged ≥65 years, and 191 with unknown age). We also excluded 5931 participants with missing data on individual-level risk factors (principally job demand–control, N=4346). Thus, 35 550 subjects (81.1% of the original sample) entered our main analysis. A flow diagram for the study is presented in figure 1.

The overall one-year prevalence of back pain in the study sample was 46.1% (95% CI 45.5–46.6) and 44.6% (95% CI 44.1–45.1) for neck/upper-limb pain. Figure 2 gives age- and sex-adjusted prevalence rates for back and neck/upper-limb pain by occupation and country. The prevalence of both outcomes varied substantially between

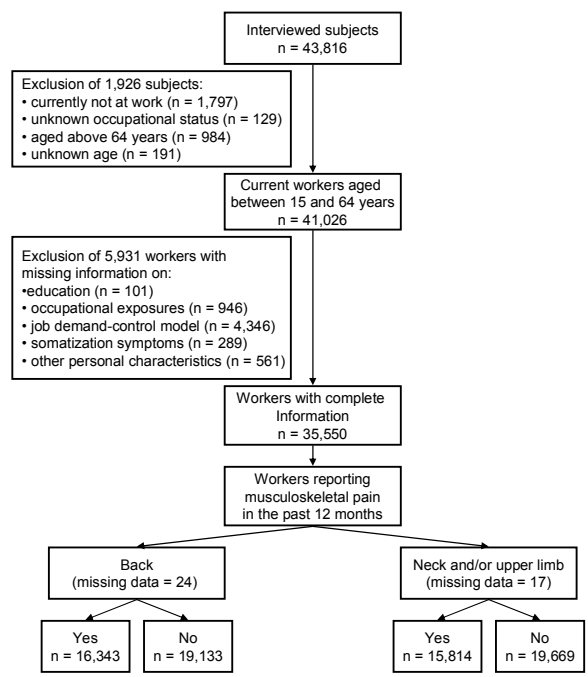

Figure 1. Flow diagram for study. Fifth European Working Conditions Survey, 34 European countries, 2010.

occupations, with relatively low values among teaching professionals (32.2% for back and 31.7% for neck/upper-limb pain) and the highest rates in agricultural, fishery, and related laborers (64.0% and 67.3%, respectively). Moreover, there was a high correlation (Pearson's r=0.97) between rates of back and neck/upper-limb pain by occupation, and this applied to both manual and non-manual workers. Major differences in prevalence were also observed by country with back pain more than twice as common in Portugal (63.8%) than Ireland (25.7%), and rates of neck/upper-limb pain ranging from 26.6% in Ireland to 67.7% in Finland. The correlation between back and neck/upper-limb pain by country (Pearson's r=0.54) was less strong than by occupation.

Table 1 summarizes the associations (mutually adjusted and adjusted also for occupation) of pain in the back and neck/upper limb with individual-level risk factors. For both anatomical sites, the prevalence of pain increased with age, and was somewhat higher among women than men, and with lower educational level. However, after adjustment for educational level and occupation, no association was apparent with socioeconomic class. Housework or cooking for more than one hour per day was associated with both back and neck/upper-limb pain (PR for both=1.11), but no clear associations were observed with frequency of gardening and repairs. The strongest associations were with number of somatic symptoms over the past year [PR for subjects reporting ≥2 versus 0 symptoms was 2.43 (95% CI 2.33–2.53) for back pain and 2.59 (95% CI 2.48–2.71) for neck/upper-limb pain]. The classification of subjects according to the job demand–control model suggested that active and high-strain jobs (both characterized by high job demand) were a risk factor for both back and neck/upper-limb pain. The physical occupational exposures analyzed showed mostly positive associations with the two pain outcomes, the two strongest associations being between, on the one hand, carrying or moving heavy loads and back pain and, on the other hand, repetitive hand or arm movements and neck/upper-limb pain. However, frequent work with computers tended to carry a lower risk of pain. Analyses

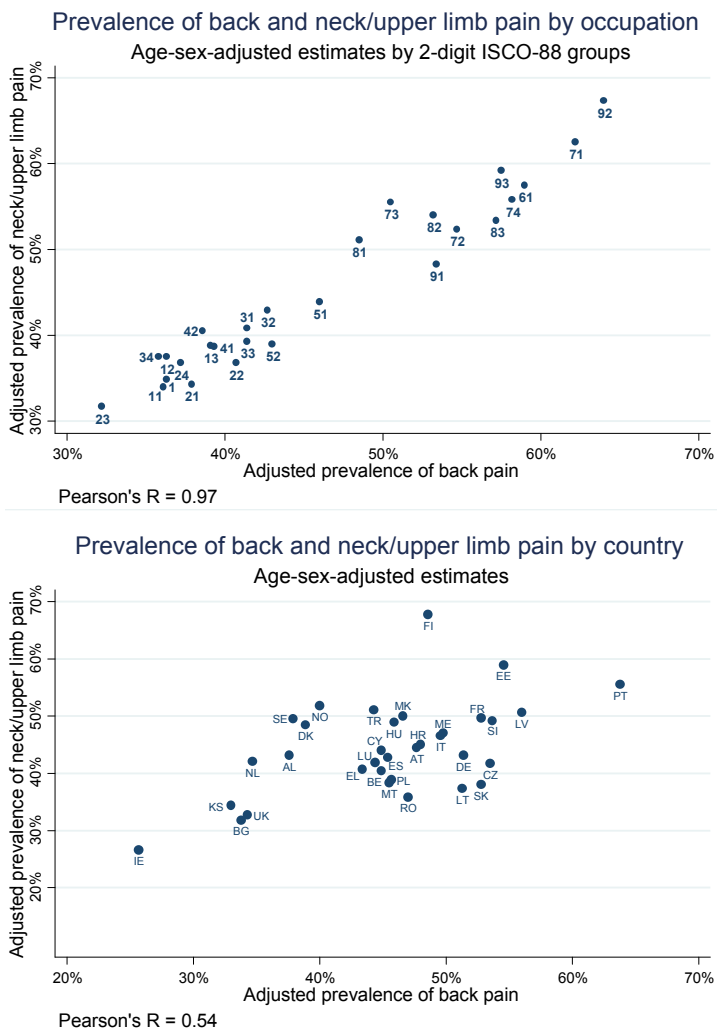

Figure 2. Prevalence of back and neck/upper-limb pain by occupation (2-digit ISCO-88) and country. Fifth European Working Conditions Survey, 34 European countries, 2010.

Table 1. Associations between musculoskeletal pain in past year and personal characteristics. Fifth European Working Conditions Survey, 34 European countries, 2010. [95% CI=95% confidence interval; ESEC=European socioeconomic classification; PR=prevalence ratio; Ref=reference category]

Characteristic	Back pain (N=35 476)						Neck/upper-limb pain (N=35 464)					
	Prevalence		Model A [a]		Model B [b]		Prevalence		Model A [a]		Model B [b]	
	N	%	PR	95%CI	PR	95%CI	N	%	PR	95%CI	PR	95%CI
Age (years)												
15–24	907	35.1	1.00	Ref	1.00	Ref	881	34.1	1.00	Ref	1.00	Ref
25–34	3244	39.1	1.12	1.04–1.21	1.11	1.03–1.20	3117	37.6	1.12	1.04–1.21	1.12	1.03–1.20
35–44	4502	45.3	1.23	1.14–1.32	1.22	1.13–1.31	4357	43.8	1.24	1.16–1.34	1.23	1.14–1.33
45–54	4965	52.3	1.39	1.29–1.49	1.37	1.28–1.48	4841	50.9	1.41	1.31–1.52	1.40	1.30–1.51
55–64	2725	52.8	1.47	1.36–1.59	1.46	1.35–1.58	2618	50.7	1.47	1.36–1.59	1.46	1.34–1.58
Gender												
Female	8271	48.4	1.00	Ref	1.00	Ref	8222	48.1	1.00	Ref	1.00	Ref
Male	8072	43.9	0.97	0.93–1.01	0.95	0.91–0.99	7592	41.3	0.92	0.88–0.96	0.89	0.86–0.94
Highest educational level												
Primary	4743	54.2	1.00	Ref	1.00	Ref	4501	51.4	1.00	Ref	1.00	Ref
Secondary	7515	47.5	0.96	0.92–1.00	0.96	0.92–1.00	7224	45.7	0.97	0.93–1.01	0.97	0.93–1.02
Tertiary	4805	37.5	0.88	0.83–0.93	0.89	0.84–0.95	4089	37.5	0.91	0.86–0.96	0.92	0.87–0.97
Socioeconomic class (ESEC)												
Salariat	3987	38.8	1.00	Ref	1.00	Ref	3945	38.4	1.00	Ref	1.00	Ref
Intermediate	4472	45.4	1.03	0.99–1.09	1.02	0.95–1.10	4370	44.4	1.03	0.99–1.09	1.03	0.95–1.11
Working class	7884	51.4	1.05	1.00–1.10	1.02	0.94–1.12	7499	48.9	1.03	0.98–1.08	1.05	0.96–1.14
Housework or cooking												
Never, occasionally	5665	42.5	1.00	Ref	1.00	Ref	5324	39.9	1.00	Ref	1.00	Ref
Everyday/every 2nd day (≤1 hour)	4935	45.7	1.06	1.02–1.11	1.07	1.02–1.11	4859	45.0	1.07	1.02–1.12	1.07	1.03–1.12
≥1 hour per day	5743	50.6	1.10	1.05–1.16	1.11	1.05–1.16	5631	49.6	1.11	1.06–1.17	1.11	1.06–1.17
Gardening and repairs												
Never, occasionally	10 578	44.7	1.00	Ref	1.00	Ref	10141	42.8	1.00	Ref	1.00	Ref
Twice per week	3581	48.3	1.03	0.99–1.07	1.03	0.99–1.07	3540	47.7	1.05	1.01–1.09	1.05	1.01–1.09
Everyday/every 2nd day	2184	49.9	1.01	0.96–1.06	1.00	0.95–1.05	2133	48.7	1.03	0.98–1.08	1.03	0.98–1.08
Number of distressing somatic symptoms in past year												
0	3605	25.8	1.00	Ref	1.00	Ref	3332	23.8	1.00	Ref	1.00	Ref
1	5207	49.8	1.83	1.75–1.91	1.83	1.76–1.91	5014	48.0	1.91	1.82–1.99	1.91	1.82–1.99
≥2	7531	68.1	2.42	2.32–2.52	2.43	2.33–2.53	7478	67.5	2.58	2.48–2.70	2.59	2.48–2.71
Job demand–control												
Low strain	3323	40.1	1.00	Ref	1.00	Ref	3174	38.3	1.00	Ref	1.00	Ref
Active	4422	47.6	1.08	1.03–1.13	1.08	1.03–1.13	4473	48.1	1.09	1.04–1.14	1.08	1.03–1.13
Passive	4177	42.9	0.97	0.92–1.02	0.96	0.92–1.01	3883	39.8	0.97	0.92–1.02	0.97	0.92–1.02
High strain	4421	54.2	1.06	1.01–1.12	1.06	1.01–1.11	4284	52.6	1.07	1.01–1.12	1.06	1.01–1.11
Carrying or moving heavy loads												
Never	6376	38.0	1.00	Ref	1.00	Ref	6123	36.5	1.00	Ref	1.00	Ref
Sometimes	5542	48.1	1.14	1.09–1.19	1.13	1.08–1.18	5408	46.9	1.15	1.11–1.20	1.15	1.10–1.20
Often	2137	57.7	1.25	1.18–1.32	1.23	1.16–1.30	2058	55.6	1.26	1.19–1.34	1.25	1.18–1.33
Always	2288	66.2	1.31	1.23–1.39	1.29	1.21–1.37	2225	64.4	1.32	1.24–1.40	1.29	1.22–1.37
Lifting or moving people												
Never	13 457	45.6	1.00	Ref	1.00	Ref	12958	43.9	1.00	Ref	1.00	Ref
Sometimes	1732	44.1	0.95	0.90–1.00	0.95	0.90–1.00	1731	44.1	0.96	0.91–1.01	0.95	0.90–1.01
Often	454	51.3	1.08	0.98–1.19	1.07	0.97–1.18	440	49.7	1.08	0.98–1.19	1.07	0.97–1.18
Always	700	61.3	1.07	0.99–1.16	1.06	0.97–1.15	685	60.0	1.05	0.97–1.14	1.05	0.96–1.14
Standing												
Never	2429	37.8	1.00	Ref	1.00	Ref	2393	37.2	1.00	Ref	1.00	Ref
Sometimes	3387	42.2	1.01	0.96–1.07	1.03	0.97–1.08	3297	41.0	0.99	0.93–1.04	1.00	0.94–1.06
Often	2902	43.7	1.00	0.94–1.06	1.03	0.97–1.10	2774	41.7	0.97	0.91–1.03	1.00	0.94–1.07
Always	7625	53.1	1.03	0.97–1.09	1.07	1.01–1.14	7350	51.2	1.00	0.94–1.05	1.04	0.98–1.11
Vibrations												
Never	9707	41.8	1.00	Ref	1.00	Ref	9371	40.4	1.00	Ref	1.00	Ref
Sometimes	3206	49.1	1.06	1.01–1.11	1.04	0.99–1.09	3123	47.8	1.06	1.02–1.11	1.04	1.00–1.09
Often	1462	58.2	1.14	1.07–1.21	1.11	1.04–1.18	1399	55.7	1.16	1.10–1.24	1.12	1.05–1.20
Always	1968	61.2	1.10	1.04–1.16	1.07	1.01–1.13	1921	59.7	1.12	1.06–1.18	1.09	1.02–1.15
Repetitive hand or arm movements												
Never	2856	34.6	1.00	Ref	1.00	Ref	2559	31.0	1.00	Ref	1.00	Ref
Sometimes	3144	40.7	1.04	0.99–1.10	1.04	0.99–1.10	3018	39.1	1.11	1.05–1.17	1.11	1.05–1.17
Often	3129	46.9	1.13	1.07–1.19	1.12	1.06–1.18	3031	45.4	1.22	1.15–1.29	1.21	1.15–1.28
Always	7214	56.2	1.22	1.17–1.29	1.21	1.15–1.27	7206	56.2	1.35	1.29–1.42	1.34	1.27–1.41
Working with computers												
Never	7387	52.8	1.00	Ref	1.00	Ref	7007	50.1	1.00	Ref	1.00	Ref
Sometimes	3273	45.7	0.97	0.93–1.01	1.00	0.95–1.05	3135	53.8	0.94	0.90–0.99	0.96	0.92–1.01
Often	1454	38.7	0.88	0.83–0.94	0.92	0.86–0.98	1435	38.2	0.89	0.83–0.95	0.91	0.85–0.97
Always	4229	40.0	0.91	0.87–0.96	0.95	0.90–1.00	4237	40.1	0.92	0.87–0.96	0.94	0.89–0.99

[a] Estimates from multivariate Poisson regression with random intercept by country.

[b] Estimates from multivariate Poisson regression models adjusted by occupational group (2-digit ISCO-88) and with random intercept by country.

stratified by sex are presented online in Appendix 3 (www.sjweh.fi/data_repository.php).

Table 2 shows risk estimates for back and neck/upper-limb pain by occupational group. For both outcomes, adjustment for other personal characteristics in addition to sex and age considerably reduced the strength of the observed associations. This effect was driven largely by the psychosocial and physical occupational risk factors. Compared to teaching professionals, the highest fully adjusted PR for back pain were observed among manual workers such as drivers and mobile-plant operators (PR=1.36), market-oriented skilled agricultural and fishery workers (PR=1.28), extraction and building trades workers (PR=1.29), and agricultural, fishery and related laborers (PR=1.28). Adjusted PR for neck/upper-limb pain were generally lower than for back pain. Again, higher risks were observed among manual workers such as agricultural, fishery and related laborers (PR=1.29), extraction and building trades workers (PR=1.25), precision, handicraft, printing and related trades workers (PR=1.24), and drivers and mobile-plant operators (PR=1.22).

Table 3 shows the relation of national socioeconomic risk factors to back and neck/upper-limb pain, after adjustment for individual-level risk factors including occupation. For both anatomical sites, the prevalence of pain was lower in countries with a higher percentage of people at risk of poverty or social exclusion. Positive associations with back pain were also observed for higher expenditure on social protection, higher rate of fatal accidents at work, and more self-reported unmet need for medical examination or treatment. Conversely, higher public expenditure on education and longer healthy life expectancy at birth were associated with a lower risk of back pain. When risk estimates were mutually adjusted, only school expectancy was positively associated with neck/upper-limb pain.

Figure 3 summarizes the distribution of one-year prevalence rates for back and neck/upper-limb pain across Europe. Prevalence maps were plotted for rates adjusted for age and sex, for all individual-level risk factors (parameterized as presented in tables 1 and 2), and for all individual-level risk factors together with significant national risk factors (as presented in table 3). For back pain, adjustment by other individual-level risk factors produced little reduction in the large variation of age and sex-adjusted prevalence between countries. When rates were adjusted also for national socioeconomic variables, they became more homogenous, although still varying from 39.0% (Netherlands) to 52.1% (Italy). For neck/upper-limb pain, even the fully adjusted prevalence rates were quite variable, ranging from 32.6% (Czech Republic) to 55.4% (Latvia). A weak autocorrelation was appreciable for the prevalence rates of back pain before adjusting for national risk factors; no evidence of autocorrelation was apparent after adjustment.

Discussion

We found large variation in the one-year prevalence of back and neck/upper-limb pain by occupational group and country. Differences between occupational groups were largely explained by individual-level risk factors (in particular, occupational determinants of musculoskeletal pain). In contrast, adjustment for individual-level risk factors did not reduce the variation in prevalence between countries. However, several national socioeconomic variables were associated with musculoskeletal pain independently from individual-level risk factors. For back pain, risk factors at the national level appeared to influence prevalence, which was more homogeneous after adjustment for these variables. However, only a small proportion of the international variation in neck/upper-limb pain was explained in fully adjusted models.

The strengths of our study include the large sample size and substantial number of countries analyzed. Also, in all countries, each stage of the survey was conducted using standardized methods (14).

Against this, the study's cross-sectional design limits the interpretation of findings. Reverse causation may have contributed to some of the observed associations, in particular for psychological risk factors. However, insofar as this occurred, the effect will have been to overestimate the influence of the risk factors concerned and would not account for the failure of adjustment for individual-level risk factors to explain international differences in prevalence. Another weakness is the incomplete response to the questionnaire (overall response rate 59.6%). We cannot exclude the possibility that people with musculoskeletal pain were over- or under-represented in the study sample. However, musculoskeletal pain was not the main focus of the EWCS, and it seems unlikely that selection bias alone could explain differences in symptom prevalence between countries of the magnitude that was observed.

More important is the limited quantity and quality of information that was available on individual participants. Data were collected through interviewer-administered questionnaires with no clinical measures of pain and disability. It is possible that participants were more aware of pain if it was exacerbated or made difficult by their work and that this exaggerated associations with certain jobs and occupational activities. On the other hand, non-differential errors in the reporting of exposures may have biased risk estimates towards the null. This in turn could have caused over-estimation of the residual variation in prevalence after adjustment for individual-level risk factors. However, it seems unlikely to have been a major problem since adjustment for individual-level risk factors caused substantial reductions in risk estimates for occupations with high

Table 2. Associations between musculoskeletal pain in past year and occupational groups. Fifth European Working Conditions Survey, 34 European countries, 2010. [95% CI=95% confidence interval; PR=prevalence ratio; Ref=reference category]

Occupations (2-digit ISCO-88)		Back pain (N=35 476)							Neck/upper-limb pain (N=35 464)						
		Prevalence		Age-sex adjusted	Adjusted by non-occupational risk factors [a]		Adjusted by all individual-level risk factors [b]		Prevalence		Age-sex adjusted	Adjusted by non-occupational risk factors [a]		Adjusted by all individual-level risk factors [b]	
		N	%	PR	PR	95% CI	PR	95% CI	N	%	PR	PR	95% CI	PR	95% CI
1	Armed forces	55	32.7	1.09	1.10	0.83–1.45	1.07	0.81–1.42	51	30.2	1.05	1.10	0.81–1.44	1.04	0.77–1.39
11	Legislators and senior officials	43	37.4	1.11	1.08	0.79–1.47	1.11	0.82–1.52	43	37.4	1.07	1.08	0.77–1.43	1.06	0.78–1.45
12	Corporate managers	399	36.9	1.11	1.09	0.96–1.23	1.10	0.96–1.25	417	38.6	1.15	1.09	1.01–1.29	1.14	1.00–1.29
13	General managers	763	39.1	1.18	1.10	0.98–1.24	1.03	0.91–1.16	755	38.6	1.19	1.10	0.99–1.25	1.02	0.91–1.15
21	Physical, mathematical, engineering science professionals	311	35.4	1.14	1.13	0.99–1.30	1.15	1.00–1.32	282	32.2	1.05	1.13	0.90–1.19	1.03	0.89–1.19
22	Life science and health professional	343	42.1	1.23	1.29	1.13–1.46	1.19	1.04–1.36	322	39.5	1.14	1.29	1.04–1.36	1.08	0.95–1.24
23	Teaching professionals	714	35.3	1.00	1.00	Ref.	1.00	Ref.	722	35.7	1.00	1.00	Ref.	1.00	Ref.
24	Other professionals	608	39.5	1.14	1.14	1.03–1.27	1.19	1.06–1.33	601	39.1	1.14	1.14	1.02–1.27	1.16	1.04–1.30
31	Physical and engineering science associate professionals	425	40.3	1.25	1.18	1.04–1.34	1.15	1.01–1.30	411	38.9	1.24	1.18	1.04–1.34	1.12	0.99–1.28
32	Life science and health associate professionals	466	47.0	1.30	1.23	1.09–1.38	1.13	1.00–1.28	472	47.6	1.31	1.23	1.10–1.40	1.13	1.00–1.27
33	Teaching associate professionals	190	43.7	1.26	1.22	1.03–1.45	1.23	1.04–1.45	189	43.4	1.21	1.22	1.00–1.40	1.19	1.00–1.41
34	Other associate professionals	1060	38.3	1.10	1.03	0.92–1.15	1.08	0.96–1.22	1107	39.9	1.16	1.03	0.97–1.21	1.12	1.00–1.26
41	Office clerks	1155	42.3	1.20	1.09	0.97–1.23	1.12	0.99–1.28	1129	41.3	1.19	1.09	0.96–1.22	1.09	0.96–1.24
42	Customer services clerks	403	40.7	1.18	1.02	0.88–1.19	1.04	0.89–1.22	417	42.1	1.24	1.02	0.91–1.23	1.06	0.90–1.23
51	Personal and protective services workers	1726	47.0	1.38	1.21	1.07–1.37	1.13	1.00–1.29	1665	45.4	1.33	1.21	1.01–1.30	1.06	0.93–1.20
52	Models, salespersons and demonstrators	1054	43.7	1.30	1.14	1.00–1.30	1.09	0.95–1.24	954	39.5	1.20	1.14	0.91–1.19	0.97	0.85–1.11
61	Market-oriented skilled agricultural and fishery workers	665	56.8	1.78	1.52	1.32–1.74	1.28	1.11–1.47	655	56.0	1.75	1.52	1.30–1.71	1.20	1.05–1.39
71	Extraction and building trades workers	992	59.0	1.90	1.61	1.41–1.84	1.29	1.12–1.48	955	56.8	1.95	1.61	1.43–1.88	1.25	1.08–1.43
72	Metal, machinery and related trades workers	764	52.6	1.66	1.41	1.23–1.62	1.20	1.04–1.38	700	48.1	1.61	1.41	1.17–1.55	1.11	0.96–1.28
73	Precision, handicraft, printing and related trades workers	110	51.4	1.52	1.31	1.05–1.62	1.16	0.93–1.45	118	55.1	1.68	1.31	1.16–1.78	1.24	1.00–1.53
74	Other craft and related trades workers	526	60.1	1.72	1.46	1.26–1.68	1.23	1.07–1.43	490	56.0	1.68	1.46	1.22–1.62	1.13	0.98–1.32
81	Stationary-plant and related operators	123	50.0	1.47	1.22	0.99–1.51	1.03	0.83–1.28	125	50.8	1.56	1.22	1.03–1.58	1.04	0.84–1.29
82	Machine operators and assemblers	613	53.4	1.59	1.33	1.15–1.53	1.13	0.98–1.31	612	53.3	1.63	1.33	1.16–1.54	1.09	0.94–1.26
83	Drivers and mobile-plant operators	825	55.1	1.73	1.47	1.28–1.68	1.36	1.18–1.58	731	48.8	1.64	1.47	1.20–1.58	1.22	1.05–1.41
91	Sales and services elementary occupations	1389	56.7	1.57	1.32	1.16–1.50	1.19	1.05–1.36	1262	51.5	1.45	1.32	1.06–1.37	1.05	0.92–1.20
92	Agricultural, fishery and related labourers	157	62.3	1.92	1.54	1.26–1.87	1.28	1.05–1.56	164	65.1	2.03	1.54	1.33–1.95	1.29	1.06–1.57
93	Laborers in mining, construction, manufacturing, transport	464	54.1	1.74	1.43	1.23–1.66	1.17	1.00–1.36	465	54.3	1.82	1.43	1.27–1.72	1.15	0.99–1.34

[a] Estimates from Poisson regression models with random intercept by country and adjusted for age class, sex, socioeconomic class, housework or cooking, gardening and repairs, number of somatic symptoms in past year.

[b] Estimates from Poisson regression models with random intercept by country and adjusted for age class, sex, socioeconomic class, housework or cooking, gardening and repairs, number of somatic symptoms in past year, job demand–control, carrying or moving loads, lifting or moving people, standing, vibrations, repetitive hand or arm movements, and working with computers.

Table 3. Associations between musculoskeletal pain in past year and national socioeconomic risk factors. Fifth European Working Conditions Survey, 28 European countries, 2010. [95% CI=95% confidence interval; PR=prevalence ratio]

Risk factors (standardized variables) [b]	Back pain (N=30 064)				Neck/upper-limb pain (N=30 071)			
	Each risk factor examined separately [a]		Forward stepwise regression [a]		Each risk factor examined separately [a]		Forward stepwise regression [a]	
	PR	95%CI	PR	95%CI	PR	95%CI	PR	95%CI
People at risk of poverty or social exclusion (%)	0.96	0.92–1.01	0.86	0.82–0.91	0.90	0.85–0.94	0.91	0.86–0.96
In-work at-risk-of-poverty rate (%)	0.99	0.94–1.04	·	··	0.92	0.87–0.98	·	··
GDP per capita (PPS)	0.99	0.94–1.04	·	··	1.07	1.00–1.14	·	··
Material deprivation rate	0.98	0.93–1.03	·	··	0.90	0.85–0.95	·	··
Distribution of income (Gini coefficient)	0.98	0.93–1.03	·	··	0.91	0.86–0.96	·	··
Hospitals beds per 100.000 inhabitants	1.03	0.98–1.08	·	··	0.95	0.90–1.02	·	··
School expectancy (years)	1.00	0.95–1.05	·	··	1.09	1.03–1.15	1.06	1.01–1.12
Public expenditure on labor market policies, category 1 (% of GDP)	0.99	0.94–1.04	·	··	1.04	0.97–1.11	·	··
Public expenditure on labor market policies, categories 2–7 (% of GDP)	1.00	0.94–1.05	·	··	1.09	1.03–1.16	·	··
Public expenditure on labor market policies, categories 8–9 (% of GDP)	1.03	0.98–1.08	·	··	1.09	1.02–1.15	·	··
Expenditure on social protection (% of GDP)	1.01	0.96–1.06	1.06	1.02–1.10	1.10	1.04–1.17	·	··
Public expenditure on education (% of GDP)	0.99	0.94–1.04	0.95	0.92–0.98	1.10	1.04–1.17	·	··
Fatal accidents at work – index	0.99	0.94–1.04	·	·	0.97	0.91–1.04	·	··
Fatal accidents at work – rate	1.03	0.98–1.08	1.09	1.05–1.13	0.94	0.88–1.00	·	··
Healthy life expectancy at birth: mean (years)	0.94	0.90–0.98	0.94	0.91–0.97	0.99	0.93–1.06	·	··
Self reported unmet need for medical examination or treatment (%)	1.00	0.95–1.05	1.08	1.04–1.13	0.95	0.89–1.01	·	··
Unemployment rate (%)	1.00	0.95–1.05	·	·	0.95	0.89–1.01	·	··

[a] Estimates from Poisson regression models with random intercept by country and adjusted for age class, sex, socioeconomic class, housework or cooking, gardening and repairs, number of somatic symptoms in past year, job demand-control, carrying or moving loads, lifting or moving people, standing, vibrations, repetitive hand or arm movements, working with computers, and occupation (2-digit ISCO-88).

[b] Standardized variables with mean=0 and standard deviation=1.

rates of musculoskeletal pain, such as agricultural and construction workers (table 2). Although the assessment of psychosocial aspects of work was not formally validated, previous studies have demonstrated the validity of Karasek's Job Content Questionnaire-like dimensions (21), and Karasek's dimensions constructed from the questionnaire used in the Fourth EWCS – which was similar to that used in the Fifth EWCS – showed good psychometric properties (22).

The EWCS questionnaire was developed in English and translated into 32 languages to be used in 34 countries (23, 24), the accuracy of translation being checked by independent back-translation. A panel of experts reviewed the final versions of all questionnaires. Nevertheless, it remains possible that terms such as "backache" and "pain" are understood differently in different languages and cultures. In analyses of risk factors, this would be taken into account to some extent by the assumption of a random effect of country. Conversely, the variation observed for prevalence rates of musculoskeletal symptoms could be partially explained by the different understanding of the questions. Assessment of "disabling pain" would probably have provided more comparable findings between countries with respect to the prevalence of musculoskeletal pain.

The EWCS data were potentially clustered at two nested levels – region within country. In our main analysis, we fitted multilevel models with random intercept by country but ignored possible clustering by regions. This choice was driven by long computing times when performing the model selection for national socioeconomic risk factors. However, to check for possible bias resulting from ignoring a region effect, we also fitted three-level models including all individual-level risk factors, with random intercepts for region and country. Values for PR, associated standard errors, and random intercepts by country were almost identical to those obtained from the two-level models (data not shown). This suggests that our findings were not importantly biased.

Findings from the analysis of individual risk factors accorded with observations made in other studies (6, 10, 11, 25). For both pain outcomes, the highest PR were associated with report of two or more somatic symptoms over the past year. A strong association between somatizing tendency and musculoskeletal pain is already well established (4–6, 11). We found that active and high-strain jobs – both characterized by high job demand – were associated with musculoskeletal pain. This finding is again in line with the balance of current knowledge, although the evidence is somewhat conflicting (7).

We found a negative association between working with computers and back and neck/upper-limb pain. Many studies have indicated positive associations of computer use with self-reported upper limb pain (eg, 11, 26), although there has been no consistent association with specific upper-limb disorders such as carpal tunnel syndrome (27, 28). In a supplementary analysis restricted to non-manual workers (ISCO-88 major

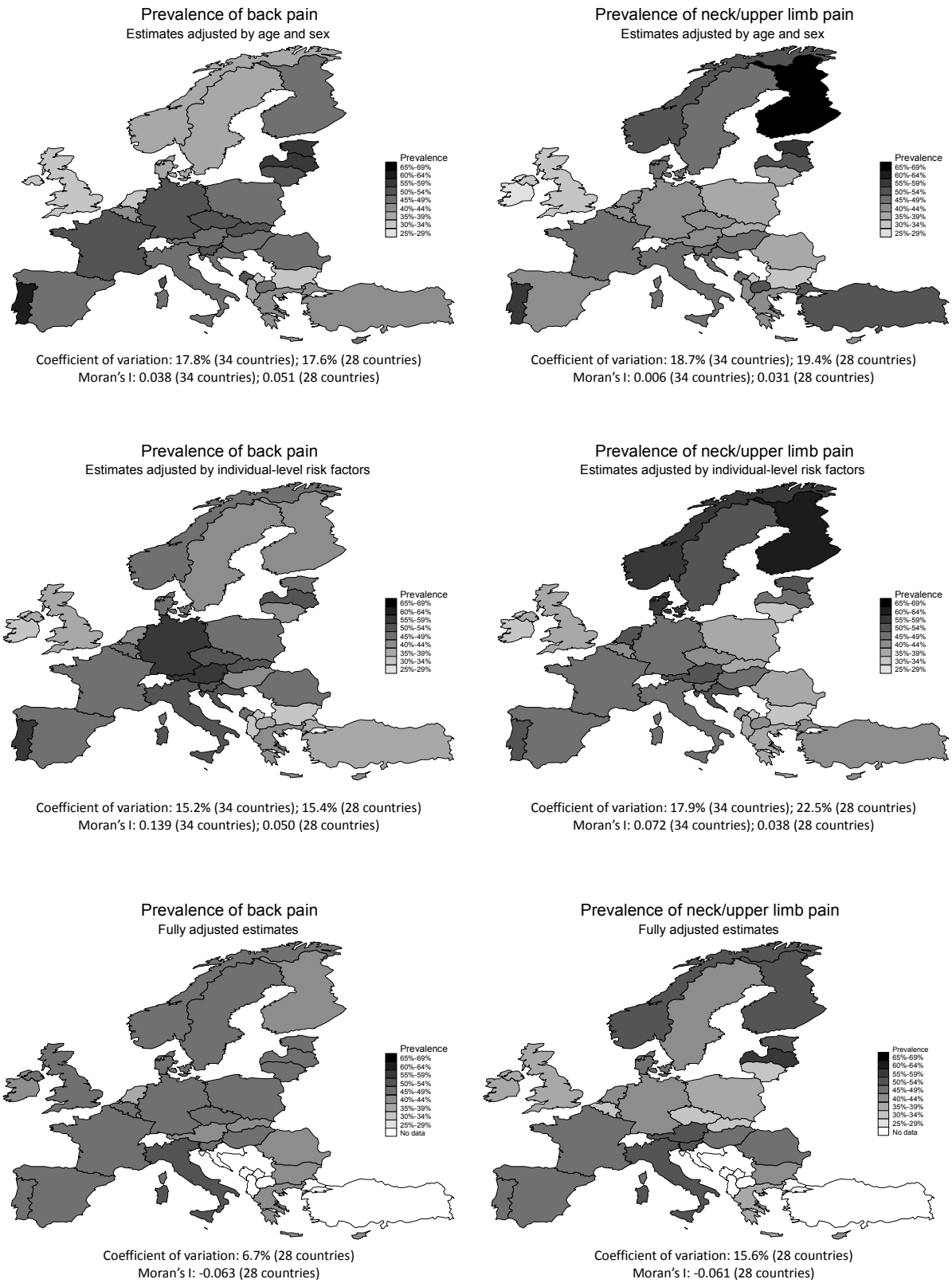

Figure 3. Estimated prevalence of back and neck/upper-limb pain by country. Fifth European Working Conditions Survey, 28 European countries, 2010.

groups 1–4), the PR for working with computers were all >1 (data not shown). Consequently, it may be that, in the full study sample, effects of using computers were negatively confounded by other occupational exposures that occur predominantly in manual work.

We did not begin our analysis with strong a-priori hypotheses about the role of specific national socioeconomic factors. Thus, selection of variables that were included in the final models was based on statistical criteria (forward selection). Given the limited number of countries for which data were available, and the relatively large number of national socioeconomic risk factors examined, it is possible that some of the associations identified were spuriously high by chance. However, this could not account for persistent variation between countries after adjustment for such risk factors. Rather it would lead to over-adjustment.

Of the associations that were observed with national socioeconomic factors, most striking was the inverse relationship with the risk of poverty or social exclusion. This applied to both pain outcomes and was present with and without adjustment for other socioeconomic risk factors. This is consistent with the tendency for higher risk found in countries with greater expenditure on social protection and with the higher rates of neck and upper-limb pain found in countries with longer education. It may be that, through psychological mechanisms, access to social support and protection from poverty encourages the development or persistence of musculoskeletal complaints, especially if those who suffer from such disorders are less likely to lose income as a consequence. That back pain was also associated with shorter healthy life expectancy and more frequent self-report of unmet need for medical examination may reflect a tendency to rate personal health worse and have greater expectations of care in countries where there is less risk of poverty or social exclusion (healthy life expectancy was calculated by a method based on life tables and self-reported general health) (29).

Back pain was also associated with higher rates of fatal accidents at work. Fatal injuries are more frequent in manual occupations (30), and the observed association could be determined by shared risk factors. However, the association between fatal accident rates and back pain emerged only after adjustment for other risk factors and was not paralleled by a similar association with neck and upper-limb pain. Thus it may be a chance finding.

Adjustment for national socioeconomic variables reduced the variation between countries in prevalence of back pain (figure 3). However, important differences remained, and the effect of such adjustment was smaller for neck and upper-limb pain. This suggests that there are important determinants of musculoskeletal pain that have yet to be identified. It is possible that these are related to affluence and social support but were not adequately captured by the variables that we analyzed. Another possibility is that they reflect differences in culturally determined health beliefs (10) and expections, which have been highlighted as predictors of outcome among people suffering from musculoskeletal pain (31, 32).

Concluding remarks

In conclusion, our analysis indicates substantial variation between European countries in the prevalence of back and neck/upper-limb pain. This variation is unexplained by established individual-level risk factors. It may be attributable in part to socioeconomic differences between countries, with higher prevalence where there is lower risk of poverty or social exclusion. Future studies should explore this possibility further, perhaps by comparing trends over time in countries where socioeconomic circumstances have changed differentially.

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