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Are occupational factors important determinants of socioeconomic inequalities in musculoskeletal pain?

by Ingrid Sivesind Mehlum, MD,¹ Petter Kristensen, PhD,¹ Helge Kjuus, PhD,¹ Ebba Wergeland, PhD²

Mehlum IS, Kristensen P, Kjuus H, Wergeland E. Are occupational factors important determinants of socioeconomic inequalities in musculoskeletal pain? *Scand J Work Environ Health* 2008;34(4);250–259.

Objectives The aim of this study was to quantify socioeconomic inequalities in low-back pain, neck–shoulder pain, and arm pain in the general working population in Oslo and to examine the impact of job characteristics on these inequalities.

Methods All economically active 30-, 40-, and 45-year-old persons who attended the Oslo health study in 2000–2001 and answered questions on physical job demands, job autonomy, and musculoskeletal pain were included (N=7293). Occupational class was used as an indicator of socioeconomic status. The lower occupational classes were compared with higher grade professionals, and prevalences, prevalence ratios, prevalence differences, and population attributable fractions were calculated.

Results There were marked, stepwise socioeconomic gradients for musculoskeletal pain, steeper for the men than for the women. The relative differences (prevalence ratios) were larger for low-back pain and arm pain than for neck–shoulder pain. The absolute differences (prevalence differences) were the largest for low-back pain. Physical job demands explained a substantial proportion of the absolute occupational class inequalities in low-back pain, while job autonomy was more important in explaining the inequalities in neck–shoulder pain and arm pain. The estimated population attributable fractions supported the impact of job characteristics at the working population level, especially for low-back pain.

Conclusions In this cross-sectional study, physical job demands and job autonomy explained a substantial proportion of occupational class inequalities in self-reported musculoskeletal pain in the working population in Oslo. This finding indicates that the workplace may be an important arena for preventive efforts to reduce socioeconomic inequalities in musculoskeletal pain.

Key terms arm pain; job autonomy; low-back pain; neck pain; occupational class; occupational health; physical job demands; questionnaire; self-reported symptom; shoulder pain.

Socioeconomic inequalities in health are well documented. The impact of work conditions on socioeconomic inequalities has been studied for various health outcomes [eg, mortality (1), coronary heart disease (2), self-rated general health (3–8), and mental health (8)]. A few studies have examined the impact of work conditions on socioeconomic inequalities in musculoskeletal disorders, measured as physician-diagnosed disorders (9), self-reported disorders diagnosed by a physician (10), sickness absence (11, 12), or disability pensioning (13). Aittomäki et al (10) showed that the occupational class-gradient in musculoskeletal disorders was largely explained by physical demands at work. Melchior et al (9) found that physical work factors accounted for over 50% of the differences between manual workers and other workers in physician-diagnosed upper-limb

disorders, higher for some diagnoses. Melchior et al (11) also reported that work conditions explained approximately 25% of the occupational class-gradients in musculoskeletal-related sickness absence. Hagen et al (13) found that the inverse association between education and occupational disability from back pain was partly mediated through work conditions. However, data on the impact of different occupational factors on socioeconomic inequalities in musculoskeletal pain in specific body regions have rarely been reported.

The Oslo health study, in 2000–2001, of which our present study is a part, was initiated to examine the health status and socioeconomic health inequalities among Oslo citizens (14). Previous studies have shown large geographic and socioeconomic inequalities in Oslo (15, 16). We have recently reported high prevalences of

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work-related health problems in this population (17). There is evidence that certain job characteristics, such as physical job demands and job autonomy, are risk factors for musculoskeletal disorders (18). Lower social classes tend to have higher prevalences of harmful work conditions, which can partly explain socioeconomic inequalities in health (4, 5, 9, 10). These issues need to be explored further.

The aim of our present study was to quantify socioeconomic inequalities in low-back pain, neck-shoulder pain, and arm pain in the general working population in Oslo and to examine the impact of physical job demands and job autonomy on these inequalities. Our hypothesis was that musculoskeletal pain is associated with occupational class and that this association can partly be explained by job characteristics and may vary between body regions.

Study population and methods

Study population

The Oslo health study, a cross-sectional population study, was conducted in 2000–2001 in joint collaboration between the Norwegian Institute of Public Health, the University of Oslo, and the municipality of Oslo. Everyone in Oslo County born in 1970, 1960, 1955, 1940–1941, and 1924–1925 were invited by letter to attend a health screening, and the three youngest cohorts were selected for our present study (N=26 074). Of these people, 10 712 (41%) attended a physical examination or filled out at least one questionnaire in the Oslo health study (17). An age-specific supplementary questionnaire, which included questions on musculoskeletal pain, was returned by 8594 persons (33%). The response frequency was higher among the women than among the men, and it increased with age. Persons with little education, low income, disability benefit, or nonwestern origin were under-represented (17). We have studied the 7293 (28%) respondents to this questionnaire with data on musculoskeletal pain, occupation, and job characteristics, 4042 women and 3251 men (table 1).

Questionnaires and study outcome

The main questionnaire was distributed with the letter of invitation. Two supplementary questionnaires were handed out at the health screening with pre-stamped self-addressed envelopes. The questionnaires asked for information on health status, symptoms, diseases, and various aspects of health behavior (14). The questions on musculoskeletal pain were similar to those used by Statistics Norway in regular national surveys (19). The introductory question, "Have you experienced any of the

following common health problems in *the last month*?" was followed by a list of health problems; among them were pain in neck or shoulders, pain in the elbow, forearm or hand, and low-back pain (17).

Determinants

Occupational class. The indicator of socioeconomic status was based on questions on the participants' longest held occupation in the past 12 months, classified according to the Erikson–Goldthorpe–Portocarero (EGP) schema (20, 21). Because 61% of the women were in category III (routine nonmanual employees), this category was subdivided into IIIa (eg, nurses, teachers) and IIIb (eg, nursing assistants, shop salespersons), as in the full 11-class version of the EGP schema (21, 22). Only 27 women (0.6%) were in category V (lower-grade technicians and supervisors of manual workers). Category V and VI (skilled manual workers) were therefore collapsed, as in the 7-class version of the schema (21), and called "skilled workers" (eg, building trade workers, home helpers), leaving seven categories in the analyses (table 1).

Job characteristics. Two separate job characteristics were measured, each by one question. Physical job demands were measured by asking "How would you

Table 1. Distribution of the men (N=3251) and women (N=4042) according to the background factors and determinant variables.

	Men (%)	Women (%)
Age		
30 years	39	38
40 years	32	31
45 years	29	30
Country of birth		
Norway	85	86
Western countries	5	7
Nonwestern countries	10	7
Occupational class		
I Higher grade professionals	30	18
II Lower grade professionals	13	10
IIIa Routine nonmanual, higher	20	34
IIIb Routine nonmanual, lower	9	27
IV Self-employed workers	10	6
V+VI Skilled workers	10	2
VII Unskilled workers	8	3
Physical job demands		
Walking	19	25
Sedentary work	65	59
Walking and lifting	14	16
Heavy physical work	2	0
Job autonomy		
4 (high)	20	12
3	58	56
2	18	28
1 (low)	3	4

describe your current work?", followed by four mutually exclusive response categories: "mainly sedentary work", "work involving a lot of walking", "work involving a lot of walking and lifting", and "heavy physical work". Job autonomy was assessed with the question, "Can you yourself decide how your work should be organized?", with the following response categories: "no, not at all", "to a small degree", "yes, largely", and "yes, I decide myself", ranging from 1 (low) to 4 (high) autonomy in the analyses.

The general characteristics of the study population are shown in table 1. Gender differences were observed. Men were more frequently professionals, skilled or unskilled workers, had sedentary or heavy physical work, and had high job autonomy, while the women were more often routine nonmanual employees, had a lot of walking in their work, and had lower job autonomy.

The participants with heavy physical work generally had lower job autonomy, while those with sedentary work had higher autonomy (data not shown).

Statistical analyses

Analyses were performed using Stata/SE 9.2 software (www.stata.com). Associations between occupational class and musculoskeletal pain were estimated both as prevalence ratios and prevalence differences (23) with their corresponding 95% confidence intervals (95% CI), using the BINREG procedure (binomial regression) in Stata. Since musculoskeletal pain was prevalent, we did not use the more conventional odds ratios in the logistic regression (24, 25). Physical job demands and job autonomy were added separately and together in four multivariate models for each of the three study outcomes of low-back pain, neck-shoulder pain, and arm pain (pain in elbow, forearm, or hand). We calculated the percentage of change in the prevalence difference by adding each factor to the model. Model 1 included age (30, 40 or 45 years) and country of birth (Norway, western countries, or nonwestern countries) in addition to occupational class. Model 2 included physical job demands, in addition to model-1 factors. Model 3 included job autonomy, in addition to model-1 factors. Model 4 included all of the determinants.

The highest occupational class (I), work involving a lot of walking, and the highest category of job autonomy (4) were chosen as reference categories. Interaction between physical job demands and job autonomy was checked for, but the analyses were inconclusive due to collinearity.

The population attributable fraction (PAF) can be interpreted as the proportional reduction in the population prevalence in the hypothetical case that the whole population experiences the prevalence of the reference category (26). Population attributable fractions for

occupational class were estimated in the AFLOGIT procedure in Stata after the inclusion of the determinants in the regression model as dummy variables (27).

Ethics approval

The study protocol was approved by the Norwegian Data Inspectorate and recommended by the Regional Committee for Medical Research Ethics.

Results

Prevalence of musculoskeletal pain

The distributions of low-back pain, neck-shoulder pain, and arm pain are shown in table 2 (men) and table 3 (women) according to occupational class and job characteristics. The lower occupational classes had higher prevalences of musculoskeletal pain. Among the unskilled workers, 62% of the women and 66% of the men reported low-back pain in the past month, while, among the higher grade professionals, the corresponding percentages were 43% and 35%, respectively. The prevalences were the lowest for arm pain and the highest for neck-shoulder pain. The differences between the three highest occupational classes (I, II and IIIa) were, in general, only minor. The prevalences for the self-employed workers (IV) were close to the overall prevalences of the population. Gender differences were the largest for the higher occupational classes.

The crude prevalences for musculoskeletal pain were the highest for the participants with heavy physical work. For both genders, low-back pain was the least prevalent among the participants with sedentary work, while arm pain was the least prevalent for both genders and neck-shoulder pain for women among the participants with a lot of walking in their work. Low autonomy was associated with musculoskeletal pain for both genders; the lower the autonomy, the higher the prevalence.

Relative and absolute differences in the prevalence of musculoskeletal pain

The relative socioeconomic gradient (prevalence ratio) was steeper for low-back pain and arm pain than for neck-shoulder pain, and steeper for the men (table 2) than for the women (table 3). For the unskilled workers, compared with the higher grade professionals, the prevalence ratio for low-back pain was 1.7 for the men and 1.3 for the women.

The absolute differences in occupational class (prevalence differences) in model 1 were also larger for the men (table 4) than for the women (table 5), and larger

Table 2. Prevalences and prevalence ratios for self-reported musculoskeletal pain according to occupational class, physical job demands, and job autonomy among the men. (95% CI = 95% confidence interval)

	N	Low-back pain			Neck-shoulder pain			Arm pain		
		Prevalence ^a (%)	Prevalence ratio ^b	95% CI	Prevalence ^a (%)	Prevalence ratio ^b	95% CI	Prevalence ^a (%)	Prevalence ratio ^b	95% CI
All men	3251	43	.	.	43	.	.	23	.	.
Occupational class										
I Higher grade professionals	975	35	1	..	40	1	..	20	1	..
II Lower grade professionals	435	33	1.0	0.8–1.1	42	1.1	0.9–1.2	21	1.0	0.8–1.3
IIIa Routine nonmanual, higher	634	39	1.1	1.0–1.3	37	0.9	0.8–1.1	17	0.9	0.7–1.1
IIIb Routine nonmanual, lower	301	52	1.5	1.3–1.7	50	1.2	1.0–1.3	26	1.2	0.9–1.5
IV Self-employed workers	329	46	1.2	1.1–1.4	44	1.0	0.9–1.2	26	1.2	1.0–1.5
V+VI Skilled workers	320	58	1.6	1.4–1.8	47	1.1	1.0–1.3	32	1.5	1.2–1.9
VII Unskilled workers	257	66	1.7	1.5–1.9	61	1.3	1.2–1.5	39	1.7	1.4–2.0
Physical job demands										
Walking	617	49	1	..	43	1	..	20	1	..
Sedentary work	2099	37	0.8	0.7–0.9	41	1.0	0.9–1.1	21	1.2	1.0–1.4
Walking and lifting	457	58	1.2	1.1–1.3	49	1.1	1.0–1.3	32	1.5	1.3–1.9
Heavy physical work	78	69	1.4	1.2–1.6	67	1.4	1.2–1.7	23	2.5	2.0–3.2
Job autonomy										
4 (high)	659	37	1	..	37	1	..	20	1	..
3	1893	40	1.1	1.0–1.2	41	1.1	1.0–1.3	22	1.1	0.9–1.3
2	587	53	1.4	1.2–1.6	52	1.4	1.2–1.5	27	1.3	1.1–1.6
1 (low)	112	67	1.5	1.3–1.8	70	1.6	1.3–1.8	45	1.7	1.3–2.3

^a Unadjusted, expressed as percentages, excluding missing answers.^b Adjusted for age and country of birth.**Table 3.** Prevalences and prevalence ratios for self-reported musculoskeletal pain according to occupational class, physical job demands, and job autonomy among the women. (95% CI = 95% confidence interval)

	N	Low-back pain			Neck-shoulder pain			Arm pain		
		Prevalence ^a (%)	Prevalence ratio ^b	95% CI	Prevalence ^a (%)	Prevalence ratio ^b	95% CI	Prevalence ^a (%)	Prevalence ratio ^b	95% CI
All women	4042	48	.	.	60	.	.	30	.	.
Occupational class										
I Higher grade professionals	709	43	1	..	59	1	..	28	1	..
II Lower grade professionals	417	42	1.0	0.9–1.1	55	0.9	0.8–1.0	30	1.1	0.9–1.3
IIIa Routine nonmanual, higher	1360	44	1.0	0.9–1.2	57	1.0	0.9–1.1	26	0.9	0.8–1.1
IIIb Routine nonmanual, lower	1111	54	1.3	1.1–1.4	65	1.1	1.0–1.2	33	1.1	1.0–1.3
IV Self-employed workers	223	50	1.2	1.0–1.4	59	1.0	0.9–1.1	29	1.0	0.8–1.3
V+VI Skilled workers	89	60	1.4	1.1–1.7	72	1.2	1.0–1.4	37	1.3	0.9–1.7
VII Unskilled workers	133	62	1.3	1.1–1.6	70	1.1	1.0–1.3	46	1.4	1.1–1.7
Physical job demands										
Walking	996	47	1	..	57	1	..	23	1	..
Sedentary work	2393	44	0.9	0.9–1.0	61	1.1	1.0–1.2	31	1.4	1.2–1.6
Walking and lifting	638	62	1.3	1.2–1.4	62	1.1	1.0–1.2	35	1.5	1.3–1.7
Heavy physical work	15	67	1.2	0.9–1.8	73	1.4	1.2–1.5	50	1.6	1.0–2.6
Job autonomy										
4 (high)	505	43	1	..	55	1	..	29	1	..
3	2261	46	1.1	1.0–1.2	59	1.1	1.0–1.2	28	1.0	0.8–1.1
2	1113	51	1.2	1.1–1.3	64	1.2	1.1–1.3	33	1.1	1.0–1.3
1 (low)	163	62	1.3	1.1–1.5	70	1.2	1.1–1.4	43	1.3	1.0–1.6

^a Unadjusted, expressed as percentages, excluding missing answers.^b Adjusted for age and country of birth.

for low-back pain than for neck-shoulder pain and arm pain. The prevalence of low-back pain for the male unskilled workers was 25 percentage points higher than

for the higher grade professionals, compared with a difference of 15 percentage points for the women. For neck-shoulder pain and arm pain, the corresponding

Table 4. Prevalences and prevalence differences (PD) of self-reported musculoskeletal pain among the men (N=3251). (95% CI = 95% confidence interval)

Type of pain	Prevalence (%)	Model 1 ^a		Model 2 ^b		Model 3 ^c		Model 4 ^d	
		PD	95% CI	PD	95% CI	PD	95% CI	PD	95% CI
Low-back pain									
I Higher grade professionals	35	—	..	—	..	—	..	—	..
II Lower grade professionals	33	-1	-7-4	-2	-7-4	-1	-7-4	-2	-7-4
IIIa Routine nonmanual, higher	39	5	0-10	4	-1-9	4	-1-8	3	-2-8
IIIb Routine nonmanual, lower	52	15	9-22	12	6-19	14	7-20	11	4-17
IV Self-employed workers	46	8	2-14	5	-1-11	10	4-16	7	1-13
V+VI Skilled workers	58	21	15-27	13	6-20	19	13-25	12	5-19
VII Unskilled workers	66	25	19-32	20	13-27	21	14-28	17	9-24
Neck-shoulder pain									
I Higher grade professionals	40	—	..	—	..	—	..	—	..
II Lower grade professionals	42	2	-4-7	2	-4-7	2	-3-8	2	-4-7
IIIa Routine nonmanual, higher	37	-2	-7-2	-2	-7-3	-4	-9-1	-4	-8-1
IIIb Routine nonmanual, lower	50	7	0-13	7	0-13	5	-2-11	5	-2-12
IV Self-employed workers	44	1	-5-8	1	-6-7	4	-3-10	3	-3-10
V+VI Skilled workers	47	4	-2-11	2	-5-9	2	-4-8	1	-6-8
VII Unskilled workers	61	15	8-22	14	7-21	10	3-17	10	3-17
Arm pain									
I Higher grade professionals	20	—	..	—	..	—	..	—	..
II Lower grade professionals	21	1	-4-5	—	-4-5	1	-4-6	—	-4-5
IIIa Routine nonmanual, higher	17	-2	-6-2	-1	-5-3	-2	-6-2	-1	-5-3
IIIb Routine nonmanual, lower	26	3	-2-9	4	-2-9	3	-3-8	3	-2-9
IV Self-employed workers	26	4	-2-9	3	-3-8	5	-1-10	4	-2-9
V+VI Skilled workers	32	10	5-16	8	2-14	9	4-15	7	1-13
VII Unskilled workers	39	14	7-21	13	6-20	12	5-19	11	4-18

^a Adjusted for age and country of birth.^b Adjusted for variables in model 1 and physical job demands.^c Adjusted for variables in model 1 and job autonomy.^d Adjusted for variables in model 1, physical job demands, and job autonomy.**Table 5.** Prevalences and prevalence differences (PD) of self-reported musculoskeletal pain among the women (N=4042). (95% CI = 95% confidence interval)

Type of pain	Prevalence (%)	Model 1 ^a		Model 2 ^b		Model 3 ^c		Model 4 ^d		
		PD	95% CI	PD	95% CI	PD	95% CI	PD	95% CI	
Low back pain										
I Higher-grade professionals	43	—	..	—	..	—	..	—	..	
II Lower-grade professionals	42	-1	-7-5	-1	-7-5	-1	-7-5	-1	-7-5	
IIIa Routine nonmanual, higher	44	2	-3-6	0	-5-4	1	-4-5	-1	-5-4	
IIIb Routine nonmanual, lower	54	11	6-16	8	3-13	9	5-14	7	2-12	
IV Self-employed workers	50	7	-1-14	5	-3-12	8	0-16	6	-2-13	
V+VI Skilled workers	60	16	5-27	11	0-22	15	4-25	10	-1-21	
VII Unskilled workers	62	15	5-24	7	-2-17	12	3-21	6	-4-15	
Neck-shoulder pain										
I Higher-grade professionals	59	—	..	—	..	—	..	—	..	
II Lower-grade professionals	55	-4	-10-2	-4	-10-2	-4	-10-2	-4	-10-2	
IIIa Routine nonmanual, higher	57	-1	-6-3	0	-5-4	-2	-7-2	-1	-6-3	
IIIb Routine nonmanual, lower	65	5	0-10	6	1-11	3	-2-8	4	-1-9	
IV Self-employed workers	59	-1	-9-6	0	-8-7	0	-7-8	2	-6-10	
V+VI Skilled workers	72	12	2-22	13	3-23	9	-1-19	10	0-20	
VII Unskilled workers	70	8	-1-16	9	0-18	6	-3-15	7	-2-16	
Arm pain										
I Higher-grade professionals	28	—	..	—	..	—	..	—	..	
II Lower-grade professionals	30	1	-5-6	1	-4-7	1	-5-6	1	-4-6	
IIIa Routine nonmanual, higher	26	-2	-6-2	-1	-5-3	-3	-7-1	-2	-6-2	
IIIb Routine nonmanual, lower	33	3	-2-7	3	-1-8	1	-3-6	2	-3-6	
IV Self-employed workers	29	-1	-8-6	1	-6-7	-1	-8-6	1	-6-8	
V+VI Skilled workers	37	6	-4-17	7	-4-18	5	-6-15	6	-5-16	
VII Unskilled workers	46	11	2-21	12	2-22	9	0-19	10	0-20	

^a Adjusted for age and country of birth.^b Adjusted for variables in model 1 and physical job demands.^c Adjusted for variables in model 1 and job autonomy.^d Adjusted for variables in model 1, physical job demands, and job autonomy.

differences were approximately 15 percentage points for the men and 10 percentage points for the women.

Impact of job characteristics

Adjustment for the two selected job characteristics generally reduced the prevalence differences in musculoskeletal pain between the occupational classes.

Low-back pain. For the male unskilled workers, compared with the higher grade professionals, the prevalence difference for low-back pain was reduced from 25 percentage points in model 1, to 17 percentage points in model 4 (34% reduction), and for the male skilled workers the corresponding decrease was from 21 to 12 percentage points (44%) (table 4). For the women, the corresponding reductions were from 15 to 6 percentage points (59%) for the unskilled workers and from 16 to 10 percentage points (36%) for the skilled workers (table 5). Most of the reduction occurred when physical job demands (model 2) were entered, resulting in a 22% and 38% reduction, respectively, in the two occupational classes for the men and 49% and 32%, respectively, for the women. Entering job autonomy separately (model 3) gave smaller reductions in the prevalence difference for low-back pain, approximately 10–15% for both genders.

Neck–shoulder pain and arm pain. When job characteristics were adjusted for, the prevalence difference for neck–shoulder pain among the male unskilled workers, compared with the higher grade professionals, was reduced from 15 percentage points in model 1 to 10 percentage points in model 4 (32% reduction) (table 4). For arm pain, the corresponding change was from 14 to 11 percentage points (20%). For the women the differences were smaller (table 5). Adjustment for physical job demands separately (model 2) generally increased the prevalence difference somewhat for neck–shoulder pain and arm pain among the women and resulted in only small changes among the men. However, entering job autonomy separately (model 3) gave somewhat larger reductions in the prevalence difference, 34% for neck–shoulder pain and 15% for arm pain among the male unskilled workers and 25% and 19%, respectively, among the female unskilled workers.

Population attributable fraction

Estimates of the population attributable fraction (PAF) are presented in table 6, ranging from 2% to 17% in model 1. Occupational class had a larger impact on the men than on the women for all three body regions, and the largest impact was on low-back pain (PAF estimates of 17% for the men and 10% for the women in model 1).

Adjustment for physical job demands and job autonomy (model 4) reduced the PAF estimates for occupational class with respect to low-back pain, when compared with the results of model 1, both for the men (30% reduction) and for the women (50% reduction). The corresponding PAF estimate for neck–shoulder pain was reduced by 40% among the men. Adjustment for physical job demands separately (model 2) reduced the PAF estimates for occupational class in respect to all three body regions among the men, but only for low-back pain among the women (data not shown). Adjustment for job autonomy separately (model 3) reduced the PAF estimates relatively more for the women than for the men, especially for neck–shoulder pain and arm pain (data not shown).

Discussion

In this study of 7293 economically active Oslo citizens, aged 30, 40, or 45 years, there were marked, step-wise socioeconomic gradients for musculoskeletal pain, steeper for the men than for the women. The relative occupational class differences were larger for low-back pain and arm pain than for neck–shoulder pain, and the absolute differences were the largest for low-back pain. Physical job demands explained a substantial proportion of the absolute inequalities between the occupational classes for low-back pain, while job autonomy was more important in explaining the inequalities in neck–shoulder pain and arm pain. The PAF estimates supported the impact of the selected job characteristics at the level of the working population, especially for low-back pain.

Methodological considerations

The Oslo health study is a large population-based study, designed to examine socioeconomic inequalities in

Table 6. Population attributable fractions (PAF) for musculoskeletal pain according to occupational class and the impact of job characteristics. (95% CI = 95% confidence interval)

Type of pain	Men (N=3251)				Women (N=4042)			
	Model 1 ^a		Model 4 ^b		Model 1 ^a		Model 4 ^b	
	PAF (%)	95% CI (%)	PAF (%)	95% CI (%)	PAF (%)	95% CI (%)	PAF (%)	95% CI (%)
Low-back pain	17	12–22	12	7–17	10	5–15	5	0–11
Neck–shoulder pain	5	0–10	3	–2–8	2	–2–5	2	–2–5
Arm pain	12	3–20	11	1–19	3	–6–11	3	–6–12

^a Adjusted for age and country of birth.

^b Adjusted for the variables in model 1, physical job demands, and job autonomy.

health. All of the participants in certain age cohorts were invited, and they represented the full variety of occupations in Oslo.

The low attendance in the study could obviously have led to selection bias. This possibility has been thoroughly examined in the Oslo health study (17, 28). Sjøgaard et al (28) evaluated the effect of self-selection in the main survey and found that unhealthy persons seemed to attend to a less degree than healthy persons but concluded that social inequality in health by different sociodemographic variables nevertheless seemed unbiased on a ratio scale (28). Mehlmum et al (17) found that the response to the supplementary questionnaire with data on musculoskeletal pain was lower in the subgroups with poorer health. This finding may imply conservative estimates of the pain prevalences and thus conservative estimates of the prevalence difference and the population attributable fraction. The consistency between the results of the Oslo health study and the survey of living conditions in 2000 from Statistics Norway, based on a representative population sample, did not, however, indicate a serious selection problem (17). Increasing non-participation has been a problem in many epidemiologic studies, especially in recent years, but most empirical work suggests that declines in participation rates are not likely to substantially influence exposure–disease associations (29). However, nonparticipation may influence descriptive results to a higher degree, often leading to underestimated prevalences of ill-health.

Among the 8594 respondents, data on occupation were missing for 11% of the men and 13% of the women, many of whom were not working. In Norway, 83% of the women and 90% of the men aged 30–44 years were employed in 2000–2001, and employment was somewhat higher in Oslo than in Norway as a whole, especially among the women (30). The exclusion of the economically inactive can lead to an underestimation of the socioeconomic differences in the total population (7, 31). However, the prevalences of musculoskeletal pain were almost identical in the whole population as among the participants of either gender with data on occupation, even though the participants without information on occupation generally had somewhat higher prevalences (data not shown).

The cross-sectional design of our study does not allow causal inference between our independent and outcome variables. A stronger tendency to report heavy work or low job autonomy among the participants with pain (32) cannot be ruled out. A lack of randomization in observational studies may lead to selection processes, which are particularly difficult to control in cross-sectional studies. The health-related job change of the participants with health problems, from heavier work in lower occupational classes to lighter work in higher occupational classes, would lead to conservative estimates

(33), as would socioeconomic differences in the healthy worker effect, with a higher tendency towards the selection of unhealthy persons completely out of work in lower occupational classes (34).

The self-report of exposure and outcome, as in our present study, could lead to misclassification. However, in a review by Stock et al (35), questions on sitting and standing posture, walking, manual handling, and the general level of physical effort were found to perform well with respect to reproducibility and validity (35). We assume that the respondents were able to discriminate well between the crude categories employed for physical job demands and job autonomy in our questionnaire. Pain is a subjective phenomenon and cannot readily be validated. However, Björkstén et al (36) found both sensitivity and specificity to be high when questionnaire answers on musculoskeletal pain were compared with a clinical assessment.

Self-reported data on both the determinants and outcome variables could also inflate the results due to common method bias (37, 38) (eg, in relation to personality traits such as negative affectivity). The questions on job characteristics and musculoskeletal pain were, however, separated in different questionnaires, among questions on other topics. In addition, the job characteristics and musculoskeletal pain had different types of response categories. These factors may reduce common method bias due to self-report tendencies (38). In a study of musculoskeletal disorders among the general working population, Toomingas et al (39) found no support for bias from rating behavior when the participants rated both exposure and outcome (39). However, we cannot exclude the possibility that common method bias may have inflated our results.

Socioeconomic differences

Trends in socioeconomic inequalities in self-assessed health have been more stable in Norway than in some European countries, where inequalities have been widening (40, 41). Still large socioeconomic inequalities in morbidity (41) and mortality (42) remain. Aittomäki et al (10) found smaller occupational class differences in musculoskeletal disorders than in self-rated health and suggested that a fairly high prevalence of musculoskeletal disorders may explain the less steep gradient. Our present study showed a higher prevalence and a less steep gradient for neck–shoulder pain than for low-back pain among the women, while, among the men, there was both a fairly high prevalence and a relatively steep gradient for low-back pain. Musculoskeletal pain is very common in the population and may be considered a normal phenomenon (43). Nevertheless, there are socioeconomic differences.

The gradient was lower than what has been found for musculoskeletal disorders as a cause of sickness absence (11, 12, 44) or disability pension (13). Higher severity (45) and a less favorable course of pain episodes (46) in lower socioeconomic classes, in addition to occupation-specific consequences of disease (34), could explain the steeper gradients of sickness absence and disability pensioning. Our outcome measures were crude, with no differentiation between degrees of pain (severity, frequency, duration, etc). We would assume that the inequalities in severe musculoskeletal pain would be larger.

Relative and absolute measures of association may offer different inferences (23, 47, 48). We found large relative (prevalence ratio) and absolute (prevalence difference) differences for low-back pain and small differences for neck-shoulder pain. For arm pain, the prevalence ratio was large, while the prevalence difference was small. Absolute measures better express the importance of inequalities in terms of the burden of ill-health and financial costs to society (22, 47), and they may better serve as a basis for preventive strategies (48).

Impact of job characteristics

The impact of work conditions on socioeconomic inequalities in musculoskeletal pain has been shown in previous studies (9–13). In our present study, work had a relatively large impact on socioeconomic differences in musculoskeletal pain, even though job characteristics were measured by only two variables. Physical job demands were classified in rather crude categories, but the variable was still able to discriminate the risk of musculoskeletal pain. The inclusion of more job characteristics (eg, more-specific ergonomic risk factors and additional psychosocial factors) could possibly explain a larger proportion of socioeconomic inequalities in musculoskeletal pain (9).

The proportion explained by each of the job characteristics differed between the body regions. Physical job demands explained a substantial proportion of occupational class inequalities in low-back pain, while job autonomy explained a larger proportion of inequalities in neck-shoulder pain. Lifting and heavy physical work are risk factors for low-back pain, and forceful arm-hand movements may cause pain in neck-shoulders and arms (18). Specific physical exposures relevant to arm pain were not captured by our question, and this lack may explain the smaller impact of physical job demands on arm pain. High psychosocial job demands and low job control are often related to neck (49) and upper-limb (50) symptoms, but low job decision latitude (combination of job content and job control) is also a risk factor for low-back pain (51).

Population attributable fractions

In the Oslo working population, women, aged 30, 40 or 45 years, would have had a prevalence of low-back pain that was 10% lower than what was actually observed if the age groups had all had the same prevalence of low-back pain as the women in the highest occupational class. The corresponding potential reductions among the men were 17% for low-back pain and 12% for arm pain. When judged from the change in the population attributable fraction between model 1 and model 4, a substantial part of the occupational class differences in musculoskeletal low-back pain in the working population is explained by the examined job characteristics. Even if the reductions represent hypothetical cases, they give an impression of the potential for prevention at the working population level.

Gender differences

We found that the socioeconomic gradients for musculoskeletal pain were steeper among the men than among the women. This finding is in accordance with the results of some earlier studies (3, 12, 52, 53), but not with others (6, 10). Socioeconomic classification systems based on occupation were originally established for male populations and may be better at classifying men than women (54–56). The same occupational class may have different meanings for men and for women and thus be differently associated with health (57). In our study, gender differences were larger in the higher than in the lower occupational classes. Vahtera et al (12) also found that women, in contrast to men, may not benefit consistently from high socioeconomic status (12). In our present study, the women in higher occupational classes had lower job autonomy than their male counterparts (data not shown). This situation may have contributed to the smaller gradient for the women. Another explanation could be the double burden of paid and unpaid work (58), which may differ between occupational classes. Among the unskilled female workers, 36% worked part-time, compared with 11% of the higher grade professionals, but the proportion living with children under the age of 18 years was similar (data not shown).

Socioeconomic indicator

Galobardes et al (59) recommend that, for socially patterned exposures that have etiological effects specific to particular stages of the life course, socioeconomic indicators should be related to these stages (59). Occupation thus seemed a logical choice as an indicator of socioeconomic status in our study. Socioeconomic classification systems based on occupation may capture specific job-related factors (56), as was apparent in this study.

The EGP class schema does not have an implicit hierarchical rank (20), and therefore it does not necessarily capture a gradient in health across its groups (60). The self-employed group resembles the white-collar classes in terms of economic factors and social networks, while they are more similar to the working classes when physical work conditions and health behavior are studied (61). Our present study showed a pronounced gradient in musculoskeletal pain; however, the heterogeneity of the self-employed group was also apparent.

In conclusion, in this large population-based study, marked, stepwise socioeconomic gradients in self-reported musculoskeletal pain were observed in the working population, steeper for the men than for the women. Physical job demands and job autonomy explained a substantial proportion of the occupational class inequalities. As the study was cross-sectional, based on self-reported data on both determinants and outcome, the results should be interpreted with caution. However, the results indicate that interventions to reduce heavy physical work and lifting and increase job autonomy may reduce socioeconomic inequalities in the occurrence of musculoskeletal pain.

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