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Gender differences in musculoskeletal health of computer and mouse users in the Swedish workforce

A. Ekman, A. Andersson, M. Hagberg and E. W. Hjelm
Department of Occupational Medicine, Sahlgrenska University hospital, Göteborg, Sweden

The objectives of the study were to explore the musculoskeletal health of computer users in the Swedish workforce with regard to gender and psychosocial factors, and to describe gender differences between the occupational groups. A subset was chosen from a large survey of 12,462 individuals representing the workforce of Sweden, performed by Statistics Sweden. Included in the subset were 2044 subjects who worked for at least half their working hours with personal computers, or an equivalent device, and also used a computer mouse. All occupational groups had prevalence ratios (women/men) > 1. When using regression models, the variables 'learn and develop' and 'involved in planning your work' were health factors, and 'too much to do' was a risk factor for upper body symptoms for both women and men. For women 'PC duration100' was a risk factor and 'support from superiors' was a health factor. Age seemed to be a stronger risk factor for men than for women.

Key words: Musculoskeletal symptoms; computer mouse; psychosocial factors; work; VDU.

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INTRODUCTION

The use of the personal computer (PC) in the workforce is growing rapidly worldwide. This paper describes symptoms in the neck and upper limb, experienced after work, by the subgroup of the Swedish workforce that works mainly with computers and computer mice. Studies have shown that these musculoskeletal disorders, which are believed to be associated with the use of a computer mouse, are prevalent and increasing.[1] The prevalence of musculoskeletal symptoms has been found to be greater in the mouse-operating arm and hand than in the other arm or hand.[2]

In previous publications, samples of different computer operators have been studied. There are no publications from any country concerning musculoskeletal symptoms among computer operators in the total workforce. In previous studies of some occupational groups, musculoskeletal symptoms were more prevalent among women than men.[3,4] To the authors' knowledge there is no study concerning gender in relation to occupational group.

The overall aim of this study was to investigate whether there is a gender difference in the reporting of musculoskeletal symptoms among computer mouse users in the Swedish workforce.

Specifically, the study aimed to determine whether:

- there is a gender difference in different occupational groups;
- there is an association between musculoskeletal symptoms and physical and psychosocial factors among computer-mouse users;
- this association is dependent upon gender.

An association between musculoskeletal disorders and psychosocial factors has been previously suggested among visual-display terminal (VDT) workers.[5]

MATERIAL AND METHODS

This cross-sectional study is based on material from a survey conducted in 1995 by Statistics Sweden (SCB),

Correspondence to: Dr Anna Ekman, Department of Occupational Medicine, Goteborg University, Sahlgrenska University hospital, St Sigridsgatan 85, SE 412 66 Goteborg, Sweden. Tel: +46 31 335 4876; fax: +46 31 40 97 28; e-mail: anna.ekman@ymk.gu.se

by order of the National Board of Occupational Safety and Health. The material is representative of the Swedish workforce and the survey consisted of interviews and questionnaires.[6,7] It should be noted that for this study the material from the survey was used, but it was not possible to influence the choice of questions asked in the survey.

The SCB survey, of 12,462 individuals, looked at the Swedish workforce as a whole. For this study, a subgroup of the SCB survey respondents was defined. The criteria for belonging to the subgroup were that: (1) the respondent worked with a personal computer, computer terminal or equivalent device; (2) they used computerized equipment for 50% or more of the work day; and (3) they used a computer mouse.

The final subset used for the statistical analysis in this study consisted of 2044 subjects, consisting of 1022 women and 1022 men.

Item (2) above was derived from the question asked during the SCB survey interview, 'What share of your work day is devoted to using the computerised equipment?' The possible answers were: (1) 'nearly all the time', (2) 'roughly three-quarters of the time', (3) 'half of the time', (4) 'roughly one-quarter of the time', (5) 'some of the time' (perhaps one-tenth), and (6) 'not at all' (Table 1). Those who gave responses 1, 2 or 3 were included in this study. The distribution of women and men in the three upper groups is described in the Results section.

The percentage of non-responders in the SCB survey, consisting of interviews and questionnaires, was 24%. The level of non-response to individual questions was between 1% and 3%.

The questionnaire used by the SCB included three questions that reflect the study interest in musculoskeletal symptoms. The following wording was used: 'After work, do you experience pain in any of the following places?'

- Upper parts of your back or neck,
- shoulders or arms,
- wrists or hands.

To 'have symptoms' was defined as experiencing pain after work, at least 1 day per week, in at least one of the three body areas.

The first part of statistical analysis of the material consisted of a descriptive section with prevalence ratios that have a 95% confidence interval (CI) (proc freq with the option cmh, SAS software). Here the material was divided into different occupational groups and by gender. The occupational groups are classified according to the headings in the ISCO-88 coding.

In a second part, a model for musculoskeletal symptoms was used which included explanatory variables representing age, physical load, demand, control, support and stimulation (Table 1). It should be noted that in the models for each gender, the factor 'age' is presented as the effect of ageing 10 years.

It should further be noted that the factor 'PC duration' is represented by two indicator variables:

- PC duration 100, which has a value of 1 when the 'PC duration' is 'Almost all the time'; and otherwise has a value of 0;
- PC duration 75, which has a value of 1 when the 'PC duration' is 'About $\frac{3}{4}$ of the time'; and otherwise has a value of 0.

In this system 'PC duration 75' represents the duration of PC work for about 75% of working hours, and 'PC duration 100' represents duration of PC work for about 100% of working hours. Logistic regression (proc logistic, SAS software) was used to estimate the odds ratios (OR), with a 95% CI and a P value (for a test of the null hypothesis, OR=1). Cox regression (proc logistic, SAS software) was used to estimate the prevalence ratios (PR), with a 95% CI. When using Cox regression, for cross-sectional data analyses, the standard error obtained for the prevalence ratios are too large.[9] That is, the confidence intervals obtained are too wide and the P values are larger then the correct P values. Therefore confidence intervals and P values for the prevalence ratios are omitted.

Table 1. The variables used in this study, explained in terms of the questions and answers used by SCB Sweden

Variable	*Question asked*	*Possible answers*
'Duration of PC work'	What amount of the work time are you occupied with the computer equipment?	1 = Almost all the time 2 = About $\frac{3}{4}$ of the time 3 = Half the time
'Too much to do at work'	Do you have far too much to do, too much to do, too little to do, or far too little to do?	1 = Far too much to do, or too much to do 0 = Too little to do, or far too little to do, neither nor
'Support from superiors'	Can you receive support and encouragement from your superiors when you have a heavy workload?	0 = Always, or almost always 1 = Mostly not, or never
'Learn and develop in occupation'	Does your job allow you opportunities to learn something new and develop in your occupation?	0 = Every day, a couple days per week, or 1 day per week 1 = A couple of days per month, not at all, or seldom in the last 3 months
'Involved in planning your work'	Are you involved in planning your work (for example what is to be done, how it is to be done or who is to work with you)?	0 = Always, or almost always 1 = Mostly not, or never

RESULTS

The results indicate that experiencing pain in the neck or upper limb after work is more common among women than among men (Table 2).

The majority of VDT workers belonged to the three occupational groups: 'professionals', 'technicians and associated professionals' and 'clerks'. The male VDT workers mainly belonged to the 'professionals' and 'technicians and associated professionals' groups. The largest group of female VDT workers was 'clerks', while male VDT workers belonged mostly to the 'professionals' and 'technicians and associated professionals' groups (Table 3).

All of the occupational groups in this study had point estimates for the prevalence ratio >1 (Fig. 1). The group 'skilled agricultural and fishery workers' was excluded from Fig. 1, as it represented only two persons.

The highest prevalence ratios of the variable 'symptoms' were found in the occupational groups 'clerks' (5.1), 'craft and related trades workers' (3.7) and 'service workers and shop sales workers' (2.8).

The impact of symptoms in the occupational groups is presented in Fig. 2 for women and in Fig. 3 for men. These figures, with a sample size of 12,462, represent the whole workforce of Sweden, divided into computer users and non-computer users. It should be noted that the four occupational groups with the largest proportion of

Table 2. Prevalence of neck and upper limb disorders among men and women in the group of computer users

	Number of cases	*Prevalence (%)*
Men	136	16
Women	317	36
Prevalence ratio (women/men)	2.23	
95% CI	1.89–2.64	

Table 3. Distribution of individuals between the occupational groups

Occupational group	*% of total workforce*		*VDT workers**	
	All workers	*VDT workers**	*% of total male workforce*	*% of total female workforce*
Legislators, senior officials and managers	3.6	0.6	0.7	0.4
Professionals	16.2	5.4	6.4	4.4
Technicians and associated professionals	19.2	5.1	6.2	3.9
Clerks	11.3	3.8	0.8	7.0
Service workers and shop sales workers	18.8	0.5	0.4	0.6
Skilled agricultural and fishery workers	2.4	0.02	0.02	0.02
Craft and related trades workers	11.2	0.3	0.5	0.1
Plant and machine operators and assemblers	10.2	0.4	0.7	0.1
Elementary occupations	6.3	0.05	0.08	0.1
Unidentified education and work	0.6	0.2	0.2	0.07

The total work force of Sweden consists of about 4 million individuals (about 2 million men and about 1.9 million women), represented here by 12,462 randomly sampled individuals (6317 men and 6145 women).

*Spend half or more of work day with VDT.

Figure 1. Symptoms in the neck and upper limb: the prevalence ratio (women/men) by occupational group.

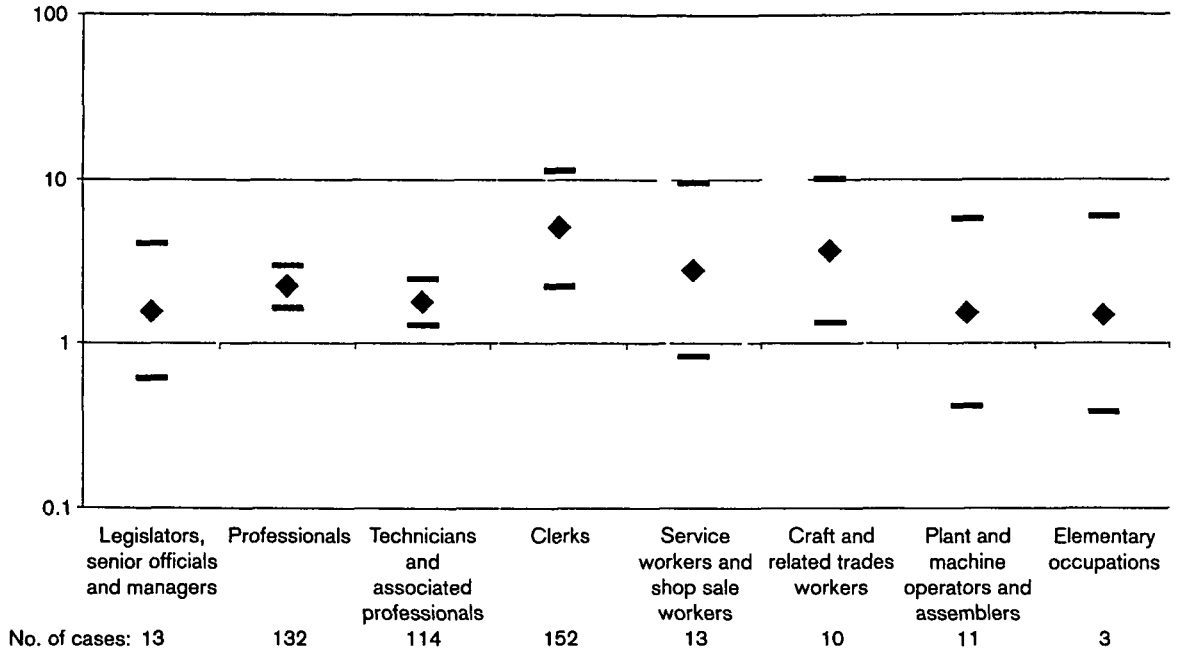


Figure 2. Impact on educational groups: women. (■), ≥50% PC, with symptoms; (□), ≥50% PC, no symptoms; (▨), <50% PC, with symptoms; (▩), <50% PC, no symptoms.

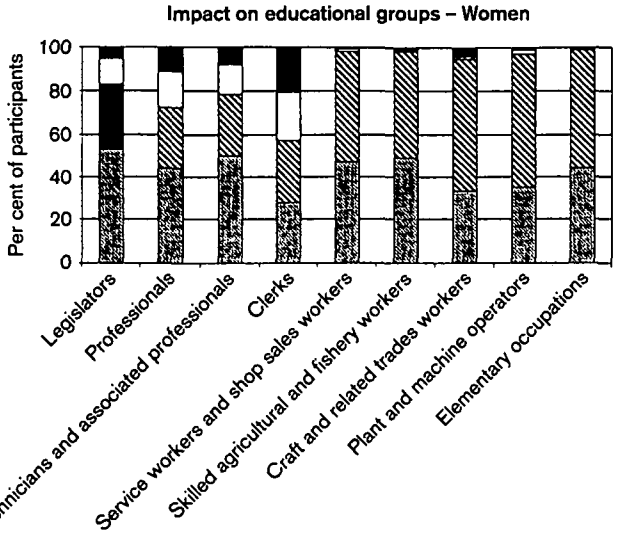


Figure 3. Impact on educational groups: men. (■), ≥50% PC, with symptoms; (□), ≥50% PC, no symptoms; (▨), <50% PC, with symptoms; (▩), <50% PC, no symptoms.

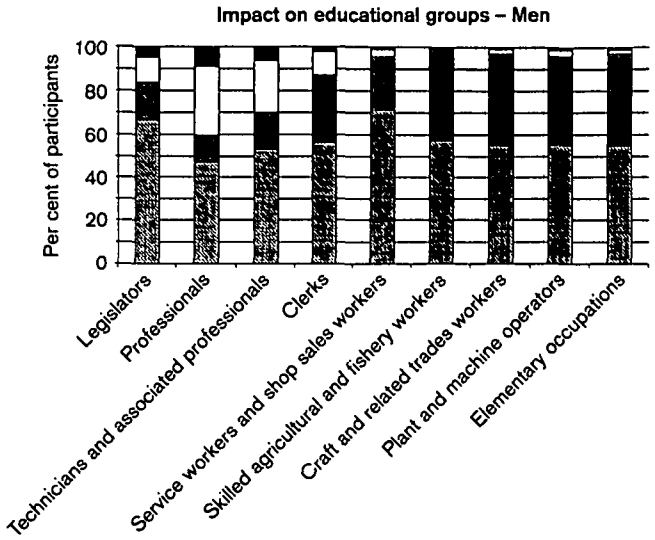
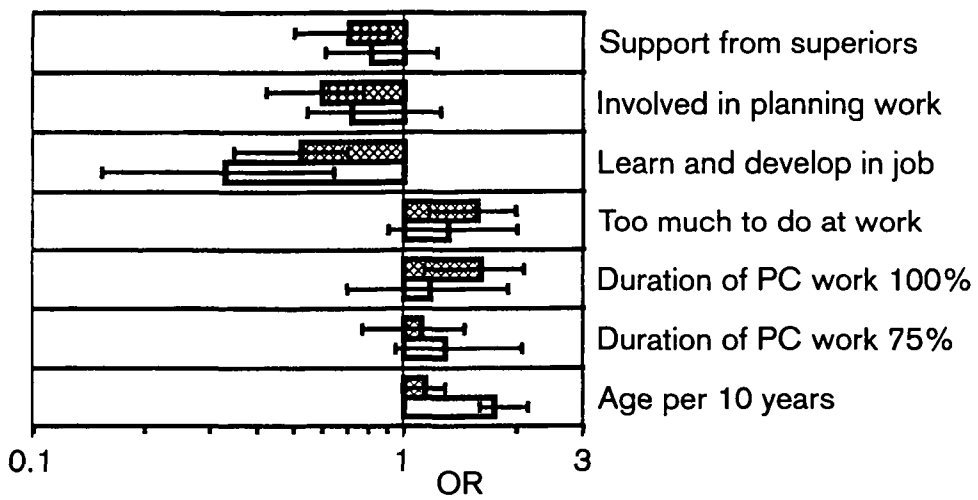


Figure 4. Neck and upper limb symptoms. Odds ratios (ORs) for the explanatory variables from the logistic regression, including 95% confidence intervals. Unshaded bars, men; shaded bars, women.



computer workers were 'legislators, senior officials and managers', 'professionals', 'technicians and associated professionals' and 'clerks'. In these four groups, women impacted most strongly in 'clerks' and 'professionals'. Men impacted most strongly in 'professionals' and in 'technicians and associated professionals'.

Model

The model was analysed in two ways. Firstly, a logistic model was used, giving estimates of prevalence odds ratios for the risk/health factors, and secondly, a Cox model was used, which gave estimates of prevalence ratios for the risk/health factors.

Logistic regression For women (Fig. 4), health factors were: 'learn and develop' (OR 0.52, P=0.002), 'involved in planning your work' (OR 0.60, P=0.004), and 'support from superiors' (OR 0.71, P=0.045). Risk factors were: 'PC duration 100' (OR 1.6, P=0.008) and 'too much to do' (OR 1.58, P=0.003). Weak risk factors were 'age' (OR per 10 years 1.14, P=0.070) and 'PC duration 75' (OR 1.11, P=0.57), which suffer from large uncertainty.

For men (Fig. 4), health factor were 'learn and develop' (OR 0.33, P=0.001), 'involved in planning your work' (OR 0.72, P=0.233) and 'support from superiors' (OR 0.82, P=0.323), although these latter two estimates suffer from large uncertainty. Risk factors were 'age' (OR 1.75 per 10 years, P=0.0001), 'PC duration 75' (OR 1.3, P=0.288), 'PC duration 100' (OR 1.18, P=0.512) and 'too much to do' (OR 1.31, P=0.198), but these latter three estimates also suffer from large uncertainty.

The above models were tested with the Hosmer and Lemeshow goodness-of-fit test, which gave P values of 0.955 (women) and 0.491 (men). Small P values here could be interpreted as evidence for a model not fitting the data.

Cox regression For women, health factors were 'learn and develop' (PR 0.71), 'involved in planning your work' (PR 0.75), and 'support from superiors' (PR 0.82). Risk factors were 'PC duration 100' (PR 1.32), and 'too much to do' (PR 1.32). The explanatory variables 'PC duration 75' (PR 1.07), and 'age' (PR per 10 years 1.08) had prevalence ratios close to 1.

For men, health factors were 'learn and develop' (PR 0.48), 'involved in planning your work' (PR 0.78), and 'support from superiors' (PR 0.86). Risk factors were 'too much to do' (PR 1.23), and 'age' (PR per 10 years 1.55). The explanatory variables 'PC duration 75' (PR 1.20), and 'PC duration 100' (PR 1.11) had prevalence ratios close to 1.

DISCUSSION

This study should be considered as an overview of musculoskeletal symptoms among members of the Swedish workforce who used computers and computer mice extensively during 1995.

For all occupational groups, the prevalence for women was greater than for men and if a single model for both genders was applied to the material, the estimated ratios for the initial explanatory variables were stable. The odds ratio estimate for gender (women/men) was 11.9 (95% CI, 2.94–50.00). The prevalence ratio estimate for gender (women/men) was 6.49. The model included the variable 'gender' and included gender as an effect modifier for all other included variables.

These results indicate that, for the most part, explanations for gender differences were not found in the analysis. Determining these explanations could help to rationalize how different interventions should be planned for men and women. Possible explanations for the gender difference could be that gender is a confounder of non-work-related factors and conditions, and in addition may act as a confounding factor for occupational exposure.[1] In our study most of the female VDT workers were in the 'clerks' group, while most of the male VDT workers were in the 'professionals' and 'technicians and associated professionals' groups (Table 3). These results indicate that in this study there might be a difference in occupational exposure among men and women. The SCB survey of the Swedish workforce who operate computer mice showed that women experienced a consistently higher onset of symptoms in the neck and upper limb than did men. This study indicates that, as a result of the rapid increase of information technology, increased attention to women's working conditions might increase their health and performance.

In this paper, logistic regression is used to identify probable risk/health factors and Cox regression is used to evaluate the impact of the risk/health effects. For both women and men 'learn and develop' was an important health factor and 'too much to do' was an important risk factor. For both women and men 'involved in planning work' was an important health factor, but this finding was less certain for men.

For women 'support from superiors' and 'PC duration 100' were important health and risk factors, respectively. For men, age was a risk factor, but for women it had no material effect.

In the model for men, the health impact of the variable 'learn and develop', was salient and of interest for further studies.

Study limits

This study looked at individuals who use computerized equipment for a minimum of half their working hours, so there is also reason to be concerned about how the non-computer work, which occupies their remaining work hours, affects them. The estimated ratios for the health/risk factors were stable, in both models, when variables that describe body postures, such as 'bent forward', 'twisted' and 'hands abreast of, or higher than, the shoulders' during work were included. The estimated ratios usually differed in the second or third decimal. There were a few exceptions, where the estimated ratios differed at most by one unit in the first decimal.

In this study the concern has been with upper limb symptoms. In the survey there are three questions most closely related to this: 'After work, do you experience pain in any of the following places?'

- Upper parts of your back or neck,
- shoulders or arms,
- wrists or hands.

The question does not reflect the fact that work-related upper limb disorders often worsens over a period of days or weeks, or that some people are only troubled at work.

Future work will combine data from this 1995 survey with that from others. The follow-up will give up-dated information about the health and computer use in the population and better precision in the estimates should then be achievable and more factors can be studied.

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