

MACRO-SOCIOECONOMIC DETERMINANTS OF OCCUPATIONAL INJURIES AND DISEASES AMONG THE TOTAL WORKFORCE OF HOME CARE WORKERS IN SWEDEN

LOTTA DELLVE^{1*}, MScPH; PETER ALLEBECK², PhD; MATS HAGBERG¹, PhD; BIRGITTA HERLOFF¹, PhD; CATARINA KARLBERG¹; MONICA LAGERSTRÖM³, PhD

1. Department of Occupational Medicine, Göteborg University, S:t Sigfridsgatan 85, SE-412 66 Göteborg, Sweden

2. Department of Social Medicine, Göteborg University, Sweden

3. Department of Nursing, Karolinska Institutet, Stockholm, Sweden

*Corresponding author. Tel.: +46 31 773 3158. Fax: +46 31 40 97 28

E-mail address: lotta.dellve@ymk.gu.se

ABSTRACT

The purpose of this study was to identify macro-socioeconomic determinants for the incidence of occupational injuries and diseases among home care workers. The study base was the total workforce of home care workers in Sweden during 1994-1998. In an ecological study design, data from three national databases were combined by record linkage. Descriptive and analytical statistics were used to estimate and interpret macro-socioeconomic determinants (economic resources, age structures of inhabitants and home care workers, unemployment, type of employment, size and location of municipality) for the incidence of occupational disorders among home care workers.

A great variation in municipal incidence of occupational disorders was found when comparing various municipalities (10-184 occupational disorders/1000 full-time equivalent workers per year and municipality). The relation between the incidence of occupational disorders and macro-socioeconomic factors is complex. The investigated socioeconomic factors together explained 12-19 % of the differences in mean municipal occupational disorders but there were different explanations related to metropolitan regions and sparsely populated areas. The factors that had a potential to explain the differences were the age structure of inhabitants and home care workers, and unemployment. The economic resources, e.g. the gross expenses for the care of the elderly and handicapped, and the average income, or the employment conditions among the home care workers did not give any explanation for differences in occupational disorders. The group of privately employed home care workers (1-3 %) had a lower incidence of occupational disorders and were younger.

The great difference in incidence of occupational disorders which appears when municipalities in Sweden are compared indicates a preventive potential. However, the relation between the incidence and macro-socioeconomic factors is complex. In order to better understand socio-environment phenomena related to occupational injuries, further studies are needed to explore the possible influence of the work system at the macro-, organisational- and micro-level.

Keywords: *nursing personnel, musculoskeletal, accidents, cohort, incidence, private, municipality*

INTRODUCTION

In Sweden, there are about 115 000 home care workers, working with the care of the elderly and disabled in the home care service in their own homes, old people's homes, warden-controlled flats and nursing homes (Dellve et al., 2000). The home care service has grown fast during the last decade, due to health care reforms. However, the development of the home care service is assumed to continue, due to the growing proportion of elderly people who are over 80 years of age (Statistics Sweden, 1999). As in other European countries, there are current and future problems related to the ageing population and the ageing workforce of home care workers, due to health problems and recruitment difficulties.

Musculoskeletal disorders are the most pronounced health problem among home care workers. Apart from a high prevalence of long-term sick leave (National Board of Occupational Health & Statistics Sweden, 1999), occupational injuries are also common (Fourtes et al., 1994; Myers et al., 1993; Ono et al., 1995; Meyer and Muntaner, 1999). The annual incidence of occupational disorders among home care workers was estimated to 52 per 1000 workers per year in West Virginia, USA (Meyer et al., 1999). In Sweden during 1990-1991, the annual incidence of reported occupational disorders was 34 per 1000 home care workers, of which 19 were occupational injuries and 15 work-related diseases (Ono et al., 1995). Over-exertion injuries and diseases constitute the most common type of disorder (Ono et al., 1995; Meyer and Muntaner, 1999). They also show a relative risk of about 6 for occupational injuries of the back compared to all the other employed Swedish women (Enkvist et al., 1992).

There are 289 municipalities in Sweden. Since the health care reform in 1992, it is the municipal authorities who have the main responsibility for taking care of and providing services to the elderly and the disabled in their own homes as well as in nursing homes. Private companies deliver a minor part of the home care services in Sweden through contracts with the municipalities, and this is gradually increasing.

Antecedent conditions in the "injury process" include macro-level determinants such as socioeconomic factors (Hagberg et al., 1997). Occupational social class has been found important for back disorders in the working population (Latza et al., 2000) even when the impact of manual vs non-manual jobs was controlled (Hagen, 2000). Full-time employment is an identified risk factor for occupational disorders among nursing personnel (Engkvist et al., 2001). Male-to-female risk ratios in service occupations, when adjusted for age, are not found to be important. However, among the nursing aides there were indications of gender disproportion (Gluck and Oleinick, 1998). It is not known whether other socioeconomic determinants related to the macro-organisational level, e.g. the municipalities, affect the risk of injury among home care workers. Possible factors of this kind could be the size and location of the municipalities; the proportion of unemployment, indicating recruitment possibilities; the age structure of the inhabitants, indicating the workload; the age structure of the workforce of home care workers and also the economic resources allocated to the care of the elderly and handicapped.

The main purpose of this study was to identify macro socio-economic determinants for the incidence of occupational injuries and diseases among home care workers. To better understand the contribution of social environmental factors we used a socio-ecologic approach with organisations, e.g. municipalities, as the units of analysis.

STUDY BASE AND METHOD

Study group

The study base consists of the total workforce of home care workers, e.g. nursing aides/assistants who were working in the home care system, caring for elderly and disabled persons, in Sweden, employed in 1994, 1995, 1996, 1997 and 1998.

Those employed by the municipalities were selected from the national database of the Swedish Association of Local Authorities. The Swedish Association of Local Authorities routinely checks the quality of the occupational coding. Five new municipalities were excluded, since there were no data available from them during the whole study period.

Nursing aides/assistants working in the home care service and employed by the private sector were selected from the national database of the Swedish Employer's Confederation during 1996, 1997 and 1998.

Data from 1994 to 1995 could not be retrieved. There are about 60 private companies affiliated to the Swedish Employer's Confederation providing care for the elderly and disabled. They account for approximately 85% of the home care provided by the private sector within the scope of this study [Jan Edling, Swedish Private Health and Social Care Employer's Association, personal communication].

The occupational coding of nursing aides/assistants was 96-98 % correct when compared to the Swedish Occupational Accidents and Work-related Diseases Database coding system of the same group.

Of all home care workers in Sweden, 97-99 % were employed by various municipalities across the country. Home care workers who are older than 50 years of age, employed by municipalities or private companies, accounted for 28 % and 17 % respectively of the study group. Male home care workers accounted for 5 % and 11-14 % respectively.

Registered occupational disorders

The statistics from the study base were reviewed concerning occupational disorders during 1994-1998. The outcomes were occupational disorders, occupational injuries, work-related diseases, musculoskeletal disorders and psychosocial occupational injuries.

Statistics on occupational injuries and work-related diseases were obtained from the Swedish Occupational Accidents and Work-related Diseases Database (ISA). ISA is maintained by the Swedish Work Environment Authority. All employees in Sweden are compulsorily insured against occupational disorders. Employers are obliged to report all occupational disorders on a special inquiry form. All reported occupational disorders are examined, coded and registered by specialised staff at the ISA.

Occupational disorders are divided into work-related diseases and occupational injuries. To be classified as a *work-related disease*, the reported symptoms should not be related to a specific event and the symptoms should have appeared gradually. The work-related diseases are coded by suspected cause of the disease, location of the disorder and days of sick leave. Occupational injuries are divided into injuries that led to sick leave and injuries with no sick leave, e.g. minor injuries. The criterion of *occupational injury* covers a reported sudden onset of symptoms that are closely related to a specific event. Occupational injuries that lead to sick leave are coded by main factors and event preceding the injury, type and location of injury and days of absence from work. The minor injuries were included in the present study, since there are indications that these injuries are not necessarily minor in this occupational group. Anecdotal evidence suggests that instead of having official sick leave, home care workers with low wages often change work shifts with each other.

Musculoskeletal disorders comprise reported occupational injuries that can be ascribed to a specific event involving musculoskeletal over-exertion, e.g. lifting, and work-related diseases presumed to be associated with musculoskeletal ergonomic risk factors.

Psychosocial occupational injuries consist of occupational disorders that are related to occupational injuries or work-related diseases that are suspected to be caused or influenced by factors in the social and organisational working environment. Occupational injuries connected with a specific event of physical or psychological violence from another person are also included. Minor injuries are not included in the musculoskeletal and psychosocial occupational injuries.

Socioeconomic factors

The incidence of occupational disorders was investigated in relation to macro-socioeconomic factors in each municipality: demographic factors and factors that related to the group of home care workers in each municipality.

Demographic factors were the proportion of elderly people (inhabitants older than 85 years of age), unemployment level, average income (of inhabitants from 16 years) and gross expenses for the care of elderly and handicapped during 1994-1998. Statistics of unemployment in each municipality were obtained from the Swedish National Labour Market Administration's register. Statistics of age structure, average income and gross expenses for the care of the elderly and handicapped were obtained from Statistics Sweden.

We used the Swedish Association of Local Authorities' method of classification of municipalities to explore the differences in incidence of occupational disorders. This classification of Sweden's 289 municipalities into nine groups is based on structural properties such as population, location, population density and business structure. The groups are metropolitan cities (population >200 000), suburban area (adjacent to metropolitan city), large town (population >50 000), urban area (population between 20 000 and 50 000), industrial area (more than 40% of the population employed in industry), rural area (more than 8.7% of the population employed in agriculture and forestry), sparsely populated area (population <20 000; population density less than 5/km²), other urban areas (population between 15 000 and 50 000) and other less populated areas (population less than 15 000). In order to embrace the problems related to a working situation in metropolitan regions, municipalities that belonged to the local labour markets of the three metropolitan regions of Sweden were analysed in stratified regression analysis. We used the criteria for local labour market that was developed by Statistics Sweden and based on statistics of commuting distance and direction. There were 60 municipalities that belonged to the local labour markets of the three metropolitan cities.

Factors that related to *the group of home care workers* were the age structure and the employment conditions, e.g. the proportion of younger (18-34 years of age) or older (55-65 years of age) home care workers and the proportion of full-time employed home care workers as compared to part-time and hourly-paid employees. The employers' register (The Swedish Association of Local Authorities) was used to obtain data of age and employment. The proportion of occupational rehabilitation among home care workers was obtained through the database of the National Social Insurance Board and gave an indication of the municipalities' rehabilitation efforts directed towards this occupational group.

Ecological analysis

Data from the three national databases described were combined by record linkage using the individual civic registration number.

In order to investigate differences in occupational disorders due to the different municipalities, the mean annual municipal incidence of occupational disorders was calculated for the period 1994-1998. The time at risk was estimated as the amount of working time in each municipality, adjusted to full-time equivalent workers (FTE workers). The mean annual municipal incidence was calculated as:

Mean annual municipal incidence:

$$\frac{\sum (\text{Annual number of cases in municipality} / \text{number of FTE workers in municipality})}{n (\text{years})} \times 1000 \text{ FTE workers}$$

The mean annual municipal incidence of occupational disorders and musculoskeletal disorders per municipality group during 1994-1998 was calculated; the same manner was used for male and female home care workers.

In order to investigate the difference in incidence of occupational disorders with regard to municipal or private employment, the mean annual incidence of occupational disorders during 1996-1998 for FTE workers was calculated for private and municipal employment separately. The sum of working time was used to estimate the time at risk per 1000 FTE workers in each sector. The mean annual incidence was calculated as:

Mean annual incidence:

$$\frac{\sum (\text{Annual number of cases} / \text{number of FTE workers})}{n (\text{years})} \times 1000 \text{ FTE workers}$$

Univariate regression and multivariate linear regression model (ANCOVA model) was used in order to estimate the impact of macro-socioeconomic factors on the variation of the five-year mean annual municipal incidence in the 284 municipalities. Stratified models of metropolitan regions and sparsely populated areas were made since these parameters were not uniquely estimated in the full model. Statistical analysis was carried out using SAS-version 8.0 (proc glm).

RESULTS

Variation in municipal incidence

The mean annual municipal incidence of occupational disorders varied between ten and 184 (figure 1). The incidence range of occupational injuries including sick leave was between two and 57 per 1000 FTE workers per year among all the municipalities; the incidence range of occupational injuries with no sick leave was between zero and 116; the incidence of work-related diseases ranged from zero to 32 and the incidence of musculoskeletal injuries varied between zero and 46 in all the municipalities.

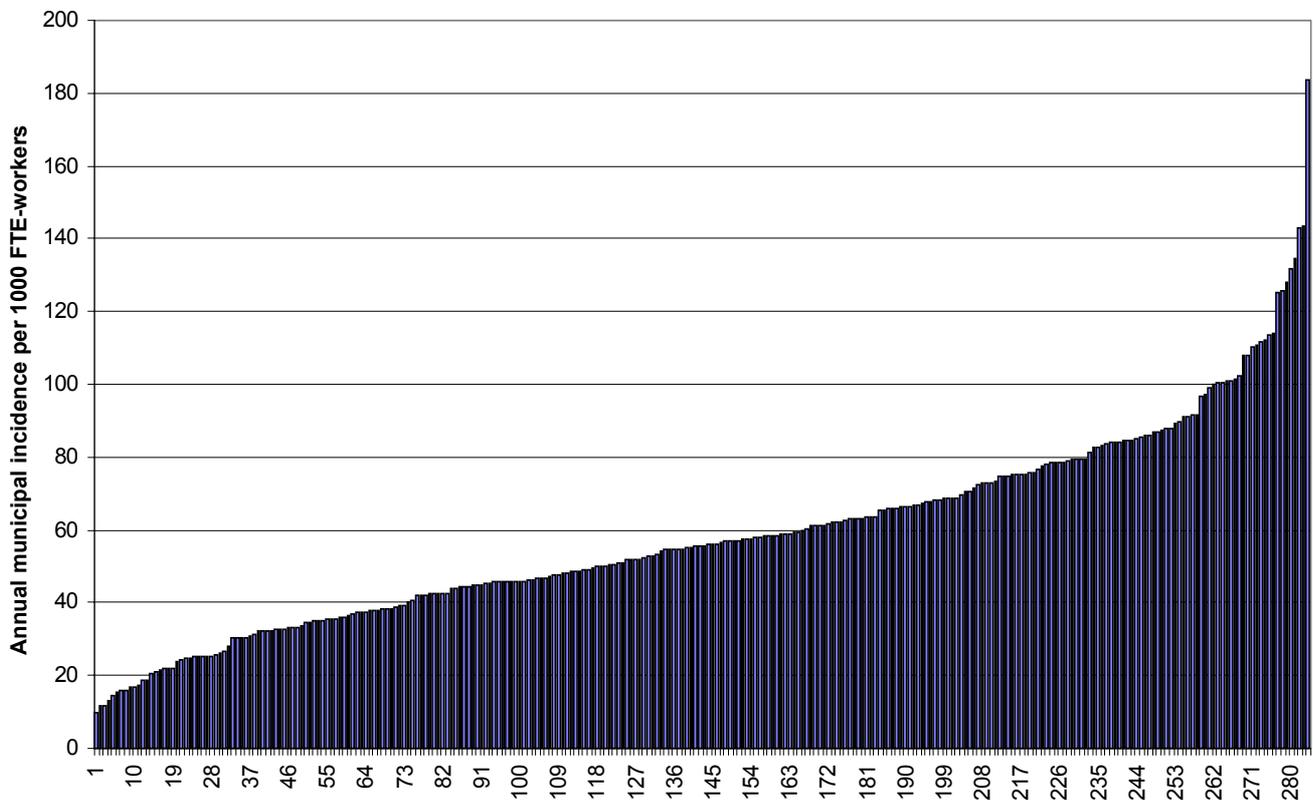


Figure 1. Five-year mean annual municipal incidence per 1000 FTE workers in all the municipalities in Sweden. The municipalities are ranked ascending from 1 to 284.

Macro-socioeconomic factors

Municipality types

The metropolitan cities had the highest average incidence of work-related diseases and occupational injuries that led to sick leave, followed by suburban areas and large towns (table 1). The lowest incidences were observed in the sparsely populated municipalities. The highest incidence of musculoskeletal injuries was observed in the large towns, while the sparsely populated areas and urban areas accounted for the lowest incidence of musculoskeletal disorders.

The incidence was lower for male than female workers in all types of municipalities (table 1). Among males, there was a higher incidence of occupational injuries and musculoskeletal injuries in metropolitan cities and in large towns.

Table 1 - Mean annual municipal incidence of occupational disorders and musculoskeletal disorders per 1000 FTE workers by municipality type and sex during 1994 -1998. Minor injuries are not included

	<i>Type of municipality</i>			<i>Occupational disorders</i>			<i>Musculoskeletal injuries</i>		
	<i>Tot</i>	<i>Male</i>	<i>Female</i>	<i>Tot</i>	<i>Male</i>	<i>Female</i>	<i>Tot</i>	<i>Male</i>	<i>Female</i>
Metropolitan city	34.6	23.5	35.5	10.3	9.5	16.0			
Suburban area	28.9	1.0	33.7	10.3	0.7	18.2			
Large town	28.4	17.9	8.6	18.9	8.3	16.3			
Urban area	25.9	8.1	27.5	10.1	4.1	15.5			
Industrial area	28.0	0.0	31.7	11.4	0.0	19.1			
Rural area	26.3	2.9	22.9	11.1	5.0	13.5			
Sparsely populated area	21.2	6.0	28.8	8.8	0.0	16.8			
Other urban area	21.9	2.8	28.4	7.6	0.9	16.7			
Other less populated area	23.7	0.0	26.4	9.5	0.0	14.6			

Regression analysis of socioeconomic determinants

In univariate analysis we found an association between mean annual municipal incidence of occupational disorders and the socioeconomic factors: proportion of elderly people, unemployment, average income, metropolitan regions, sparsely populated areas, younger and older home care workers. Neither the proportion of non-full-time workers nor the gross expenses for the service of elderly and handicapped were found to be important factors for occupational disorders.

In the linear regression models, 12-19 % of the variation in mean annual municipal incidence of occupational disorders was explained by investigated socioeconomic factors (table 2). Indications of regional differences with respect to age structure were found in the stratified models of metropolitan regions and sparsely populated areas. The factors that had a potential to explain the differences were the municipal age structure of inhabitants and home care workers. However no single factor alone was significant in the models.

Table 2 - Regression analysis, univariate and multivariate of socioeconomic factors (parameter [95%CI])of annual mean municipal incidence of occupational disorders per 1000 FTE workers during 1994-1998

Socioeconomic variables	Univariate	Multivariate model	Stratified model	
			Metropolitan regions	Sparsely populated areas
<i>Demographic factors</i>				
Metropolitan region	10.27 [2.67;17.68]	-2.66 [-12.79;7.48]*		
Sparsely populated area ²	-14.75 [-24.98;-4.51]	-6.45 [-17.38;4.49]*		
Inhabitants >85 years ¹	-11.43 [-16.53;-6.32]	-6.67 [-13.84;0.51]	-8.28 [-21.83;5.28]	14.14 [-16.60;44.86]
Unemployment ¹	-2.61 [-4.38;-0.83]	-1.38 [-3.58;0.80]	-1.05 [-9.24;7.14]	2.77 [-5.58;11.11]
Average income ³	0.46 [0.26;0.66]	0,07 [-0.27;0.41]	-0.08 [-0.70;0.58]	0.08 [-3.01;3.16]
Gross expenses ⁴	-0.00 [0.00;0.00]	-0.00 [-0.00;0.00]	0.00 [-0.00;0.00]	0.00 [-0.00;0.00]
<i>Factors relating to the group of home care workers</i>				
Workers <34 years ¹	118.46 [63.75;173.17]	48.33 [-26.20;122.86]	44.35 [-117.02;205.72]	-8.02 [-282.35;266.32]
Workers >55 years ¹	-198.69 [-289.42;-107.97]	-92.15 [-219.97;35.67]	51.08 [-226.67;328.82]	-93.05 [-471.28;285.19]
Non-full-time workers ¹	-0.21 [-0.66;0.23]	-0.01 [-0.51;0.49]	-0.26 [-1.19;0.67]	0.29 [-1.50;2.09]
Occupational rehabilitation ¹	-100.12 [-415.06;214.82]	78.15 [-243.05;399.34]	-405.94 [-1485.16;673.27]	670.19 [-487.62;1828.01]
		R ² =0.12	R ² =0.19	R ² =0.16

¹mean annual proportion (%) 1994-1998, continuous variable

²binary variable

³mean annual average income among 16-w year old inhabitants in each municipality during 1994-1997, continuous variable

⁴mean annual gross expenses for the care of the elderly and handicapped in each municipality during 1995-1998

*parameters are not uniquely estimated, and therefore stratified models were made

Municipal vs. private employment

The privately employed workforce was younger and accounted for 1-3 % of the total workforce of home care workers (table 3). The municipalities accounted for the highest mean annual incidence of the total reported occupational disorders among home care workers (table 4). This was also true for the subgroups of work-related diseases, occupational injuries and psychosocial work-related injuries, while the private employers accounted for the highest annual incidence of musculoskeletal disorders.

Table 3 - Number of occupational injuries and musculoskeletal diseases among male and female home care workers employed by a municipality or private company during 1996-1998

<i>Age</i>	<i>Occupational injuries</i>				<i>Work-related diseases</i>				
	<i>Sick-leave</i>		<i>No sick-leave</i>		<i>Musculoskeletal</i>				
	<i>M</i>	<i>F</i>	<i>M</i>	<i>F</i>	<i>M</i>	<i>F</i>	<i>M</i>	<i>F</i>	
<i>Municipal home care workers</i>									
18-19	3	36	12	111	0	2	0	19	
20-29	90	962	235	2327	21	249	32	621	
30-39	72	1493	144	2827	37	451	45	1076	
40-49	64	1741	83	2998	22	581	33	1250	
50-59	29	1852	29	2754	8	556	15	1283	
60-65	2	451	1	545	1	121	1	266	
No age		2	0	2	0	0	0	0	
All	260	6537	504	11564	89	1960	126	4515	
<i>Private home care workers</i>									
18-19	0	0	0	0	0	0	0	0	
20-29	3	14	18	74	0	3	1	14	
30-39	7	30	11	90	1	4	5	20	
40-49	2	27	9	76	1	12	2	25	
50-59	1	35	2	58	0	7	0	23	
60-65	0	3	0	10	0	1	0	3	
All	13	109	40	308	2	27	8	85	

Table 4 - Mean annual incidence of occupational disorders per 1000 FTE workers during 1996-1998

<i>Type of injury</i>	<i>Employer</i>	
	<i>Municipal</i>	<i>Private</i>
Occupational disorders	64.5	49.1
- Work-related diseases	6.3	4.5
- Occupational injuries (with sick leave)	21.0	16.9
- Occupational injuries (no sick leave)	37.1	27.7
Musculoskeletal injuries	10.6	13.5
Work-related psychosocial injuries	4.3	2.8

DISCUSSION

The great difference in incidence of occupational disorders among home care workers which appears when municipalities in Sweden are compared (10-184/1000 FTE workers) indicates a preventive potential.

The relation between the incidence of occupational disorders and macro-level socioeconomic factors is complex. In the univariate analysis the proportion of elderly people, unemployment, average income, metropolitan region, sparsely populated areas, younger and older home care workers correlated significantly with occupational disorders. However, in the multivariate analysis no factor alone was found to correlate significantly. The socioeconomic factors together explained 12-19 % of the variations in mean annual municipal incidence of occupational disorders in the regression models. The factors that had a potential to explain the differences were the municipal age structure of inhabitants and home care workers, and unemployment. However, the estimate of these factors was different in metropolitan regions and sparsely populated areas. The municipal variation in occupational disorders was not found to be convincingly explained by the economic resources, e.g. the gross expenses for the care of the elderly and handicapped, or the average income, or the proportion of full-time employed home care workers.

There were fewer occupational disorders in municipalities with a higher proportion of older home care workers, and more in municipalities with a higher proportion of younger workers. This might reflect a healthy worker selection of the workers that stay in the occupation, or a safer working technique practised by the older home care workers.

Possible reasons for a higher incidence of occupational disorders among the municipally employed home care workers as compared to those employed by a private company are: differences in the age structure and health of the employees, the work system, as well as safety efforts by the trade union and routines for reporting occupational injuries. These factors need to be further investigated. Only the incidence of musculoskeletal disorders among home care workers was higher in the privately employed group. Since the proportion of privately employed home care workers was only a few per cent of all home care workers in the study group, it was impossible to compare the incidence of occupational disorders at the municipality level. To our knowledge, there are no other studies that have compared occupational disorders in employees in the public sector and those in the private sector. However, our results should be interpreted with caution since the sample of home care workers is drawn from different databases.

In this study, the annual incidence of reported occupational disorders has been found to be lower than in earlier studies from the United States (Myers et al., 1993; Meyer and Muntaner, 1999) and Sweden (Ono et al., 1995). The incidences in the subgroups: work-related diseases, occupational injuries and musculoskeletal disorders were also lower (Ono et al., 1995). In Sweden, this could be explained by less reporting of such injuries due to changes in the Occupational Injury Act (in 1993), which made it more difficult to have a disorder accepted as work-related and obtain compensation from the social insurance system (National Board of Occupational Safety and Health & Statistics Sweden, 2000). Also, the earlier study in Sweden had a more restricted group of home workers, which could possibly explain the higher incidence rate (Ono et al., 1995). In the study from West Virginia, the incidence of low-back injuries was higher among nursing home personnel (132 per 1000 workers per year) than among a selected group of home care workers (Myers et al., 1993; Meyer and Muntaner, 1999). In the present study, the nursing home personnel were included in the group of home care workers.

There were differences according to sex when adjusted for time of exposure within the same working population. The sex-adjusted incidence of occupational disorders and musculoskeletal disorders also varied according to municipality grouping. Although the overall incidence was higher among females than among males, there were higher male incidences in the metropolitan and large cities as compared to smaller, rural and sparsely populated municipalities. In a study focusing on workers with low-back symptoms, the incidence and severity of low-back pain were found to be higher among female workers, although they were less exposed to known occupational risk factors as compared to the males. Therefore, the lifting of heavy weights and uncomfortable working postures seemed to be more important in female jobs (Alcouffe et al., 1999). According to official statistics for Sweden, there are more reported occupational injuries among male workers (about 10 per 1000 workers per year) than among female workers (about 6). About 25 % of all reports of work-related diseases and 21% of all occupational injuries come from the health care sector. Within the home care sector, about 28% report work-related ill health (National Board of Occupational Safety and Health & Statistics Sweden, 2000).

The results suggest that there could be other factors within the work systems that could explain the differences in municipal incidence, for example factors related to organisation and safety management or attitudes among the employees. As a rule, caution should be observed when comparing results based on register data from different nations and regions, with different routines and legislation, and when drawing conclusions regarding their relationship to the work system. Due to the lack of conformity in the rules, rights and routines related to the registration of occupational disorders in Sweden, variations in incidences of occupational disorders between municipalities are of particular interest for further investigation of their relationship to the different work systems. There is a lack of systematic knowledge about the relationship between work systems and the health of the workers in the home care service.

The level of underreporting in self-reported statistics of occupational disorders is unclear but considered as high. Studies have shown a low rate of reporting occupational disorders compared to official statistics, due to unwillingness to report or administrative failure (Quinlan and Mayhew, 1999; National Board of Occupational Safety and Health & Statistics Sweden, 2000). Methodological limitations make estimation of underreporting vague. Studies from US and Australia found that 30-60 % of fatal injuries at work were not recorded as occupational injuries. Even more accentuated were the patterns of underreporting of the non-fatal occupational injuries (Quinlan and Mayhew, 1999). At the macro-level, willingness to report has been associated with the social insurance system and the rules for workers' compensation. In Sweden, occupational injuries are more likely to be reported than work-related diseases (National Board of Occupational Safety and Health & Statistics Sweden, 2000). At the municipal level, willingness to report has been associated with aspects of work organisation such as precarious employment (Quinlan and Mayhew, 1999). The willingness to report has been less studied from the perspective of the workers themselves (micro-level).

A cautious interpretation of these findings is necessary due to the ecological design. The risk of confounding factors in ecological analysis and ecological fallacy is well-documented (Greenland and Robins, 1994). Sources of bias in this study could be the dynamic population at risk, making it difficult to estimate the time of exposure, under-reporting of injuries and the inclusion of multiple injuries per individual (Mittleman et al., 1997). Selection bias was roughly controlled by double-checking the classification of occupational groupings in the three different databases.

The great difference in incidence of occupational disorders between municipalities in Sweden indicates a preventive potential. However, the relation between the incidence and macro-socioeconomic factors is complex. In order to better understand phenomena related to organisational and regional differences in occupational injuries and diseases, further quantitative and qualitative studies are needed to explore the possible influence of the work system at the macro-, organisational- and micro-level.

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