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Prevalence of Musculoskeletal Symptoms Related With Activities of Daily Living and Contributing Factors in Korean Adults

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Objectives: This study aims to investigate the prevalence of musculoskeletal symptoms and factors related to daily activities in a representative Korean population.

Methods: This study was based on the questions about musculoskeletal symptoms in the Korean General Social Survey 2010. The questionnaire about musculoskeletal symptoms was adopted from Korean Occupational Safety and Health Agency guide, and it includes general characteristics, characteristics of pain, work type, work intensity and a 12-item Short Form Health Survey (SF-12). We utilized the criteria of the National Institute for Occupational Safety and Health to define the prevalence of musculoskeletal symptoms. Demographic, behavioral and socioeconomic factors were analyzed using logistic regression.

Results: The prevalence of musculoskeletal symptoms was 38.3%. The prevalence was higher in females, the elderly, those without health insurance, and those with a low income, low education, and occupations with a heavy workload. The prevalence by body part was highest in the back, shoulder, and knee, in that order. The physical component summary and mental component summary of the SF-12 decreased with increasing musculoskeletal symptoms.

Conclusions: Musculoskeletal symptoms are very common in the general population, and related to various socio-demographic factors. These results suggest that active prevention and management of musculoskeletal symptoms is needed at a national level.

Key words: Musculoskeletal diseases, Korean General Social Survey, 12-Item Short Form Health Survey, Quality of life, Activities of daily living

INTRODUCTION

According to a study on the prevalence rate of musculoskeletal symptoms in South Korea, 19.7% of Korean adults aged 19 and over have musculoskeletal disease (osteoarthritis) in at least one part of the body [1].

An increase in the prevalence rate of musculoskeletal symptoms in the Korean population can be expected in the future because Korean society has recently become an aging society. Thus, the need for the management of musculoskeletal symptoms has been accumulating.

Musculoskeletal symptoms are defined as pain in the muscles, tendons, and nerves arising from repetitive, continuous, and unnatural movements. These symptoms can be expressed in various areas of the body and affect the quality of life by causing difficulties in performing occupational tasks and activities of daily living (ADL) [2,3].

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Causes and risk factors for musculoskeletal symptoms can be classified into demographic factors such as sex and age, and occupational factors including work environment, procedures, and equipment, and socio-psychological factors [4].

So far, studies in Korea on the prevalence rate of musculoskeletal symptoms have focused on the prevalence of occupational diseases and the risk factors of having musculoskeletal symptoms in specific occupational categories [5].

However, the current state of musculoskeletal symptoms in Korea could have changed for the following reasons: degenerative musculoskeletal symptoms in the lumbar vertebrae and knee joints have been increasing due to the aging population [1,6]. While the number of jobs in agriculture and unskilled labor has decreased, service-related jobs have rapidly increased with changing industrial structure [7]. Office workers have been increasingly using computers in their jobs. Musculoskeletal symptoms in the shoulders, neck, hands, and wrists have increased due to changes in personal behaviors such as using handheld electronic devices like smart phones [8,9]. However, it is difficult to investigate the prevalence rate of musculoskeletal symptoms in the entire population based on studies of work-related musculoskeletal symptoms only in particular occupational groups. In addition, such studies are insufficient for examining the recent transitions in musculoskeletal symptoms described above. In particular, it is difficult to review musculoskeletal symptoms in non-work ADL based on previous studies.

Although some studies have examined representative samples of the entire population, including a national survey on the prevalence of specific musculoskeletal symptoms such as the Korean National Health and Nutrition Examination Survey (KNHANES) [1] and studies using national health insurance health service utilization data [10], these studies were inadequate for analyzing factors affecting the entire population due to insufficient statistical analysis of clinical and socioeconomic factors related to musculoskeletal symptoms, such as symptom areas and types of symptoms by particular occupations.

Thus, this study investigated the overall prevalence rates of musculoskeletal symptoms excluding rheumatic musculoskeletal disorder and trauma, the difference in prevalence rates by socio-demographic characteristics and behaviors, and factors affecting the prevalence rates using data representing the working conditions and ADL of the entire population in order to provide information useful for the prevention and management of musculoskeletal symptoms at the national level.

METHODS

Study Population and Survey Method

The data source for this study was the Korean General Social Survey (KGSS) of 2010. The KGSS is a macro scale survey of a national sample aimed at providing basic data for research in the social sciences. This survey has the advantage of systematically investigating people's major values and attitudes, attributes, behaviors, and patterns of daily living. In addition, it represents the entire population, and shows the relationship between various socio-demographic indicators and indicators of quality of life.

The KGSS questionnaires contain about 300 core survey questions every year inquiring about important factors in areas such as politics, the economy, and society. In addition, the KGSS administers annual international topical modules in 46 member countries as part of the International Social Survey Program, East Asian Social Surveys (EASS) performed by four East Asian countries (South Korea, Japan, China, and Taiwan) every other year, and survey items for special research. These questionnaires have 60 to 100 items each and the contents are combined in light of the needs in a given year.

In this study, health-related questionnaires were included in the EASS module, and musculoskeletal symptom questionnaires were included in the special subject module. The in-depth interview survey was performed by interviewers who visited respondents face-to-face, including 1576 people aged 18 and over who were selected by random sampling according to the multi-level area probability sampling for the 2010 KGSS [11].

Measurement Tools

The demographic variables included sex, age, educational level, type of insurance, income level, occupation, smoking, alcohol drinking, and exercise. To measure the work intensity, the number of hours of housework, physical burden at the current workplace, a frequency of using a computer keyboard and mouse of more than 4 hours per day in the previous year, a frequency of repetitive movements with the neck, shoulders, elbows, wrists, and hands of more than two hours a day in a previous year, and frequent work in a crouched position or on one's knees in the previous year.

The evaluation tool for musculoskeletal symptoms was adapted from the Musculoskeletal Workload Evaluation Guideline [12] of the Korea Occupational Safety and Health Agency.

With this tool, areas of pain (arms/elbows, hands/wrists/fingers, shoulders, the neck, the lower back, and knees), the duration of pain, the intensity of pain, and the frequency of pain experienced in the past year, symptoms in the past week, treatments for the pain, and switching tasks at work due to pain were examined.

The musculoskeletal symptoms were investigated according to the criteria of the National Institute of Occupational Safety and Health (NIOSH). These criteria were originally developed for decisions about work-related musculoskeletal symptoms and their severity. However, in this study, the criteria were extended to apply to all ADL including occupational activities because work-related factors are indistinguishable from non-occupational activities in the current post-industrial work environment as mentioned above in the introduction, and focusing on work-related factors alone is not the purpose of this study. Thus, musculoskeletal symptoms were defined as the pain caused by ADL including work activities that continued for over a week in the previous year or at least once every month at a severe or extremely severe level according to the NIOSH criteria [13]. Moreover, to analyze the prevalence rate of musculoskeletal symptoms in ADL including working activities, musculoskeletal symptoms arising from rheumatic musculoskeletal disorders and trauma were excluded.

To examine variables for the quality of life, a 12-item Short Form Health Survey (SF-12) questionnaire [14,15], which is a summarized version of the 36-item Short Form Health Survey (SF-36), was used. The SF-12 questionnaire has a high consistency with the SF-36, and it is easy to measure variables [16]. The SF-12 questionnaire includes 8 categories and 12 questions of the physical component summary (PCS; general health, physical functioning, physical role, and bodily pain) and mental component summary (MCS; vitality, emotional role, social functioning, and mental health) [6,15,16].

Statistical Analysis

To analyze the prevalence rate of musculoskeletal symptoms by socio-demographic characteristics, the frequency analysis, the χ^2-test, and the χ^2-for-trend test were performed (Table 1). Next, the prevalence rate of musculoskeletal symptoms by the part of the body was analyzed with a frequency analysis and the χ^2-test (Table 2). A multiple logistic regression analysis was used for the significance test (Table 3). Moreover, to investigate the relationship between the quality of life and musculoskeletal symptoms, the T-score was used for the SF-12 indicators (the evaluation tool for the quality of life related to health) [17], and a multiple linear regression analysis was performed (Table 4).

The statistical analyses were performed with SPSS version 18.0 (SPSS Inc., Chicago, IL, USA). A p-value of <0.05 was considered to be statistically significant. This study was conducted after institutional review board (IRB) approval at Samsung Medical Center (IRB file no. 2010-07-241-003). All respondents provided written informed consent.

RESULTS

The subjects' general characteristics are shown in Table 1. The total number of subjects was 1576. The number of females, at 832 (52.8%), was slightly higher than that of males (774, 47.2%). The number in the age group of 18 to 39 years old was the largest, at 665 (42.4%). By the types of insurance, the number of the group who were covered by both the National Health Service and private health insurance was the highest, at 840 (54.1%). Regarding income levels, the number in the group with an income of 1 500 000 to 2 990 000 Korean won (1000 Korean won is about 1.00 US dollar) was highest (314, 35.1%). Among the educational levels, the number in the group that graduated from a four-year college and above was 500 (31.7%). By occupational group, the number in the group engaged in service and sales businesses was largest, at 40.0%.

In examining the prevalence rate of musculoskeletal symptoms by socio-demographic indicators and behaviors according to the NIOSH criteria, it was found that the overall prevalence rate of musculoskeletal symptoms was 38.3%. The prevalence rate was significantly higher in the females, at 46.9%, than in the males, at 28.8%. Significantly higher prevalence rates were shown in the eldest group, the population without health insurance, the group with low income, with a low education level, and in agricultural and fishery technical workers, the nonsmoking and the nondrinking groups, and the group lacking exercise (Table 1) .

The highest prevalence rate by the body part was in the back (13.2% in males and 25.1% in females), followed by the shoulders (9.7% in males and 23.3% in females) and knees (8.5% in males and 18.4% in females) in that order (Table 2).

When considered by occupation, the highest prevalence rate of musculoskeletal symptoms in every body part was shown in the occupations involving heavy labor. The prevalence rates of musculoskeletal symptoms in the body parts

Table 1. General characteristics and prevalence of musculoskeletal symptoms of study population

		n (%)	Prevalence (%)	95% CI	*p*-value
Total		1576 (100.0)	38.3		
Gender	Male	744 (47.2)	28.8	25.5, 31.9	<0.001
	Female	832 (57.8)	46.9	43.8, 50.1	
Age (y)	18-39	665 (42.4)	32.3	28.6, 36.0	<0.001
	40-59	579 (36.9)	35.8	32.2, 39.7	
	≥60	326 (20.8)	55.5	50.0, 60.6	
Health insurance	NHI and PI	840 (54.1)	35.0	31.7, 38.0	0.007
	NHI	570 (36.7)	41.8	37.5, 45.5	
	PI	60 (3.9)	36.7	25.0, 48.6	
	No insurance	83 (5.3)	50.6	40.0, 61.7	
Income (10 000 Korean won)	0-149	312 (34.9)	43.9	38.3, 49.5	<0.001
	150-299	314 (35.1)	33.8	28.8, 39.1	
	300-449	159 (17.8)	24.5	17.8, 31.6	
	≥450	110 (12.3)	28.2	19.8, 37.4	
Education	Elementary school or less	222 (14.1)	68.9	62.8, 75.1	<0.001
	Middle school	139 (8.8)	48.2	40.0, 55.9	
	High school	475 (30.1)	37.3	33.0, 41.6	
	College	235 (14.9)	27.2	21.6, 33.2	
	University or more	500 (31.7)	28.0	24.2, 32.1	
Job	Management, office work	433 (31.0)	26.6	22.5, 30.6	<0.001
	Service, sales	558 (40.0)	36.7	33.0, 40.6	
	Physical labor	404 (29.0)	48.8	44.0, 53.7	
BMI	<18.5	116 (7.4)	37.1	28.0, 46.8	0.50
	18.5-22.9	775 (49.7)	38.2	34.9, 41.7	
	23-24.9	317 (20.3)	36.9	31.5, 42.0	
	25-29.9	316 (20.3)	38.6	33.1, 43.8	
	≥30	36 (2.3)	50.0	33.3, 67.6	
Drinking (>1/mo)	Yes	844 (53.6)	31.8	28.5, 34.8	<0.001
	No	732 (46.4)	45.9	42.3, 49.5	
Smoking	Yes	436 (27.7)	30.7	26.2, 35.1	<0.001
	No	1140 (72.3)	41.2	38.4, 44.0	
Exercise (>1/wk)	Yes	716 (45.4)	33.2	30.0, 36.8	<0.001
	No	860 (54.6)	42.6	39.5, 46.0	
House work	<10 min	334 (21.2)	29.9	24.9, 35.0	<0.001
	10 min - 59 min	509 (32.3)	35.0	31.0, 39.2	
	1-1.9 h	258 (16.4)	41.5	35.7, 47.7	
	2-2.9 h	202 (12.8)	42.1	35.6, 48.8	
	≥3 h	272 (17.3)	49.3	43.1, 55.3	
Physical burden of work	Not hard	324 (20.6)	21.9	17.6, 26.6	<0.001
	Less hard	450 (28.6)	29.6	25.4, 33.9	
	Moderate hard	580 (36.9)	43.6	39.4, 47.5	
	Very hard	208 (13.2)	69.7	63.5, 76.2	
[1]Computer use	No	802 (50.9)	45.0	41.6, 48.5	<0.001
	1-2 d/mo	199 (12.6)	29.6	23.1, 35.6	
	1 d/wk	1369 (8.6)	34.6	26.5, 43.1	

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Table 1. *(Continued from the previous page)*

		n (%)	Prevalence (%)	95% CI	*p*-value
	2-4 d/wk	186 (11.8)	26.9	20.8, 32.6	
	≥5 d/wk	252 (16.0)	34.1	28.3, 39.8	
[2]Repetitive motion	No	577 (36.6)	38.3	34.3, 42.3	0.14
	1-2 d/mo	180 (11.4)	33.3	26.4, 40.4	
	1 d/wk	119 (7.6)	27.7	19.8, 35.8	
	2-4 d/wk	245 (15.5)	38.4	32.3, 44.7	
	≥5 d/wk	454 (28.8)	43.0	38.4, 47.5	
[3]Squatt leg or bended knee position	No	944 (59.9)	36.2	32.9, 39.5	0.002
	1-2 d/mo	243 (15.4)	39.1	33.1, 45.6	
	1 d/wk	124 (7.9)	29.0	20.8, 37.9	
	2-4 d/wk	118 (7.5)	44.1	34.2, 53.1	
	≥5 d/wk	145 (9.2)	53.1	44.4, 61.4	

χ^2-test (χ^2 for trend test in case of age; education; income; BMI group; housework; physical burden of work; keyboard or mouse use; repetitive motion of neck, shoulder, elbow, wrist, hand; and work with squatted leg or bended knee).
CI, confidence interval; NHI, national health insurance; PI, private insurance; BMI, body mass index.
[1](During 1 year) keyboard or mouse use time 4 h.
[2](During 1 year) repetitive motion of neck, shoulder, elbow, wrist, and hand 2 h.
[3](During 1 year) work with squatted leg or bended knee.

other than the neck were high in the groups performing housework for a long period, using a computer keyboard and mouse less than 4 hours per day, and working in a position on their knees. Repetitive movements using the neck, shoulders, elbows, wrists, and hands more than two hours a day in the previous year increased the prevalence rate of musculoskeletal symptoms in the shoulders (Table 2).

The multiple logistic regression analysis with the adjustment for the variables of sex, age, educational level, occupation, income level, and type of insurance showed that the prevalence rates of musculoskeletal symptoms were higher in the hands/fingers/wrists and the lower back in the females than in the males, in the lower back in the agricultural and fishery technical workers, in the knees in those in the high body mass index (BMI) group, in the shoulders in the nonsmoking group, and in the neck in the group with a use of a keyboard or mouse more than 4 hours per day. In every body part except the knees, when the physical burden was high in the working conditions, the prevalence rate of musculoskeletal symptoms was high. On the other hand, there was no difference by age, type of insurance, income level, educational level, exercise, drinking, duration of housework, more than two hours of repetitive movement, or crouching or working on one's knees (Table 3).

After adjusting for age, type of insurance, income level, educational level, and occupation, the multiple regression analysis was performed. As the prevalence rate of musculoskeletal symptoms increased in every body part, the scores on the PCS and the MCS of the SF-12 questionnaire decreased. When there were musculoskeletal symptoms in every part, the scores on the PCS and the MCS were significantly lower.

DISCUSSION

The prevalence rate of musculoskeletal symptoms in females (46.9%) was around 20% higher than that in males (28.8%) according to the NIOSH criteria. Although the prevalence rates of musculoskeletal symptoms by sex vary in other studies [18], women's sensitivity to physical workload and pain and the difference of hours of housework between the sexes could have caused the higher prevalence rate in the females than in the males [18-20].

The prevalence rate of musculoskeletal symptoms increased with age. In particular, the prevalence rate sharply increased in the back and knees. These results correspond to previous findings that osteoporosis and degenerative musculoskeletal symptoms increase with age [21] and that the back and knees are the parts most disposed to degenerative musculoskeletal symptoms [22]. The prevalence rates were significantly higher in the group without health insurance, with low income, a low education level, the long period of housework, physical labor at work, and long working hours crouching or on one's knees. These findings could be explained by the difficulty of visiting

Table 2. Prevalence of musculoskeletal symptoms by body parts and affecting factors of its differences

		Finger/hand/wrist		Arm/elbow		Shoulder		Neck		Waist		Knee	
		%	*p*-value	%	*p*-value	%	*p*-value	%	*p*-value	%	*p*-value	%	*p*-value
Total		9.3		5.9		16.9		8.1		19.5		13.7	
Gender	Male	3.9	<0.001	3.2	<0.001	9.7	<0.001	5.8	0.002	13.2	<0.001	8.5	<0.001
	Female	14.1		8.3		23.3		10.2		25.1		18.4	
Age (y)	18-39	6.9	<0.001	2.4	<0.001	13.8	<0.001	7.4	0.31	14.9	<0.001	5.6	<0.001
	40-59	9.2		7.3		16.9		8.3		15.9		10.7	
	≥60	14.4		10.7		23.0		9.2		35.6		35.9	
Healthinsurance	NHI and PI	8.1	0.02	3.2	<0.001	15.5	0.18	7.5	0.66	16.2	0.005	8.9	<0.001
	NHI	11.1		9.5		18.9		9.1		23.3		18.9	
	PI	1.7		0.0		11.7		6.7		20.0		11.7	
	Noinsurance	14.5		13.3		20.5		9.6		25.3		27.7	
Income (10 000 Korean won)	0-149	15.4	<0.001	7.7	0.03	19.6	0.007	8.7	0.98	22.8	<0.001	16.7	<0.001
	150-299	6.7		3.8		13.7		7.6		15.3		7.0	
	300-449	3.1		1.9		11.3		3.8		11.3		3.1	
	≥450	5.5		4.5		10.9		11.8		10.9		4.5	
Education	Elementary school or less	19.8	<0.001	14.9	<0.001	31.5	<0.001	12.2	0.04	43.7	<0.001	44.6	<0.001
	Middle school	15.8		12.2		18.0		9.4		28.8		25.9	
	High school	9.3		5.5		15.6		7.8		16.0		9.3	
	College	6.8		2.1		12.8		5.5		14.5		5.1	
	University or more	3.8		2.4		13.0		7.6		11.8		4.8	
Job	Management, officework	3.7	<0.001	3.0	<0.001	12.7	0.02	7.4	0.78	10.9	<0.001	4.6	<0.001
	Service, sales	9.7		4.1		16.3		7.7		17.6		10.4	
	Physical labor	14.6		9.9		20.0		8.7		28.5		22.8	
BMI	<18.5	11.2	0.50	8.6	0.06	17.2	0.63	9.5	0.70	17.2	0.05	12.9	<0.001
	18.5-22.9	9.0		4.5		17.7		8.1		18.6		10.2	
	23-24.9	5.7		4.1		13.2		5.7		17.4		12.6	
	25-29.9	11.1		8.9		17.4		9.2		22.8		21.2	
	≥30	16.7		11.1		16.7		13.9		30.6		33.3	
Drinking (>1/mo)	Yes	5.8	<0.001	3.4	<0.001	11.9	<0.001	6.3	0.005	15.5	<0.001	7.0	<0.001
	No	13.3		8.7		21.4		10.2		24.0		21.4	
Smoking	Yes	5.5	0.001	3.7	0.02	9.9	<0.001	8.0	10.00	15.1	0.01	8.9	0.001
	No	10.7		6.8		19.6		8.2		21.1		15.5	
Exercise (>1/wk)	Yes	11.4	0.002	5.3	0.39	14.4	0.02	6.3	0.02	15.8	0.001	9.1	<0.001
	No	6.7		6.4		19.0		9.7		22.6		17.6	
House work	<10 min	6.0	<0.001	3.9	0.001	12.6	0.009	6.6	0.12	15.0	<0.001	9.0	<0.001
	10 min - 59 min	6.5		3.9		15.9		7.9		18.3		10.0	
	1-1.9 h	10.1		7.8		20.5		7.4		18.2		19.0	
	2-2.9 h	12.4		8.4		16.3		10.4		22.8		16.8	
	≥3 h	15.4		8.5		21.0		9.6		26.1		19.1	
Physical burden of work	Not hard	3.4	<0.001	1.2	<0.001	7.1	<0.001	4.0	<0.001	9.6	<0.001	6.5	<0.001
	Less hard	4.9		2.2		11.3		5.3		11.8		9.3	
	Moderate hard	10.3		6.7		21.6		10.0		22.9		13.8	
	Very hard	25.0		19.2		31.7		15.9		42.8		34.6	

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Table 2. *(Continued from the previous page)*

		Finger/hand/wrist		Arm/elbow		Shoulder		Neck		Waist		Knee	
		%	*p*-value	%	*p*-value	%	*p*-value	%	*p*-value	%	*p*-value	%	*p*-value
[1]Computer use	No	11.3	0.08	8.4	<0.001	19.8	0.01	9.0	0.65	25.6	<0.001	20.8	<0.001
	1-2 d/mo	6.5		4.5		14.6		4.0		11.6		3.0	
	1 d/wk	5.9		5.1		13.2		5.1		12.5		9.6	
	2-4 d/wk	4.3		2.2		11.3		7.0		12.4		5.9	
	≥5 d/wk	10.3		2.0		15.5		11.1		15.5		7.1	
[2]Repetitive motion	No	8.3	0.002	5.5	0.35	15.3	0.01	8.3	0.19	22.2	0.61	17.3	0.09
	1-2 d/mo	5.0		3.3		13.9		4.4		13.3		7.8	
	1 d/wk	5.0		5.9		11.8		5.9		15.1		7.6	
	2-4 d/wk	7.3		6.1		17.6		6.9		18.0		12.2	
	≥5 d/wk	14.3		7.0		21.1		10.6		20.5		13.7	
[3]Squatt leg or bended Knee position	No	8.8	0.009	5.6	0.29	15.0	0.004	8.6	0.88	18.2	0.03	13.0	0.004
	1-2 d/mo	5.8		4.5		18.1		7.8		19.3		9.1	
	1 d/wk	9.7		5.6		12.9		2.4		15.3		8.9	
	2-4 d/wk	11.9		7.6		22.9		10.2		25.4		19.5	
	≥5 d/wk	15.9		8.3		24.8		9.0		26.2		24.1	

χ^2-test (χ^2 for trend test in case of age; education; income; BMI group; housework; physical burden of work; keyboard or mouse use; repetitive motion of neck, shoulder, elbow, wrist, hand; and work with squatted leg or bended knee).
NHI, national health insurance; PI, private insurance; BMI, body mass index.
[1](During 1 year) keyboard or mouse use time 4 h.
[2](During 1 year) repetitive motion of neck, shoulder, elbow, wrist, hand 2 h.
[3](During 1 year) work with squatted leg or bended knee.

the doctor's office in the population without adequate health insurance and the difference in the burden of work by occupation [23,24]. Furthermore, the reason that the prevalence rate of musculoskeletal symptoms was higher in the group using a computer keyboard less than 4 hours per day could be that seniors use computers less than the young population.

Another previous study based on data from the 2001 KNHANES showed lower prevalence rates of musculoskeletal symptoms in males, at 14.7%, and females, at 28.1% [1], than ones in this study. These differences likely arose from details in how the questionnaires inquired about musculoskeletal symptoms in the present study, resulting in relatively high prevalence rates.

Examining the factors affecting the prevalence rate by logistic regression analysis, the prevalence rates in the females were significantly higher in the hands/fingers/wrists and the lower back. This could be explained by the difference in the number of hours of housework between the males and the females. Even though the difference in housework hours between the males and the females was not significant in this study, other studies generally show longer housework times for females than males. While the parts of the musculoskeletal system vulnerable to symptoms in people who were more involved in housework were the shoulders and the wrist in other studies [19], in this study, the prevalence rates in the female were high in the hands/fingers/wrists. This result suggests that females use hands/fingers/wrists more for delicate work during housework. In addition, it can be concluded that this difference in the prevalence rate is suggests that females are more sensitive to the time spent doing housework with regard to musculoskeletal symptoms [18,19].

The prevalence rate by occupation showed a significant difference for the wrist, considering that workers performing physical labor are relatively more exposed to repetitive movements, lifting heavy loads, and inappropriate working positions [23].

Reviewing the relationship between the BMI and musculoskeletal symptoms, while the symptoms are significantly higher with higher BMI [25] in general, the prevalence rate of musculoskeletal symptoms was significantly different only in the knee by BMI in this study. This seems reasonable because the knee would be most impacted by body weight. According to a previous study, the risk of musculoskeletal symptoms in the knees was up to 7.5 times higher in people with a high BMI compared to those with a normal BMI [26].

By occupation type, the prevalence rate of symptoms in the

Table 3. ORs of the factors affecting prevalence of musculoskeletal symptoms

		Total		Finger/hand/wrist		Arm/elbow		Shoulder		Neck		Waist		Knee	
		OR	*p*-value	OR	*p*-value	OR	*p*-value	OR	*p*-value	OR	*p*-value	OR	*p*-value	OR	*p*-value
Gender	Male	1.00	0.19	1.00	0.003	1.00	0.44	1.00	0.25	1.00	0.22	1.00	0.03	1.00	0.26
	Female	1.39		4.16		1.60		1.47		1.72		2.00		1.63	
Age (y)	18-39	1.00	0.94	1.00	0.68	1.00	0.16	1.00	0.71	1.00	0.86	1.00	0.88	1.00	0.33
	40-59	0.95		0.71		1.28		1.08		1.08		0.98		1.20	
	≥60	0.89		0.70		0.36		0.77		0.76		0.81		2.17	
Health insurance	NHI and PI	1.00	0.66	1.00	0.73	1.00	<0.001	1.00	0.99	1.00	0.89	1.00	0.71	1.00	0.19
	NHI	1.18		1.27		4.69		0.96		0.90		0.95		1.52	
	PI	0.77		0.00		0.00		0.92		1.41		0.49		1.08	
	No insurance	1.30		1.89		13.30		0.87		0.62		1.17		3.39	
Income (10 000 Korean won)	0-149	1.00	0.37	1.00	0.20	1.00	0.22	1.00	1.00	1.00	0.08	1.00	0.97	1.00	0.46
	150-299	0.91		0.67		1.13		0.96		0.79		0.93		0.79	
	300-449	0.68		0.45		0.62		0.93		0.42		0.88		0.37	
	≥450	1.12		1.68		3.30		0.93		1.72		0.83		0.76	
Education	Elementary school or less	1.00	0.89	1.00	0.60	1.00	0.61	1.00	0.45	1.00	0.59	1.00	0.86	1.00	0.41
	Middle school	0.81		1.77		0.75		0.56		2.53		0.76		1.30	
	High school	0.72		0.84		0.58		1.03		0.60		0.83		0.49	
	College	0.60		0.82		0.41		0.54		4.05		1.24		0.63	
	University or more	0.72		0.57		0.20		0.94		5.00		1.01		0.54	
Job	Management, officework	1.00	0.17	1.00	0.25	1.00	0.36	1.00	0.71	1.00	0.47	1.00	0.02	1.00	0.48
	Service, sales	0.96		1.63		0.45		0.81		0.75		1.09		1.09	
	Physical labor	1.48		2.35		0.67		0.97		1.24		2.35		1.68	
Body mass index	<18.5	1.00	0.21	1.00	0.23	1.00	0.32	1.00	0.42	1.00	0.50	1.00	0.38	1.00	0.009
	18.5-22.9	2.29		4.99		0.83		2.45		1.93		1.66		3.21	
	23-24.9	2.38		3.93		0.65		2.31		1.25		1.59		3.99	
	25-29.9	1.98		7.06		1.83		2.41		2.42		2.51		6.02	
	≥30	3.57		12.67		1.93		0.76		3.11		1.59		27.70	
Drinking (>1/mo)	Yes	1.00	0.44	1.00	0.37	1.00	0.21	1.00	0.36	1.00	0.17	1.00	0.89	1.00	0.08
	No	1.14		1.64		1.64		1.23		1.52		1.03		1.68	
Smoking	Yes	1.00	0.37	1.00	0.09	1.00	0.46	1.00	0.02	1.00	0.94	1.00	0.99	1.00	0.85
	No	1.20		0.67		1.53		2.08		0.97		1.00		0.93	
Exercise (>1/wk)	Yes	1.00	0.38	1.00	0.71	1.00	0.14	1.00	0.20	1.00	0.14	1.00	0.98	1.00	0.78
	No	1.15		0.89		0.56		1.34		1.55		1.01		1.08	
House work	<10 min	1.00	0.13	1.00	0.49	1.00	0.40	1.00	0.53	1.00	0.81	1.00	0.50	1.00	0.57
	10 min - 59 min	1.65		0.85		1.74		1.35		1.34		1.37		2.08	
	1-1.9 h	1.79		1.26		3.34		1.59		1.34		0.96		1.94	
	2-2.9 h	1.40		1.25		2.68		1.11		1.82		1.65		2.03	
	≥3 h	1.89		1.87		1.63		0.94		1.07		1.30		1.76	
Physical burden of work	Not hard	1.00	<0.001	1.00	<0.001	1.00	0.03	1.00	<0.001	1.00	0.03	1.00	<0.001	1.00	0.39
	Less hard	1.13		1.00		2.85		1.46		0.99		1.37		2.16	
	Moderate hard	2.07		2.18		11.17		3.62		2.09		2.34		3.00	
	Very hard	4.47		6.54		15.50		5.59		4.23		5.03		2.88	

(Continued to the next page)

Table 3. *(Continued from the previous page)*

		Total		Finger/hand/wrist		Arm/elbow		Shoulder		Neck		Waist		Knee	
		OR	*p*-value	OR	*p*-value	OR	*p*-value	OR	*p*-value	OR	*p*-value	OR	*p*-value	OR	*p*-value
[1]Computer use	No	1.00	0.17	1.00	0.12	1.00	0.45	1.00	0.99	1.00	0.006	1.00	0.19	1.00	0.06
	1-2 d/mo	1.63		1.43		0.94		0.88		0.28		0.58		0.34	
	1 d/wk	1.17		2.99		0.97		1.15		1.51		1.27		2.40	
	2-4 d/wk	1.88		2.54		0.30		0.99		2.40		1.16		0.61	
	≥5 d/wk	1.71		3.46		0.26		1.10		3.34		1.59		1.52	
[2]Repetitive motion	No	1.00	0.40	1.00	0.08	1.00	0.29	1.00	0.19	1.00	0.15	1.00	0.75	1.00	0.46
	1-2 d/mo	1.12		2.75		3.63		1.12		0.82		0.90		1.36	
	1 d/wk	1.92		8.20		0.92		1.00		0.39		0.49		0.20	
	2-4 d/wk	0.98		1.26		1.24		1.69		0.26		0.85		0.97	
	≥5 d/wk	1.24		1.95		2.36		2.00		0.92		0.85		1.29	
[3]Squatt leg or bended Knee position	No	1.00	0.12	1.00	0.97	1.00	0.78	1.00	0.13	1.00	0.70	1.00	0.46	1.00	0.48
	1-2 d/mo	1.37		0.80		1.45		1.80		1.85		1.61		1.53	
	1 d/wk	1.76		0.79		0.36		0.46		0.00		0.95		0.45	
	2-4 d/wk	0.74		0.64		0.50		1.42		1.41		1.02		0.73	
	≥5 d/wk	1.26		0.77		0.94		1.38		1.09		1.58		1.51	

Multiple logistic regression analysis (adjusted for sex, age, education, job, income, and health insurance).
OR, odds ratio; NHI, National health insurance; PI, private insurance.
[1](During 1 year) keyboard or mouse use time 4 h.
[2](During 1 year) repetitive motion of neck, shoulder, elbow, wrist, hand 2 h.
[3](During 1 year) work with squatted leg or bended knee.

Table 4. Effect of musculoskeletal symptoms on quality of life (SF-12)

	Total		Finger/hand/wrist		Arm/elbow		Shoulder		Neck		Waist		Knee	
	ß	*p*-value	ß	*p*-value	ß	*p*-value	ß	*p*-value	ß	*p*-value	ß	*p*-value	ß	*p*-value
PCS	-0.298	<0.001	-0.197	<0.001	-0.135	<0.001	-0.201	<0.001	-0.164	<0.001	-0.234	<0.001	-0.234	<0.001
General health	-0.272	<0.001	-0.156	<0.001	-0.113	0.001	-0.179	<0.001	-0.163	<0.001	-0.216	<0.001	-0.235	<0.001
Physical functioning	-0.214	<0.001	-0.147	<0.001	-0.082	0.01	-0.169	<0.001	-0.121	<0.001	-0.176	<0.001	-0.180	<0.001
Role-physical	-0.240	<0.001	-0.180	<0.001	-0.153	<0.001	-0.227	<0.001	-0.199	<0.001	-0.165	<0.001	-0.191	<0.001
Bodily pain	-0.339	<0.001	-0.228	<0.001	-0.209	<0.001	-0.201	<0.001	-0.160	<0.001	-0.216	<0.001	-0.242	<0.001
MCS	-0.182	<0.001	-0.127	<0.001	-0.145	<0.001	-0.150	<0.001	-0.129	<0.001	-0.152	<0.001	-0.106	<0.001
Vitality	-0.198	<0.001	-0.107	<0.001	-0.120	<0.001	-0.140	<0.001	-0.087	0.009	-0.134	<0.001	-0.183	<0.001
Role-emotional	-0.166	<0.001	-0.137	<0.001	-0.148	<0.001	-0.167	<0.001	-0.131	<0.001	-0.085	<0.001	-0.104	<0.001
Social functioning	-0.255	<0.001	-0.215	<0.001	-0.137	<0.001	-0.171	<0.001	-0.150	<0.001	-0.165	<0.001	-0.230	<0.001
Mental health	-0.217	<0.001	-0.127	<0.001	-0.149	<0.001	-0.173	<0.001	-0.158	<0.001	-0.156	<0.001	-0.168	<0.001

Multiple regression analysis (adjusted for sex, age, education, job, income, and health insurance).
SF-12, 12-item Short Form Health Survey; PCS, physical component summary; MCS, mental component summary.

neck was higher in the group who used the computer keyboard and the mouse more than 4 hours per day because using a computer for a long time burdens the neck in the fixed head-down position [23]. This was likely to have contributed to the higher prevalence of musculoskeletal symptoms in office workers. Heavy physical burdens produced a significantly higher prevalence rate of musculoskeletal symptoms on every body part besides the knees. This result corresponds with a previous study showing that physical burden was the main risk factor for musculoskeletal symptoms [23]. Thus, this result implies that musculoskeletal symptoms can be managed by the improvement of the work environment to reduce the physical

burden and the rectification of inappropriate postures.

Considering the quality of life, musculoskeletal symptoms decreased the quality of life even after correction for socio-demographic variables. This finding agrees with the results of other studies [27]. This result suggests that the active management of musculoskeletal symptoms is important to improve the quality of life.

However, the present study has the limitation of being a cross-sectional study, which means that the order of the cause-and-effect relationship is not clear. In addition, due to the insufficient analysis of the detailed patterns of work causing the symptoms, it was difficult to verify specific occupational factors. In particular, an analysis with subdivided occupational categories is needed in future studies. However, considering that a heavy physical burden produces a high prevalence of musculoskeletal symptoms, it can be postulated that the type of occupation affects the expression of musculoskeletal symptoms. In addition, another limitation is that this study used only questionnaires without physical examinations. Besides, a recall bias could have occurred in some portions of the data because it was collected only from the questionnaires, and there would be some errors in the severity of musculoskeletal symptoms.

Despite these limitations, this study is meaningful because musculoskeletal symptoms in work and ADL were considered comprehensively by investigating the prevalence rate of musculoskeletal symptoms with representative national scale sampling. In particular, this study suggests that it is important to manage musculoskeletal symptoms caused by not only occupational factors but also women's housework, obesity, the increasing number of office workers, and students' use of computers. In addition, it is notable that musculoskeletal symptoms were found to considerably decrease quality of life.

In this study, the relationship between the high prevalence rate of musculoskeletal symptoms and the low quality of life suggests the need for strategies to reduce the causal cycle involving heavy physical burdens producing musculoskeletal symptoms resulting in a low quality of life. Therefore, the prevention and management of musculoskeletal symptoms cased by ADL as well as work-related factors would be important.

CONFLICT OF INTEREST

The authors have no conflicts of interest with the material presented in this paper.

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