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Work-Related Musculoskeletal Symptoms Among Dairy Farmers in Gyeonggi Province, Korea

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Objectives: The prevalence of work-related musculoskeletal symptoms (WMS) among Korean dairy farmers has not been investigated. The purpose of this study was to assess the prevalence of WMS and to evaluate the relationship between WMS and risk factors.
Methods: Self-developed questionnaires including the questionnaire developed by the Korean Occupational Safety and Health agency (KOSHA) were used to investigate WMS among dairy farmers in Gyeonggi Province, Korea. We informed selected dairy farmers about the study and sent the questionnaires by registered mail. They visited a public health center nearby or a branch of public health center on the appointed date and skillful researchers identified or conducted the questionnaires by interview. We analyzed 598 (32.8%) of the 1824 dairy farmers. Multiple logistic regression was implemented to estimate the odds ratios of risk factors.
Results: The mean age of the respondents was 50.4 ± 8.7 years and the proportion of males was 63.0%. The prevalence of WMS at any site was 33.3%. The prevalence of neck WMS was 2.2%, shoulders 10.0%, arms/elbows 5.0%, hands/wrists/fingers 4.2%, low back 11.5%, and legs/feet 11.7%. The adjusted odds ratio of low back WMS for milking 4 or more hours per day was 4.231 (95% CI = 1.124 - 15.932) and statistically significant. Low back WMS (2.827, 95% CI = 1.545 - 5.174) was significantly decreased by education.
Conclusions: Low back WMS increased with milking hours and milking 4 or more hours per day was significantly associated with low back WMS. Low back WMS was significantly reduced with education. We hope that there will be increased attention about WMS in dairy farmers and the subject of future investigations.

Key words: Dairy farmers, Prevalence, Risk factors, Work-related musculoskeletal symptoms
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INTRODUCTION

The situation of dairy farming in Korea has not been good recently because of the free trade agreement (FTA), economic difficulties due to rises in feed prices. The mean number of cows in Korea has consistently decreased from 518645 in Dec. 2003 to 445754 in Dec. 2008, and the number of dairy farms has also consistently decreased from 10514 in Dec. 2003 to 7000 in Dec. 2008 [1]. The mean number of cows per dairy farm, however, has continuously increased from 49.3 in Dec. 2003 to 63.7 in Dec. 2008 due to dairy farm closures below 50 cows per farm [2].

Musculoskeletal disorders (MSDs) refer to conditions that involve the nerves, tendons, muscles, and supporting structures of the body [3]. The risk factors for MSDs include awkward posture, repetition, force, vibration, velocity of work, tool design, and personal factors. Musculoskeletal symptoms (MSS) include pain, sensitivity, weakness, swelling, and numbness [4]. Among work-related diseases in Korea, the proportion of occupational diseases has decreased, but MSDs has rapidly increased from 38.7% (2901) in 2005 to 67.3% (7723) in 2007 [5,6].

Farming is a physically demanding occupation with work tasks that cause MSDs and work disability, such as lifting heavy objects, moving and carrying equipment and awkward working postures [7]. Similarly, dairy farming-related work, such as milking, cleaning stalls, feeding, caring for calves, and milk processing can have a negative impact on the musculoskeletal system.

Dairy farmers have to work at least twice per day due to milking, so they must stay at their dairy farm. Dairy farms in Korea are small and dairy farmers take MSS for granted. Few surveys have been performed because there is little concern about their health, and the proportion of dairy farming within agriculture is small in number.

The purpose of this study was to assess the prevalence of work-related musculoskeletal symptoms (WMS) amongst dairy farmers and to evaluate the relationship between WMS and risk factors.

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Table 1. Demographic characteristics*

	1st survey (n=313)	2nd survey (n=285)	Total (n=598)
Gender (male)	206 (65.8%)	171 (60.0%)	377 (63.0%)
Age (y)	51.4 ± 8.9	49.4 ± 8.3	50.4 ± 8.7
Body mass index (kg/m²)†	24.2 ± 2.7	24.1 ± 2.7	24.1 ± 2.7
Education			
≤ Middle school or less	159 (50.8%)	143 (50.2%)	302 (50.5%)
≥ High school or more	154 (49.2%)	142 (49.8%)	296 (49.5%)
Marital state (married)	297 (94.9%)	271 (95.1%)	568 (95.0%)
Smoking (current)	81 (25.9%)	78 (27.4%)	159 (26.6%)
Alcohol (yes)	154 (49.2%)	122 (42.8%)	276 (46.2%)

* Number (%) or mean ± SD (standard deviation).
† The number in the first survey was 312 and the total number was 597.

Table 2. Farm characteristics and dairy operation activities

	Mean	SD
Farm characteristics (n=401)		
Herd size (cows/farm)	66.9	36.7
Dairy farmer (people/farm)*	2.1	0.7
Dairy operation activities (n=598)		
Working duration (y)	19.9	8.3
Cows per person	32.7	16.5
Work types (h/d)		
Caring for stalls	1.2	1.3
Feeding	1.2	1.0
Milking	2.1	1.2
Caring for calves	0.8	0.8
Cleaning stalls	0.9	1.1
Milk processing	5 (0.8%)†	

SD: standard deviation.
*The range of dairy farmer was between 1 and 5.
† This represents number (%).

Table 3. Prevalence of work-related musculoskeletal symptoms (N=598)

	n	%
Neck	13	2.2
Shoulders	60	10.0
Arms/Elbows	30	5.0
Hands/Wrists/Fingers	25	4.2
Low back	69	11.5
Legs/Feet	70	11.7
WMS at any site	199	33.3
WMS at two or more sites	51	8.5

WMS: work-related musculoskeletal symptoms.

METHODS AND MATERIALS

Ⅰ. Subjects

There were 7657 dairy farms in Korea in Dec. 2007 and 3219 (42.0%) dairy farms in Gyeonggi Province [8]. The proportion of dairy farms in Gyeonggi Province was higher than other provinces, which served as the basis for its selection. The city/county/district above 50 dairy farms was selected (1200 people from 600 dairy farms) and the 1st survey was conducted in Nov. 2008. The town/township above 50 dairy farms was selected (624 people from 312 dairy farms) and the 2nd survey was conducted in Dec. 2008. For each dairy farm, two dairy farmers were expected to participate in these surveys. The respondent dairy farms were 401 (44.5%) of 912 and the respondents were 719 (39.4%) of 1824. But the respondents with insufficient information (96) and breeding cows that represented less than one-half of the total cattle (25) were excluded. The final analysis was compromised of 598 (32.8%).

Ⅱ. Methods

We informed the selected dairy farmers about the study and sent the questionnaires by registered mail using the information provided by the Korea Centers for Disease Control and Prevention (KCDC). The dairy farmers visited the nearest one among 15 public centers during the 1st survey period (2 weeks) or the nearest one among 5 branches of public health center during the 2nd survey period (1 week) on the appointed date. Skillful researchers (8 people) identified or conducted the questionnaires by interview. The questionnaires were self-developed.

A. Questionnaires of general characteristics

The questionnaires of demographic characteristics contained inquiries about gender, age, height, weight, marital state, smoking, alcohol consumption, etc. The questionnaires of farm characteristics contained inquiries about herd size, number of dairy farmers, working duration, and so on. The questionnaires of dairy operation activities contain inquiries about caring for stalls, feeding, milking, caring for calves, cleaning stalls, milk processing (cheese or yogurt), etc.

B. Questionnaires of WMS

The questionnaires of WMS were based on the NIOSH-style MSS questionnaires of the Korea Occupational Safety and Health Agency (KOSHA). The body was classified into neck, shoulders, arms/elbows, hands/wrists/fingers, low back, and legs/feet. The criteria of WMS are defined below.

(1) WMS (pain, ache, stiffness, burning sensation, numbness, and tingling) were experienced during the past 12 months.

(2) Symptoms lasted a week or more, or were observed once a month or more during the past 12 months.

(3) Severity of symptoms was moderate or more.

Table 4. Work-related musculoskeletal symptoms and demographic characteristics by body sites* (N=598)

	Neck WMS (%)	p-value	Shoulders WMS (%)	p-value	Arms/ Elbows WMS (%)	p-value	Hands/ Wrists/ Fingers WMS (%)	p-value	Low back WMS (%)	p-value	Legs/ Feet WMS (%)	p-value
Gender												
Male	2.1	1.000†	9.5	0.607	4.2	0.258	2.7	0.015	8.8	0.005	9.0	0.008
Female	2.3		10.9		6.3		6.8		16.3		16.3	
Age (y)												
≤ 39	2.2	0.485	4.4	0.041	2.2	0.420	6.7	0.171	4.4	0.021	4.4	0.436
40 - 49	1.8		7.4		6.0		4.6		10.1		12.9	
50 - 59	1.9		12.7		6.2		4.2		12.0		11.6	
≥ 60	3.9		11.7		0.0		1.3		18.2		13.0	
BMI (n=597)												
< 25	2.6	0.558†	10.3	0.675	5.1	0.874	4.6	0.474	12.6	0.291	10.8	0.319
≥ 25	1.4		9.2		4.8		3.4		9.7		13.5	
Education												
≤ Middle school or less	2.6	0.421	12.6	0.036	5.3	0.750	4.0	0.798	16.6	< 0.001	15.6	0.003
≥ High school or more	1.7		7.4		4.7		4.4		6.4		7.8	
Marital state†												
Married	2.3	1.000	10.2	0.758	5.3	0.391	4.2	1.000	11.3	0.375	11.6	0.770
Unmarried	0.0		6.7		0.0		3.3		16.7		13.3	
Smoking												
Non-smoker	2.8	0.230	10.7	0.197	6.5	0.080	5.3	0.039	13.2	0.172	13.8	0.080
Ex-smoker	1.2		14.5		2.4		4.8		8.4		8.4	
Current smoker	1.3		6.3		3.1		1.3		9.4		8.8	
Alcohol												
No	2.5	0.574	11.2	0.313	5.3	0.751	6.2	0.007	13.4	0.133	11.8	0.937
Yes	1.8		8.7		4.7		1.8		9.4		11.6	

WMS: work-related musculoskeletal symptoms, BMI: body mass index.
*Chi-square test or chi-square for trend test was used.
†Fisher's exact test was used.

C. Statistical analysis

The variables of dairy operation activities were categorized into 2 or 4 classes considering the percentile. We performed a chi-square test or chi-square for trend test to compare the prevalence of WMS according to each variable. If the number of expected cells was below 5, we performed a Fisher's exact test. We implemented multiple logistic regression with the variables including working duration, gender, and all important ($p<0.10$) risk factors except age. Age was not selected because of the multicollinearity with working duration. SPSS 17.0K (SPSS Inc. Chicago, IL, USA) was used and the statistical significance of p-value set at below 0.05.

RESULTS

Ⅰ. Demographic Characteristics (Table 1)

The male participants numbered 377 (63.0%) and those of the 1st and 2nd surveys were 206 (65.8%) and 171 (60.0%), respectively. The mean age of the participants was 50.4 ± 8.7 years and the mean age of the participants in the 1st and 2nd surveys was 51.4 ± 8.9 and 49.4 ± 8.3 years, respectively. The mean body mass index (BMI) was 24.1 ± 2.7 kg/m^2 and the mean BMI of the participants in the 1st and 2nd surveys was 24.2 ± 2.7 and 24.1 ± 2.7 kg/m^2, respectively. The participants who have graduated from a middle school or less were 302 (50.5%). The participants in the 1st and 2nd surveys who have graduated from a middle school or less were 159 (50.8%) and 143 (50.2%), respectively. The married participants were 568 (95.0%) and the married participants of the 1st and 2nd surveys were 297 (94.9%) and 271 (95.1%), respectively. There were slight differences between the 1st and 2nd surveys, but they were very similar in most characteristics, so we analyzed the entire group of participants.

Ⅱ. Farm Characteristics and Dairy Operation Activities (Table 2)

The average herd size was 66.9 ± 36.7 cows per farm and the average dairy farmers were 2.1 ± 0.7 per farm. The average working duration was 19.9 ± 8.3 years and the longest work type was milking at 2.1 hours per day.

Table 5. Work-related musculoskeletal symptoms and dairy operation activities by body sites* (N=598)

	Neck WMS (%)	p-value	Shoul-ders WMS (%)	p-value	Arms/ Elbows WMS (%)	p-value	Hands/ Wrists/ Fingers WMS (%)	p-value	Low back WMS (%)	p-value	Legs/ Feet WMS (%)	p-value
Working duration (y)												
≤ 9	1.3	0.598	1.3	0.013	2.7	0.193	4.0	0.980	10.7	0.601	4.0	0.025
10 - 19	2.1		10.2		4.3		4.3		10.7		11.2	
≥ 20	2.4		11.9		6.0		4.2		12.2		13.7	
Cows per person												
< 30	2.5	0.634	11.3	0.326	5.7	0.499	3.5	0.454	11.7	0.929	12.0	0.824
≥ 30	1.9		8.9		4.4		4.8		11.4		11.4	
Caring for stalls (h/d)												
No	2.0	0.977	9.2	0.273	9.2	0.383	6.1	0.840	15.3	0.951	16.3	0.080
< 1	2.6		7.8		3.5		2.6		8.7		13.9	
1 - < 1.9	1.8		9.7		3.2		3.7		9.7		9.7	
≥ 2	2.4		12.5		6.0		4.8		13.7		10.1	
Feeding (h/d)												
No	1.3	0.579	11.7	0.938	7.8	0.892	7.8	0.210	10.4	0.781	13.0	0.199
< 1	3.4		6.9		2.6		4.3		12.1		12.9	
1 - < 1.9	2.6		11.8		4.4		3.1		13.1		13.5	
≥ 2	1.1		9.1		6.3		4.0		9.7		8.0	
Milking (h/d)												
No	3.4	0.795	8.6	0.463	8.6	0.234	3.4	0.593	5.2	0.024	5.2	0.291
< 2	1.9		12.1		3.8		3.8		10.2		12.1	
2 - < 3.9	2.0		10.2		5.9		4.3		11.8		12.8	
≥ 4	2.6		6.4		1.3		5.1		17.9		11.5	
Caring for calves (h/d)												
No	1.2	0.798	6.1	0.146	9.8	0.078	6.1	0.254	12.2	0.197	13.4	0.054
< 1	2.7		8.5		4.9		4.5		13.4		15.2	
1 - < 1.9	1.8		13.4		3.7		3.7		11.1		8.8	
≥ 2	2.7		9.3		4.0		2.7		6.7		8.0	
Cleaning stalls (h/d)												
No	3.2	0.711	8.1	0.590	6.5	0.388	5.6	0.140	15.3	0.024	14.5	0.158
< 1	0.7		10.5		3.9		5.9		15.1		11.8	
1 - < 1.9	3.0		10.9		6.1		2.6		8.3		11.7	
≥ 2	1.1		9.8		2.2		3.3		8.7		7.6	
Milk processing†												
No	2.2	1.000	9.8	0.081	4.9	0.228	4.2	1.000	11.6	1.000	11.6	0.465
Yes	0.0		40.0		20.0		0.0		0.0		20.0	

WMS: work-related musculoskeletal symptoms.
*Chi-square test or chi-square for trend test was used.
† Fisher's exact test was used.

Ⅲ. Prevalence of WMS (Table 3)

The highest prevalence of WMS by body site was the legs/feet (11.7%). The proportion of low back WMS was 11.5%, shoulders 10.0%, arms/elbows 5.0%, hands/wrists/fingers 4.2%, and neck 2.2%. The prevalence of WMS at any site was 33.3%, and the prevalence of WMS at two or more sites was 8.5%.

Ⅳ. WMS and Risk Factors (Table 4-6)

There were no important work-related risk factors for involving the neck, arms/elbows, hands/wrists/fingers, and legs/feet WMS. BMI, marital state, cows per person, and feeding were not important risk factors for WMS. Based on univariate analysis, gender was important in hands/wrists/fingers WMS, low back WMS, and legs/feet WMS. Education was important in shoulders WMS, low back WMS, and legs/feet WMS. Working duration was important in shoulders WMS and legs/feet WMS. Milking and cleaning stalls were important in low back WMS. Based on multiple logistic regression, working duration 20 years or more was significant in shoulders WMS. Education and milking 4 or more hours per day were significant in low back WMS.

A. Neck

There was no important risk factor based on univariate analysis.

B. Shoulders

Age (p=0.041), education (p=0.036), working duration (p=0.013), and milk processing (p=0.081) were important risk factors based on univariate analysis. The prevalence of shoulders WMS was decreased by higher education. Shoulders WMS increased with working duration. Based on multiple logistic regression, the adjusted odds ratio for working duration 20 years or more was 8.187 (95% CI=1.088-61.588) and statistically significant.

C. Arms/elbows

Smoking (p=0.080) and caring for calves (p=0.078) were important risk factors based on univariate analysis. The prevalence of arms/elbows WMS was decreased by smoking and caring for calves. Based on multiple logistic regression, there was no significant risk factor.

D. Hands/wrists/fingers

Gender (p=0.015), smoking (p=0.039), and alcohol (p=0.007) were important risk factors based on univariate analysis. The prevalence of hands/wrists/fingers WMS for women was higher than men and the prevalence of hands/wrists/fingers WMS was decreased by smoking and alcohol. In multiple logistic regression, there was no significant risk factor.

E. Low back

Gender (p=0.005), age (p=0.021), education (p<0.001), milking (p=0.024), and cleaning stalls (p=0.024) were important risk factors based on univariate analysis. The prevalence of low back WMS was decreased by higher education and cleaning stalls. In multiple logistic regression, the adjusted odds ratio of low back WMS for milking 4 or more hours per day was 4.231 (95% CI=1.124-15.932) and statistically significant. Also, low back WMS increased with the number of milking hours. The adjusted odds ratio of low back WMS for education was 2.827 (95% CI=1.545-5.174) and statistically significant.

F. Legs/Feet

Gender (p=0.008), education (p=0.003), smoking (p=0.080), working duration (p=0.025), caring for stalls (p=0.080), and caring for calves (p=0.054) were important risk factors based on univariate analysis. The prevalence of legs/feet WMS was decreased by smoking, higher education, caring for stalls, and caring for calves. In multiple logistic regression, there was no significant risk factor.

Table 6. Adjusted odds ratios between work-related musculoskeletal symptoms and risk factors

	Adjusted OR*	95% CI	p-value
Shoulders			
Working duration (y)			
≤ 9	1.000		
10 - 19	7.197	0.938-55.214	0.058
≥ 20	8.187	1.088-61.588	0.041
Gender			
Male	1.000		
Female	1.031	0.577-1.842	0.919
Education			
≤ Middle school or less	1.516	0.850-2.702	0.159
≥ High school or more	1.000		
Milk processing			
No	1.000		
Yes	5.743	0.888-37.151	0.066
Low back			
Working duration (y)			
≤ 9	1.000		
10 - 19	0.662	0.261-1.675	0.383
≥ 20	0.735	0.305-1.773	0.493
Gender			
Male	1.000		
Female	1.677	0.930-3.024	0.085
Education			
≤ Middle school or less	2.827	1.545-5.174	0.001
≥ High school or more	1.000		
Milking (h/d)			
No	1.000		
< 1	2.265	0.611-8.393	0.221
1 - 3.9	2.817	0.808-9.817	0.104
≥ 4	4.231	1.124-15.932	0.033
Cleaning stalls (h/d)			
No	1.024	0.419-2.499	0.959
< 1	2.087	0.864-5.043	0.102
1 - 1.9	1.783	0.679-4.681	0.241
≥ 2	1.000		

OR: odds ratio, CI: confidence interval.
*Adjusted for working duration, gender, and all important (p<0.10) risk factors except age.

DISCUSSION

Dairy farmers have to milk at least twice per day, otherwise cows may get mastitis. When dairy farmers milk, their postures are awkward and there is a burden placed on the upper extremities especially in the case of hand milking [9].

The milking machines are composed of a milking unit and a vacuum pump. The working postures when using milking machines are different according to the machine types. The milking systems are classified as a bucket milking system, a pipeline milking system, and a parlor milking system (tandem, herringbone, parallel, and rotary). In the bucket milking system, dairy farmers have to transport buckets and it places a burden on the musculoskeletal system. In the pipeline milking system,

dairy farmers have to wander around their cows with a bent posture. However, transport of buckets is not required. Transfer of buckets is not required for the parlor milking system either. In addition, the level of the working position in the parlor milking system is lower than the cow nipples by 65-90 cm, so dairy farmers bend their back less than in other milking systems. Thus, the burden on the musculoskeletal system is diminished [10].

According to the Korea Dairy and Beef Farming Association, in 2009 the proportion of herringbone and tandem parlor milking systems was 55%, and the proportion of pipeline milking system was 38%. Recently the hand milking and bucket milking system have rarely been used [11], so the burden on the musculoskeletal system for Korean dairy farmers may be smaller than in the past.

We analyzed the total rather than each survey component, because the participants' characteristics of the first and second survey were similar. The adjusted odds ratio of low back WMS for milking 4 or more hours per day was significant and low back WMS was increased by the number of milking hours per day. Other working types like cleaning stalls can have a negative impact on the musculoskeletal system, but they were not significant.

In low back MSDs, the risk factors in strong evidence are lifting/forceful movement and whole body vibration. The risk factors in evidence are awkward postures like bending or twisting and heavy physical work [3]. Awkward postures like bending or twisting are risk factors for farmers' low back pain [12,13]. Flexion and rotation of the trunk and lifting at work were moderate risk factors for low back pain in a prospective cohort study [14]. The adjusted odds ratio of low back WMS for education was 2.827 (95% CI=1.545-5.174) and low back WMS was decreased by education. The adjusted odds ratio of low back WMS for gender was 1.677 (95% CI=0.930-3.024), but it was not significant. If women do the same job, the prevalence of women's WMS may be higher than men because of the higher pain sensitivity and muscular activity [15].

The risk factors of shoulders MSDs were repetition and working postures (flexion or abduction) [3]. Milk processing was important for univariate analysis but was not significant for multiple logistic regression. Considering the dairy farmers doing milk processing were small in number (5), there was a limit to the interpretation of the association between WMS and milk processing. The association between WMS and working duration has to be interpreted considering the small number of WMS.

A study involving Finnish farmers indicated that farmers who milked regularly had a higher prevalence of upper limbs MSDs [16]. The wrist positions and movements are possible risk factors during machine milking [17]. However, there were no significant risk factors in arms/elbows and hands/wrists/fingers WMS. The decreased use of hand milking and the improvement in milking system might affect arms/elbows and hands/wrist/fingers WMS.

In neck MSDs, the risk factors in strong evidence were static or specific postures. The risk factors in evidence were repetition and force [3]. Flexion of the neck was a risk factor in other studies [18-20], but there were some discrepancies in the rotation of the neck [19,21]. The prevalence of neck WMS was low and there was no important risk factor for univariate analysis. The working posture of milking was not the flexed posture of the neck in the case of herringbone and tandem milking systems.

A study of MSS involving dairy farmers in southern Sweden using the Nordic questionnaires indicated that the male farmers in 2002 reported symptoms in the low back, shoulders, and knees (53.6%, 43.6%, and 37.7%, respectively) most frequently. The female farmers reported symptoms in the shoulders, low back, and wrists/hands (55.6%, 46.7%, and 46.2%, respectively) most frequently. The prevalence of low back and shoulders MSS was high, however, the results of legs/feet MSS were dissimilar because of the different classification of the lower limbs. In 1988 almost all dairy farmers were working in the old-fashioned tethering system, while in 2002 more than one-fourth of dairy farmers were working in the loose-housing system (parlor milking). Low back MSS decreased from 49.3% in 1998 to 42.0% in 2002, and knees MSS decreased from 35.3% in 1998 to 32.6% in 2002. The tethering system involves more loading work posture and more handling of manual materials than the loose-housing system, and in the tethering system the worker has to squat, kneel, or sit when milking while in the loose-housing system the worker is able to stand with a straight back [22].

Using the Nordic questionnaires, a study of neck and upper extremities MSS for Iowa dairy farmers in the USA indicated that the prevalence of neck MSS was 43%, shoulders 54%, elbows 24%, and wrists/hands 40%. These results have to be interpreted considering that the herd size (174.7 cows/farm) was higher than the current study (66.9 cows/farm) and the participants who performed the majority of the milking operations. The

highest milking facilities were the older stanchion facilities. The risk factors of neck MSS were manually feeding and tractor use. The risk factor of wrists/hands MSS was manually cleaning stalls [23].

The facilities and working conditions of dairy farmers are different for each country. The definition of MSS in Nordic questionnaires was the 12-month period prevalence of MSS, while the definition of WMS in this study included the 12-month period, duration, and severity. In the comparison study between the Nordic and NIOSH-style questionnaires (period and duration only), the sensitivity and specificity of the Nordic questionnaires were 73.9% and 68.0%, respectively, while the sensitivity and specificity of NIOSH-style questionnaires were 59.5% and 68.0% [24]. The different definitions between two questionnaires must be taken into consideration.

There have been some investigations on MSS among rural farmers in Korea. A study of musculoskeletal pain in 1991 resulted that the prevalence of low back pain was 40.7%, shoulders pain 20.6%, arms pain 14.1%, and lower legs pain 11.5% [25]. Another study using the Nordic questionnaires in 2001 showed that the prevalence of back MSS for men was 42.3%, legs/knees MSS 36.4%, shoulders MSS 21.4%, and arms/hands MSS 12.7%. The prevalence of low back MSS for women was 59.4%, legs/knees MSS 48.5%, shoulders MSS 20.2%, and arms/hands MSS 13.8%. Regardless of gender, the low back was the most prevalent body site, which may be due to more frequent bending and lifting [26].

There have been many investigations of WMS and MSS among diverse groups. A study among motor engine assembly plant workers using the same criteria resulted that the prevalence of shoulders WMS was 20.5%, low back 20.0%, knees/legs 13.3%, and neck 11.8%. The mean age of the plant workers was 31.4 years and the average working duration was 6.0 years [27]. A study among street cleaners using the same criteria resulted that the prevalence of upper limbs WMS was 27.9%, low back 19.7%, and legs 17.1%. They were mostly male workers (95.6%) and the mean age was 51.7 years. The average working duration was more than 10 years [28]. A study among shipbuilding workers using the same criteria and more exclusion criteria of injuries and diseases resulted that the prevalence of low back MSS was 28.2%, shoulders 26.1%, legs/knees 22.3%, and neck 17.6%. The mean age was more than 30 years and the average working duration was 7.6 years [29].

The prevalence of WMS in this study was not particularly high. First, more healthy people may have been selected because of the study design so that they must visit a public health center nearby or a branch of public health center. Second, the dairy farms in Korea are relatively small and working duration was shorter than in other countries. Third, the milking types and facilities might be improved and the burden on the musculoskeletal system could be less. And the recent increase of dairy farm size in Korea may also mean that dairy farms which have more advanced milking types or facilities are survived.

This study is a rare investigation on the WMS of dairy farmers in Korea, and the relationship between milking and low back WMS was statistically significant. Questions about milking types, manual work, and lifting were not included in the questionnaires. The results may be influenced by other factors except dairy operation activities which were not included in this study. The response rate was not high and some respondents' information was insufficient and could not be analyzed.

Dairy farmers have suffered from WMS, but they do not recognize WMS as an occupational disease. Dairy farmers must be educated about WMS, risk factors, and prevention. They have to exert an effort to prevent WMS for their health. More improved facilities and milking types can diminish the prevalence of WMS. We hope that there will be increased attention about WMS in dairy farmers and the subject of future investigations.

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