

Prevalence and Characteristics of Musculoskeletal Pain in Korean Farmers

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Objective To investigate the prevalence and characteristics of musculoskeletal pain (MSK) pain in Korean farmers using initial survey data of Farmers' Cohort for Agricultural Work-Related MSK pain (FARM) study.

Methods Farmers (534 females and 479 males; mean age 57.2±7.5 years) who owned or rented a farm and belonged to an agricultural cooperative unit were recruited. Presence of pain for each body part (neck, shoulder, arm/elbow, wrist/hand/finger, low back, leg/foot), and characteristics of MSK pain (prevalence, location, duration, severity, and frequency) during the last year was assessed. Additionally, demographic data such as farming duration, history of prior injury, and workload (low, moderate, somewhat hard, or hard) were collected using structured questionnaires.

Results Almost all subjects (n=925; 91.3%) complained of pain in more than one body part. The frequency order was low back (63.8%), leg/foot (43.3%), shoulder (42.9%), wrist/hand/finger (26.6%), arm/elbow (25.3%), and neck (21.8%). Low back pain was more frequent in those with over 30 years of farming experience (odds ratio [OR], 1.40; 95% confidence interval, 1.08–1.81). MSK pain was related to history of prior injury (OR, 2.18–5.24; p<0.05) in all body parts except for leg/foot, and very hard workload was associated with low back, leg/foot, neck, shoulder, and wrist/hand/finger pain (OR, 2.88–10.83; p<0.05).

Conclusion Most Korean farmers experience MSK pain; furthermore, there is a significant association between pain, history of prior injury, and workload, suggestive of the necessity of coping and preventive strategies to reduce injury or workload.

Keywords Agriculture, Musculoskeletal pain, Low back pain, Injuries, Workload

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INTRODUCTION

Farmers are at particular risk of developing agricultural work-related musculoskeletal (MSK) pain, because farming work consists of strenuous physical activities and high levels of manual labor, which has been considered a high-risk occupation for MSK disorders [1-3]. Likewise, Walker-Bone and Palmer [4] suggested that several physical risk factors for MSK pain (such as lifting and carrying heavy loads, work with the trunk flexed, and exposure to whole-body vibration) were present more frequently among farmers, and farmers more often have knee osteoarthritis and low back pain, as compared to the workers in occupations with fewer physical demands.

Agricultural work-related MSK pain may lead to further negative consequences such as reduced work ability, lower farm income, poorer quality of life, and the onset of other health problems such as stress or depression. Since medical expenses and loss of the labor force are enormous, developed countries have started to pay attention to these problems [5,6]. In Korea, regulation for prevention and management of MSK pain was established by law; however, the priority was industrial manufacturing business and did not include farmers as a result of their comparatively small numbers and cultivation [7]. Studies on the prevalence and characteristics of MSK pain and its related risk factors are required to improve the health condition of farmers, as well as the supportive legislative system.

Several studies have focused on MSK in Korean farmers. Sun et al. [8] reported that almost all recruited Korean farmers had pain and discomfort in their back, shoulders, or arms, but they did not use structured questionnaire. Lee [2] reported high rates of MSK such as back pain and knee osteoarthritis, however, they were unable to distinguish the influence between work-related and natural aging effects. Another systemic survey about the work-related MSK among the dairy farmers showed that the prevalence of MSK pain at any body site was 33.3% suggesting limited application to general farmers due to the relatively low population of dairy farmers [3]. In terms of agricultural work-related injuries, several studies only reported incidence and cause of injuries, and did not show the association between MSK pain and related injuries [9,10]. Thus, systematic survey on MSK pain and related factors (sociodemographic, health characteristics

and agricultural work-related factors) is needed.

Therefore, the purpose of this study was to examine the prevalence and characteristics of agricultural work-related MSK pain, and its association with farming duration, history of prior injury, workload, and type of farming among Korea farmers based on a large sample and a standard questionnaire developed by the Korean Occupational Safety and Health Agency (KOSHA) [11].

MATERIALS AND METHODS

Subjects

We performed a cross-sectional analysis for initial survey data of Farmers' Cohort for Agricultural Work-Related MSK pain (FARM) study [12], which recruited active farmers who owned or rented a farm and belonged to an agricultural cooperative unit. Local representatives of the National Agricultural Cooperative Federation verified farmer status. The study took place from September 2013 to June 2014. A total of 1,027 farmers in the Gangwon province in South Korea completed the survey. Fourteen subjects (4 amputees, 1 very low weight individual [37.7 kg], and 9 non-farmers) were excluded. Thus, a total of 1,013 subjects were included in the analysis (Fig. 1).

This study was conducted by the Center for Farmers' Safety and Health at Kangwon National University Hospital, and was approved by the Institutional Review Board of the Kangwon National University Hospital (IRB No. 2013-06-009-007). Written informed consent was obtained from all participants in the study.

Questionnaire

Age (<65 vs. ≥65 years), gender, farming period (<30 vs. ≥30 years), previous employment period (years), marital status (single/married), working hours a day (<10, 10-12, ≥12 hours), regular leisure activities, housework time per

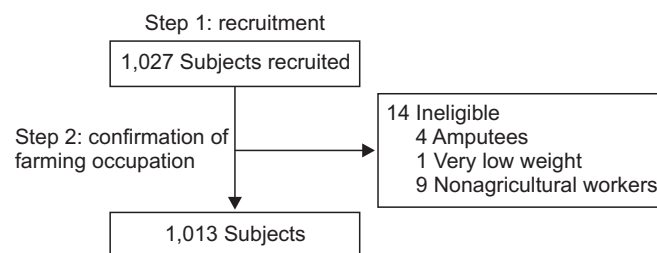


Fig. 1. Inclusion flowchart.

day (rarely, <1, 1-2, 2-3, ≥3 hours), history of prior injury (yes/no), injury location (neck, shoulder, arm/elbow, wrist/hand/finger, low back, leg/foot), and severity of workload (low, moderate, somewhat hard, very hard) of the research subjects were surveyed using a structured questionnaire. In addition, type of farming was classified into 4 types: rice farming (rice), dry fields farming (e.g., corn, potato), greenhouses farming (e.g., cucumber, tomato), and orchards farming (e.g., apple, peach).

The questionnaire was the standard questionnaire for one-year self-reported prevalence and characteristics of MSK pain, which was developed by the KOSHA [11]. The case definition of MSK symptoms was as follows: 1) those who felt musculoskeletal symptoms during the past 12 months in any body part, and 2) the symptom lasted over a week or the symptom was observed more than once a month during the past year.

Respondents were asked to answer questions about presence of pain (yes or no), pain location (neck, neck, shoulder, arm/elbow, wrist/hand/finger, low back, leg/foot), specific side of pain (left/right/both), duration (<1 day, 1 day-1 week, 1 week-1 month, 1 month-6 months, ≥6 months), severity (mild, moderate, severe, very severe), frequency (semiannually, quarterly, monthly, weekly, daily), presence of pain within 1 week (yes or no), and consequence of pain (visit clinic, visit pharmacy, sick leave, change job, do nothing or etc.) during the past 12 months.

Statistics

Statistical analyses were conducted using SPSS ver. 21.0 (IBM, Armonk, NY, USA) and the detailed statistical methodology was as follows. Descriptive statistics were conducted to analyze the subjects' general characteristics and frequency of pain characteristics. Logistic regression analysis was used to calculate the odds ratio (OR) of various risk factors with respect to each body part where MSK pain was present. Significance was accepted at $p < 0.05$ and 95% confidence intervals (CI) were calculated. Variables with $p < 0.20$ in univariate analyses were examined in multivariate binary logistic regression models.

RESULTS

The average age of the 1,013 subjects was 57.15 ± 7.52 years old. Of all subjects, 479 (47.3%) were male and 534

(52.7%) were female. In addition, 78.8% of farmers were under 65 years old, which is relatively high. Farmers who had worked longer than 30 years made up 53.0% of the sample, 361 (35.6%) had history of injury. The total number of subjects who undertook no regular leisure activities was 895 (88.4%). Eighteen (1.8%) male farmers worked ≥3 hours a day in the home, as compared to 225 (22.2%) of female farmers who did so. Of those reporting a very hard workload, 225 (22.2%) were female and 141 (13.9%) were male. Females reported longer amounts of time doing housework ($\chi^2 = 584.84$, $p < 0.01$), and felt their work was hard more often than males ($\chi^2 = 24.00$, $p < 0.01$). Other demographic characteristics were described in Table 1.

Frequency analysis of the symptoms of musculoskeletal disorder revealed 925 subjects (91.3%) had pain in ≥1 area. The 1-year prevalence rates for MSK were as follows: low back (63.8%), leg/foot (43.3%), shoulder (42.9%), wrist/hands/finger (26.6%), arm/elbow (25.3%), and neck (21.8%). Thus, the low back was the most affected anatomical region. In terms of frequency of daily pain, the order was neck (30.3%), shoulder (42.8%), arm/elbow (41.0%), wrist/hand/finger (43.1%), low back (43.8%), and leg/foot (48.7%). For all body parts, pain duration of 1 day-1 week was most common, followed by ≤6 months. Neck (39.8%), shoulder (38.4%), low back (34.8%), arm/elbow (30.5%), wrist/hand/finger (30.5%), and leg/foot (30.1%) had 1 day-1 week pain duration; and low back (31.1%), leg/foot (29.6%), wrist/hand/finger (29.4%), arm/elbow (27.7%), shoulder (26.4%), and neck (21.7%) had pain duration of ≥6 months. Regarding the severity of pain, a moderate degree of MSK pain was most common in all body parts as follows: low back (45.8%), leg/foot (44.9%), shoulder (44.4%), arm/elbow (44.1%), neck (41.6%), and wrist/hand/finger (41.6%).

Concerning the frequency of pain, pain for approximately 1-7 days was also most common in the neck (39.8%), shoulder (38.4%), low back (34.8%), arm/elbow (30.5%), wrist/hand/finger (30.5%), and leg/foot (30.1%). Health care consultation as a consequence of MSK pain was most frequently visiting a clinic for all body parts: low back (59.4%), leg/foot (54.0%), shoulder (51.0%), neck (48.4%), arm/elbow (43.4%), and wrist/hand/finger (36.1%). However, although many subjects had MSK pain, most did nothing to overcome their pain in the wrist/hand/finger (39.8%), arm/elbow (36.7%), neck

Table 1. Demographic characteristics of enrolled subjects

Variable	Male	Female
Sex	479 (47.3)	534 (52.7)
Age (yr)	57.2±7.5	
<65	798 (78.8)	
≥65	215 (21.2)	
Farming period (yr)	27.8±14.1	
<30	476 (47.0)	
≥30	537 (53.0)	
Marital status		
Single	90 (8.9)	
Married	923 (91.1)	
Working time per day (hr)		
<10	162 (16.0)	186 (18.4)
10-12	114 (11.3)	121 (11.9)
≥12	203 (20.0)	227 (22.4)
Previous employment period (yr)	5.2±9.0	
Regular leisure activities		
No regular leisure activities	895 (88.4)	
Computer-related	47 (4.6)	
Musical instrument (piano, violin, etc.)	22 (2.2)	
Crochet, calligraphy	15 (1.5)	
Tennis/badminton/squash	19 (1.9)	
Football/basketball/ski/ foot volley ball	15 (1.5)	
House working time per day (hr)		
Rarely	250 (24.7)	6 (0.6)
<1	143 (14.1)	42 (4.1)
1-2	56 (5.5)	152 (15.0)
2-3	12 (1.2)	109 (10.8)
≥3	18 (1.8)	225 (22.2)
History of injury		
No	652 (61.7)	
Yes	361 (35.6)	
Workload		
Low	23 (2.3)	15 (1.5)
Moderate	186 (18.4)	144 (14.2)
Somewhat hard	129 (12.7)	154 (15.2)
Very hard	141 (13.9)	221 (21.8)
Type of farming		
Rice farming	157 (15.5)	
Dry fields farming	420 (41.5)	
Greenhouses farming	311 (30.7)	
Orchards farming	125 (12.3)	

Values are presented as number (%) or mean±standard deviation.

(31.2%), leg/foot (29.4%), shoulder (28.7%), and low back (23.4%) (Table 2).

Our results indicated that subjects aged over 65 years had more leg/foot (OR, 1.49; 95% CI, 1.10-2.02; $p=0.009$) pain than those under 65. However, this result was not statistically significant for neck, shoulder, arm/elbow, wrist/hand/finger and low back pain. Significant associations between MSK pain and history of prior injury were found for the neck (OR, 4.65; 95% CI, 2.61-8.29; $p<0.001$), shoulder (OR, 2.18; 95% CI, 1.18-4.06; $p<0.001$), arm/elbow (OR, 2.29; 95% CI, 1.55-5.25; $p<0.001$), wrist/hand/finger (OR, 2.70; 95% CI, 1.62-4.53; $p<0.001$), and low back (OR, 5.24; 95% CI, 2.76-9.94; $p<0.001$). The only non-significant relationship was for the leg/foot (OR, 1.00; 95% CI, 0.68-1.47; $p=0.540$). The influence of a very hard workload on the prevalence of pain was significant for MSK pain in the shoulder (OR, 2.89; 95% CI, 1.37-6.13; $p=0.006$), wrist/hand/finger (OR, 2.88; 95% CI, 1.10-7.58; $p=0.032$), low back (OR, 10.83; 95% CI, 4.93-23.79; $p<0.001$), and leg/foot (OR, 3.92; 95% CI, 1.75-8.78; $p<0.001$). Relative risk of dry fields farming was 1.64 times higher than rice farming (OR, 1.64; 95% CI, 1.02-2.63; $p=0.042$). Female farmers showed higher prevalence of pain in the neck (OR, 1.83; 95% CI, 1.35-2.50; $p<0.001$), shoulder (OR, 2.12; 95% CI, 1.64-2.73; $p<0.001$), wrist/hand/finger (OR, 3.39; 95% CI, 2.49-4.60; $p<0.001$), low back (OR, 2.20; 95% CI, 1.69-2.85; $p<0.001$) and leg/foot (OR, 2.04; 95% CI, 1.58-2.63; $p<0.001$). The only body part that was non-significant was the arm/elbow. Low back pain was more prevalent among those in the >30 years of farming period group than in the <30 years group (OR, 1.40; 95% CI, 1.08-1.81). However, the prevalence of MSK pain in the neck (OR, 0.64; 95% CI, 0.48-0.87) and wrist/hand/finger (OR, 0.71; 95% CI, 0.54-0.94) were lower in subjects who were engaged in farming over 30 years. Working >12 hours a day was a significant contributing factor to wrist/hand/finger pain (OR, 1.50; 95% CI, 1.09-2.07) (Table 3).

Multivariate analysis indicated that the prevalence of neck pain was significant for >30 years of farming duration, 2-3 hours of work in the home, presence of prior injury, and very hard workload. Shoulder pain was more prevalent among females, subjects with history of prior injury, and those with a very hard workload. Doing >3 hours of housework a day and history of prior injury remained factors significantly related to arm/elbow pain.

Table 2. Prevalence and characteristics of one-year self-reported musculoskeletal pain

Variable	Pain					
	Neck	Shoulder	Arm/elbow	Wrist/hand/ finger	Low back	Leg/foot
No	792 (78.2)	578 (57.1)	757 (74.7)	744 (73.4)	367 (36.2)	574 (56.7)
Yes	221 (21.8)	435 (42.9)	256 (25.3)	269 (26.6)	646 (63.8)	439 (43.3)
Location						
Right	-	123 (28.3)	98 (38.3)	68 (25.3)	-	108 (24.6)
Left	-	79 (18.2)	39 (15.2)	30 (11.2)	-	94 (21.4)
Both	-	216 (49.7)	105 (41.0)	153 (56.9)	-	199 (45.3)
Non-response	-	17 (3.9)	14 (5.5)	18 (6.7)	-	38 (8.7)
Duration						
<1 day	56 (25.3)	93 (21.4)	67 (26.2)	63 (23.4)	124 (19.2)	115 (26.2)
1 day-1 wk	88 (39.8)	167 (38.4)	78 (30.5)	82 (30.5)	225 (34.8)	132 (30.1)
1 wk-1 mo	22 (10.0)	37 (8.5)	22 (8.6)	26 (9.7)	65 (10.1)	33 (7.5)
1-6 mo	6 (2.7)	19 (4.4)	17 (6.6)	16 (5.9)	29 (4.5)	23 (5.2)
≥6 mo	48 (21.7)	115 (26.4)	71 (27.7)	79 (29.4)	201 (31.1)	130 (29.6)
Non-response	1 (0.5)	4 (0.9)	1 (0.4)	3 (1.1)	2 (0.3)	6 (1.4)
Severity						
Mild	78 (35.3)	132 (30.3)	85 (33.2)	99 (36.8)	127 (19.7)	133 (30.3)
Moderate	92 (41.6)	193 (44.4)	113 (44.1)	112 (41.6)	296 (45.8)	197 (44.9)
Severe	46 (20.8)	97 (22.3)	52 (20.3)	48 (17.8)	186 (28.8)	92 (21.0)
Very severe	3 (1.4)	13 (3.0)	5 (2.0)	8 (3.0)	33 (5.1)	16 (3.6)
Non-response	2 (0.9)	0 (0.0)	1 (0.4)	2 (0.7)	4 (0.6)	1 (0.2)
Frequency						
Semiannually	22 (10.0)	29 (6.7)	15 (5.9)	19 (7.1)	52 (8.0)	35 (8.0)
Quarterly	36 (16.3)	67 (15.4)	39 (15.2)	30 (11.2)	92 (14.2)	54 (12.3)
Monthly	39 (17.6)	65 (14.9)	36 (14.1)	43 (16.0)	90 (13.9)	72 (16.4)
Weekly	54 (24.4)	86 (19.8)	59 (23.0)	58 (21.6)	125 (19.3)	61 (13.9)
Daily	67 (30.3)	186 (42.8)	105 (41.0)	116 (43.1)	283 (43.8)	214 (48.7)
Non-response	3 (1.4)	2 (0.5)	2 (0.8)	3 (1.1)	4 (0.6)	3 (0.7)
Presence of pain within 1 wk						
Yes	150 (67.9)	317 (72.9)	185 (72.3)	200 (74.3)	468 (72.4)	330 (75.2)
No	68 (30.8)	116 (26.7)	69 (27.0)	68 (25.3)	172 (26.6)	106 (24.1)
Non-response	3 (1.4)	2 (0.5)	2 (0.8)	1 (0.4)	6 (0.9)	3 (0.7)
Consequence of pain						
Visit clinic	107 (48.4)	222 (51.0)	111 (43.4)	97 (36.1)	384 (59.4)	237 (54.0)
Visit pharmacy	17 (7.7)	32 (7.4)	15 (5.9)	18 (6.7)	34 (5.3)	24 (5.5)
Sick leave	16 (7.2)	29 (6.7)	22 (8.6)	26 (9.7)	46 (7.1)	29 (6.6)
Change job	5 (2.3)	10 (2.3)	4 (1.6)	6 (2.2)	6 (0.9)	5 (1.1)
Do nothing	69 (31.2)	125 (28.7)	94 (36.7)	107 (39.8)	151 (23.4)	129 (29.4)
Etc.	5 (2.3)	11 (2.5)	5 (2.0)	8 (3.0)	17 (2.6)	10 (2.3)
Non-response	2 (0.9)	6 (1.4)	5 (2.0)	7 (2.6)	8 (1.2)	5 (1.1)

Values are presented as number (%).

Table 3. The association between musculoskeletal pain and demographic data inferred from univariate logistic regression analyses

Variable	Neck pain			Shoulder pain			Arm/elbow pain		
	No. (%)	OR (95% CI)	p-value	No. (%)	OR (95% CI)	p-value	No. (%)	OR (95% CI)	p-value
Age (yr)									
<65	179 (22.4)	1.00		348 (43.6)	1.00		203 (25.4)	1.00	
≥65	42 (19.5)	0.84 (0.58-1.22)	0.362	87 (40.5)	0.88 (0.65-1.19)	0.409	53 (24.7)	0.96 (0.68-1.36)	0.814
Gender									
Male	79 (16.5)	1.00		160 (33.4)	1.00		106 (22.1)	1.00	
Female	142 (26.6)	1.83 (1.35-2.50)	<0.001**	275 (51.5)	2.12 (1.64-2.73)	<0.001**	150 (28.1)	1.37 (1.03-1.83)	1.375
Farming period (yr)									
<30	123 (25.8)	1.00		213 (44.7)	1.00		130 (27.3)	1.00	
≥30	98 (18.2)	0.64 (0.48-0.87)	0.002**	222 (41.3)	0.87 (0.68-1.12)	0.152	126 (23.5)	0.82 (0.61-1.08)	0.091
Marital status									
Single	13 (14.4)	1.00		39 (43.3)	1.00		19 (21.1)	1.00	
Married	208 (22.5)	1.72 (0.94-3.16)	0.079	396 (42.9)	0.98 (0.63-1.52)	0.937	237 (25.7)	1.29 (0.76-2.19)	0.342
Working time per day (hr)									
<10	72 (20.7)	1.00		145 (41.7)	1.00		77 (22.1)	1.00	
10-12	60 (25.5)	1.31 (0.89-1.94)	0.171	102 (43.4)	1.07 (0.77-1.50)	0.677	64 (27.2)	1.32 (0.90-1.93)	0.158
≥12	89 (20.7)	1.00 (0.71-1.42)	0.998	188 (43.7)	1.09 (0.82-1.45)	0.565	115 (26.7)	1.28 (0.92-1.79)	0.138
Regular leisure activities									
Yes	31 (26.3)	1.00		56 (47.5)	1.00		37 (31.4)	1.00	
No	190 (21.3)	0.76 (0.49-1.18)	0.216	379 (42.4)	0.81 (0.55-1.20)	0.297	219 (24.5)	0.71 (0.47-1.08)	0.108
House working time per day (hr)									
Rarely	35 (13.7)	1.00		79 (30.9)	1.00		52 (20.3)	1.00	
<1	37 (20.0)	1.58 (0.95-2.62)	0.078	73 (39.5)	1.46 (0.98-2.17)	0.061	43 (23.2)	1.19 (0.75-1.88)	0.460
1-2	46 (22.1)	1.79 (1.10-2.91)	0.018*	96 (46.2)	1.92 (1.31-2.81)	0.001**	55 (26.4)	1.41 (0.91-2.17)	0.120
2-3	36 (29.8)	2.67 (1.58-4.54)	<0.001**	63 (52.1)	2.43 (1.56-3.80)	<0.001**	33 (27.3)	1.47 (0.89-2.43)	0.132
≥3	67 (27.6)	2.40 (1.53-3.79)	<0.001**	124 (51.0)	2.33 (1.62-3.36)	<0.001**	73 (30.0)	1.68 (1.12-2.54)	0.013*
History of injury									
No	194 (20.1)	1.00		408 (42.1)	1.00		235 (24.3)	1.00	
Yes	27 (54.0)	4.65 (2.61-8.29)	<0.001**	27 (61.4)	2.18 (1.18-4.06)	0.010*	21 (47.7)	2.29 (1.55-5.25)	<0.001**
Workload									
Low	3 (7.9)	1.00		10 (26.3)	1.00		7 (18.4)	1.00	
Moderate	63 (19.1)	2.75 (0.82-9.24)	0.101	120 (36.4)	1.60 (0.75-3.41)	0.223	82 (24.8)	1.46 (0.62-3.45)	0.383
Somewhat hard	59 (20.8)	3.07 (0.91-10.34)	0.070	121 (42.8)	2.09 (0.98-4.47)	0.057	67 (23.7)	1.37 (0.58-3.26)	0.472
Very hard	96 (26.5)	4.21 (1.27-14.01)	0.019*	184 (50.8)	2.89 (1.37-6.13)	0.006**	100 (27.6)	1.69 (0.72-3.96)	0.227
Type of farming									
Rice farming	26 (16.6)	1.00		60 (38.2)	1.00		33 (21.0)	1.00	
Dry fields farming	103 (24.5)	1.64 (1.02-2.63)	0.042*	167 (39.8)	1.07 (0.73-1.56)	0.735	117 (27.9)	1.45 (0.94-2.25)	0.097
Greenhouses farming	62 (19.9)	1.25 (0.76-2.08)	0.378	148 (47.6)	1.47 (0.99-2.17)	0.055	80 (25.7)	1.30 (0.82-2.06)	0.262
Orchards farming	30 (24.0)	1.59 (0.88-2.86)	0.122	60 (48.0)	1.49 (0.93-2.40)	0.099	26 (20.8)	0.99 (0.55-1.76)	0.964

OR, odds ratio; CI, confidence interval.

*p<0.05, **p<0.01 by univariate logistic regression analysis.

Table 3. Continued

Variable	Wrist/hand/finger pain			Low back pain			Leg/foot pain		
	No. (%)	OR (95% CI)	p-value	No. (%)	OR (95% CI)	p-value	No. (%)	OR (95% CI)	p-value
Age (yr)									
<65	223 (27.9)	1.00		502 (62.9)	1.00		329 (41.2)	1.00	
≥65	46 (21.4)	0.70 (0.49-1.01)	0.054	144 (67.0)	1.20 (0.87-1.64)	0.271	110 (51.2)	1.49 (1.10-2.02)	0.009**
Gender									
Male	71 (14.8)	1.00		260 (54.3)	1.00		164 (34.2)	1.00	
Female	198 (37.1)	3.39 (2.49-4.60)	<0.001**	386 (72.3)	2.20 (1.69-2.85)	<0.001**	275 (51.5)	2.04 (1.58-2.63)	<0.001**
Farming period (yr)									
<30	143 (30.0)	1.00		284 (59.7)	1.00		195 (41.0)	1.00	
≥30	126 (23.5)	0.71 (0.54-0.94)	0.011*	362 (67.4)	1.40 (1.08-1.81)	0.006**	244 (45.4)	1.20 (0.94-1.54)	0.085
Marital status									
Single	22 (24.4)	1.00		57 (63.3)	1.00		48 (53.3)	1.00	
Married	247 (26.8)	1.13 (0.68-1.87)	0.635	589 (63.8)	1.02 (0.65-1.60)	0.928	391 (42.4)	0.64 (0.42-0.99)	0.046
Working time per day (hr)									
<10	80 (23.0)	1.00		209 (60.1)	1.00		145 (41.7)	1.00	
10-12	56 (23.8)	1.05 (0.71-1.55)	0.814	152 (64.7)	1.22 (0.86-1.72)	0.260	103 (43.8)	1.09 (0.78-1.53)	0.604
≥12	133 (30.9)	1.50 (1.09-2.07)	0.014*	285 (66.3)	1.31 (0.97-1.75)	0.073	191 (44.4)	1.12 (0.84-1.49)	0.441
Regular leisure activities									
Yes	38 (32.2)	1.00		73 (61.9)	1.00		46 (39.0)	1.00	
No	230 (25.7)	0.73 (0.48-1.10)	0.135	572 (64.0)	1.10 (0.74-1.63)	0.653	393 (44.0)	1.23 (0.83-1.82)	0.306
House working time per day (hr)									
Rarely	37 (14.5)	1.00		144 (56.3)	1.00		84 (32.8)	1.00	
<1	44 (23.8)	1.85 (1.14-3.00)	0.013*	103 (55.7)	0.98 (0.67-1.43)	0.905	74 (40.0)	1.37 (0.92-2.02)	0.121
1-2	60 (28.8)	2.40 (1.52-3.80)	<0.001**	141 (67.8)	1.64 (1.12-2.40)	0.011*	110 (52.9)	2.30 (1.58-3.35)	<0.001**
2-3	37 (30.6)	2.61 (1.55-4.39)	<0.001**	86 (71.1)	1.91 (1.20-3.04)	0.006*	54 (44.6)	1.65 (1.06-2.57)	0.027*
≥3	91 (37.4)	3.54 (2.29-5.47)	<0.001**	172 (70.8)	1.88 (1.30-2.73)	0.001*	117 (48.1)	1.90 (1.32-2.73)	0.001**
History of injury									
No	239 (25.2)	1.00		556 (61.0)	1.00		387 (43.3)	1.00	
Yes	30 (47.6)	2.70 (1.62-4.53)	<0.001**	90 (89.1)	5.24 (2.76-9.94)	<0.001**	52 (43.3)	1.00 (0.68-1.47)	0.540
Workload									
Low	5 (13.2)	1.00		9 (23.7)	1.00		8 (21.1)	1.00	
Moderate	68 (20.6)	1.71 (0.64-4.55)	0.281	185 (56.1)	4.11 (1.89-8.96)	<0.001**	114 (34.5)	1.98 (0.88-4.46)	0.099
Somewhat hard	86 (30.4)	2.88 (1.09-7.63)	0.033*	173 (61.1)	5.07 (2.31-11.11)	<0.001**	132 (46.6)	3.28 (1.45-7.40)	0.004**
Very hard	110 (30.4)	2.88 (1.10-7.58)	0.032*	279 (77.1)	10.83 (4.93-23.79)	<0.001**	185 (51.1)	3.92 (1.75-8.78)	0.001**
Type of farming									
Rice farming	40 (25.5)	1.00		99 (63.1)	1.00		63 (40.1)	1.00	
Dry fields farming	109 (26.0)	1.03 (0.67-1.56)	0.908	271 (64.5)	1.07 (0.73-1.56)	0.744	187 (44.5)	1.20 (0.82-1.74)	0.343
Greenhouses farming	94 (30.2)	1.27 (0.82-1.95)	0.284	203 (65.3)	1.10 (0.74-1.64)	0.636	136 (43.7)	1.16 (0.79-1.71)	0.457
Orchards farming	26 (20.8)	0.77 (0.44-1.35)	0.357	73 (58.4)	0.82 (0.51-1.33)	0.426	53 (42.4)	1.10 (0.68-1.77)	0.700

OR, odds ratio; CI, confidence interval.

*p<0.05, **p<0.01 by univariate logistic regression analysis.

Table 4. Related factors with musculoskeletal pain inferred from multivariate logistic regression analyses

Variable	Neck pain		Shoulder pain		Arm/elbow pain	
	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value
Age (yr)						
<65	-	-	-	-	-	-
≥65	-	-	-	-	-	-
Gender						
Male	1.00	1.00	1.00	1.00	1.00	1.00
Female	1.20 (0.74-1.94)	0.470	1.77 (1.18-2.64)	0.006**	-	-
Farming period (yr)						
<30	1.00	1.00	1.00	1.00	1.00	1.00
≥30	0.63 (0.46-0.87)	0.005**	0.81 (0.62-1.06)	0.131	0.85 (0.63-1.15)	0.287
Marital status						
Single	-	-	-	-	-	-
Married	-	-	-	-	-	-
Working time per day (hr)						
<10	1.00	1.00	1.00	1.00	1.00	1.00
10-12	1.31 (0.86-1.99)	0.204	-	-	1.38 (0.93-2.05)	0.108
≥12	0.95 (0.65-1.39)	0.801	-	-	1.34 (0.95-1.89)	0.100
Regular leisure activities						
Yes	-	-	-	-	1.00	1.00
No	-	-	-	-	0.73 (0.47-1.13)	0.162
House working time per day (hr)						
Rarely	1.00	1.00	1.00	1.00	1.00	1.00
<1	1.57 (0.92-2.68)	0.095	1.35 (0.89-2.05)	0.160	1.18 (0.74-1.88)	0.488
1-2	1.49 (0.80-2.76)	0.208	1.29 (0.79-2.11)	0.302	1.34 (0.86-2.08)	0.196
2-3	2.06 (1.03-4.13)	0.042*	1.50 (0.84-2.67)	0.171	1.57 (0.94-2.62)	0.084
≥3	1.86 (0.98-3.56)	0.059	1.41 (0.84-2.38)	0.195	1.61 (1.06-2.45)	0.025*
History of injury						
No	1.00	1.00	1.00	1.00	1.00	1.00
Yes	4.14 (2.27-7.54)	<0.001**	2.64 (1.38-5.06)	0.003**	2.93 (1.58-5.45)	0.001**
Workload						
Low	1.00	1.00	1.00	1.00	-	-
Moderate	3.09 (0.89-10.75)	0.077	1.52 (0.70-3.31)	0.288	-	-
Somewhat hard	3.47 (0.99-12.15)	0.052	1.94 (0.89-4.24)	0.095	-	-
Very hard	4.62 (1.33-16.14)	0.016*	2.48 (1.14-5.40)	0.022*	-	-
Type of farming						
Rice farming	1.00	1.00	1.00	1.00	1.00	1.00
Dry fields farming	1.41 (0.86-2.31)	0.170	0.93 (0.63-1.38)	0.729	1.36 (0.87-2.13)	0.183
Greenhouses farming	1.05 (0.61-1.80)	0.853	1.40 (0.92-2.11)	0.113	1.19 (0.73-1.92)	0.485
Orchards farming	1.36 (0.74-2.50)	0.320	1.47 (0.90-2.41)	0.128	0.94 (0.52-1.69)	0.823

OR, odds ratio; CI, confidence interval.

*p<0.05, **p<0.01 by multivariate logistic regression analysis.

Table 4. Continued

Variables	Wrist/hand/finger pain		Low back pain		Leg/foot pain	
	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value
Age (yr)						
<65	-	-	-	-	1.00	-
≥65	-	-	-	-	1.50 (1.08-2.06)	0.014*
Gender						
Male	1.00	-	1.00	-	1.00	-
Female	3.88 (2.35-6.42)	<0.001**	2.13 (1.39-3.24)	<0.001**	1.92 (1.29-2.86)	0.001**
Farming period (yr)						
<30	1.00	-	1.00	-	1.00	-
≥30	0.67 (0.49-0.91)	0.011*	1.27 (0.97-1.68)	0.087	1.06 (0.81-1.38)	0.674
Marital status						
Single	-	-	-	-	1.00	-
Married	-	-	-	-	0.76 (0.48-1.20)	0.232
Working time per day (hr)						
<10	1.00	-	1.00	-	-	-
10-12	0.96 (0.63-1.47)	0.867	1.12 (0.77-1.62)	0.565	-	-
≥12	1.43 (1.00-2.02)	0.047*	1.08 (0.78-1.49)	0.646	-	-
Regular leisure activities						
Yes	1.00	-	-	-	-	-
No	0.69 (0.44-1.09)	0.115	-	-	-	-
House working time per day (hr)						
Rarely	1.00	-	1.00	-	1.00	-
<1	1.34 (0.79-2.27)	0.271	0.84 (0.56-1.27)	0.415	1.14 (0.76-1.73)	0.523
1-2	0.86 (0.46-1.61)	0.645	0.97 (0.59-1.59)	0.904	1.43 (0.88-2.31)	0.148
2-3	0.81 (0.40-1.63)	0.550	0.96 (0.52-1.76)	0.894	0.87 (0.49-1.55)	0.641
≥3	1.03 (0.54-1.95)	0.938	0.85 (0.50-1.47)	0.565	0.99 (0.59-1.66)	0.975
History of injury						
No	1.00	-	1.00	-	-	-
Yes	3.03 (1.74-5.28)	<0.001**	4.84 (2.50-9.33)	<0.001**	-	-
Workload						
Low	1.00	-	1.00	-	1.00	-
Moderate	1.75 (0.64-4.80)	0.279	3.73 (1.68-8.29)	0.001**	1.91 (0.83-4.37)	0.127
Somewhat hard	2.67 (0.97-7.33)	0.057	4.24 (1.89-9.51)	<0.001**	2.97 (1.29-6.83)	0.010*
Very hard	2.51 (0.91-6.89)	0.075	8.23 (3.64-18.58)	<0.001**	3.42 (1.49-7.83)	0.004**
Type of farming						
Rice farming	-	-	-	-	-	-
Dry fields farming	-	-	-	-	-	-
Greenhouses farming	-	-	-	-	-	-
Orchards farming	-	-	-	-	-	-

OR, odds ratio; CI, confidence interval.

*p<0.05, **p<0.01 by multivariate logistic regression analysis.

For wrist/hand/finger pain key, factors included being female, over 30 years of farming period, working over 12 hours a day, history of prior injury were related, and for low back pain key, female, history of prior injury, and workload severity were related significantly. For pain in the leg/foot, related factors included old age, female gender, and very hard workload. Table 4 listed the result of multivariate logistic regression analysis for each factor.

DISCUSSION

Farming is a physically arduous occupation and many farmers are at potential risk of developing MSK pain because of chronic cumulative or high intensity workload. The purpose of this study was to verify the prevalence and characteristics of MSK pain in Korean farmers. Previous studies using the KOSHA structured questionnaire reported that Korean farmers showed higher prevalence of MSK pain than other occupational clusters in Korea during the previous 12 months [13-16]. Many agricultural workloads are physically very strenuous because of the repetitive motions, awkward postures, forceful exertion, and stress level, and farmers are at particular risk of developing MSK pain, as compared with other workers [4,17,18].

Previous systematic review for prevalence of MSK disorders among farmers reported that low back is the most common painful body region followed by upper and then lower extremity, and the prevalence of MSK disorder in farmers is greater than in non-farmers [19]. In this study, the most frequent painful body part was also low back, followed by the leg/foot and shoulder. The pain location may be different according to the body part used, degree of muscle activity, and working environment [20]. The National Institute for Occupational Safety and Health reported that repeated work, excessive force, and improper working postures cumulatively affected MSK system symptoms in the arm/wrist/hand region. Furthermore, the neck/shoulder region was affected by improper working postures, and the lumbar region was affected by lifting, hard physical work, or systemic vibrations [21]. Therefore, we can easily assume the farming activities are related to pain in various body parts, and then recommend coping strategies or modifications for risky farming activities.

Workload is also known to be a significant risk factor

for MSK pain [22]. Oliveira Dantas and de Lima [23] assessed the relationship between physical load and MSK complaints among dentists; they concluded that there was a high prevalence of MSK complaints and significant associations with variables related to physical workload. Our study also demonstrates that the prevalence of pain in body parts (except arm/elbow) was closely related to agricultural workload. Furthermore, these associations between workload and pain in the neck, shoulder, low back, and leg/foot were also detected on multivariate analysis. Thus, workload is a powerful predictor of MSK pain.

In terms of gender differences, female farmers were found to complain of more frequent [15] and severe pain, as compared to males [24]. In the study sample, there were significant associations between being female and MSK pain in most body parts except for the arm/elbow. Similarly, in the present study, the same results were found for females. Consequently, this may explain the gender difference of higher physical vulnerability or sensitivity to pain among women [14,15,25]. Kilbom and Messing [26] discussed potential reasons for higher MSK morbidity rates among female workers. One such reason is that, outside of work, females may be more frequently exposed to risk factors for MSK pain during household and childcare activities than males. In this study, females did housework for a longer time and reported harder work experience than males. Thus, we can expect that many women must cope with the housework and a job that are known to contribute to the proportion of MSK pain [16,25].

Recently the mechanization of agriculture has made many farmers, especially rice farmers, use farming machinery because of the characteristics of land in relatively even level. However, farmers of dry farming still need to use their bodies in agricultural work instead of farming machinery, and work in squat posture for a long time. In our study, farmers of dry farming complained of neck pain significantly more than those of rice farming, suggesting the different characteristics of agricultural work according to the types of farming and the need for further study considering the ergonomic factors.

Regarding the workload, pain in lower extremities and low back tended to increase with workload increase, while pain in upper extremities was influenced little by the workload. In terms of role of body in farming, upper

extremities are used in repetitive motions or handling, while low back and lower extremities support the body weight. These results may show the indirect association between workload and weight-supporting agricultural works.

Over the years, several cross-sectional studies on MSK complaints have reported a sharp increase in prevalence rates with workers' advancing age. However, in this study, prevalence of MSK pain for subjects under 65 years old and over 65 years old was no different, except in terms of leg/foot pain. A possible explanation for this observation is that other factors are more strongly related to MSK. In the case of low back pain, MSK symptoms increased significantly as farming duration increased; therefore, we could expect that this is because older people have longer farming duration [2,10].

Although it is generally accepted that gaining more experience and older age may lead to more frequent MSK pain, this study shows different results in terms of neck and wrist/hand/finger pain. Specifically, it was found that as farming duration increased, MSK pain decreased based on subjects' experience. In another study, Salik and Ozcan [27] found that physiotherapists in the early years of their careers tended to experience work-related MSK pain associated with lack of professional experience, and lower knowledge and skill levels reflected the importance of the skills acquired by experience. Additionally, Park et al. [28] suggested that older farmers might perform less physical labor with high levels of difficulty and high force tasks, as compared to younger farmers. Moreover, older experienced farmers may have learned to modify their work habits to avoid pain, discomfort, and injury.

There was a significant relationship between MSK symptoms and a history of acute injury. Most studies about work-related MSK disorders exclude MSK symptoms from acute injuries such as those caused by accidents [9,10]. However, as longevity increases, the chance of acute injuries in daily life increases. In cases of non-fatal injury, it is likely that people will return to their previous work. Hence, MSK symptoms due to acute injuries are highly likely to become chronic pain or recur among employees who are exposed to risks for MSK pain [29]. In this study, history of injury had a significant impact on MSK symptoms at the same injury site, with the exception of leg/foot pain. As a result, previous injuries is likely to make farmers suffer from related MSK pain on the ex-

isting injured site [1].

In fact, only a few Korean farmers who suffer MSK pain sought periodic medical examinations and consulted a doctor [8], and farmers may not acknowledge symptoms as serious until they are unable to perform specific tasks [28]. In this study, many farmers received medical treatment but the rate of those without any medical intervention was considerably higher. This high burden of illness should be considered in planning healthcare services and setting research priorities.

This study had several limitations. First, self-reported health outcomes can include recall bias since farmers may not remember or may be inaccurate in recall, leading to the possibility of subjectivity in responses. Second, because we only considered the presence or absence of pain with respect to MSK symptoms, we could not diagnose MSK diseases. To check the exact factors that affect the MSK symptoms, objective analysis is a prerequisite. However, it would be unrealistic to use this method in such a large-scale study, which was why our study was based on subjective reporting of MSK symptoms. Third, questionnaires for presence of pain and level of workload rely on subjective answering, which affect each other, with reflecting the need for objective clarified measurements for pain or workload. Fourth, we investigated the side of pain without considering their dominant side, which may involve the increase of workload or severity of pain.

In conclusion, most Korean farmers experienced MSK pain, which was significantly associated with a history of prior injury and workload. Furthermore, females and younger farmers showed a high prevalence of MSK pain. These results suggest that farmers should be educated about the agricultural work-related MSK pain, risk factors, and prevention strategies. Additionally, for the effective management of agricultural work-related MSK pain, the development of preventive measures, surveillance systems for health problems, and strengthening insurance and compensation systems should be required at the government level. We presented the initial results of cohort study, and thus, we expect that serial changes in MSK pain with changes in sociodemographic, health characteristics and agricultural work-related conditions with suggestions on the scientific bases for coping and preventive strategies.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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