

Musculoskeletal disorders among rice farmers in Phimai District, Nakhon Ratchasima Province, Thailand

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Abstract

Purpose – The purpose of this paper is to explore the prevalence of musculoskeletal disorders (MSDs) and determine factors influencing MSDs among rice farmers.

Design/methodology/approach – A cross-sectional study was carried out among 156 rice farmers from 14 villages in Tarnlalord sub-district, Phimai district, Nakhon Ratchasima province, Thailand, from February 2017 to March 2017. Face-to-face interviews, including demographics, work characteristics and musculoskeletal pain, were conducted using a modified standardized Nordic questionnaire.

Findings – The results revealed that both 78 males and 78 females participated in the study to which the average of age and body mass index (BMI) was 45.5 ± 11.4 years and 24.9 ± 4.0 kg/m², respectively. All rice farmers reported MSDs in at least one body region during the six months preceding the interview. The highest prevalence of MSDs showed 86.5 percent in the lower back area, followed by 85.9 percent in the neck, and 80.7 percent in the shoulders. The analysis of binary logistic regression and Spearman's rank correlation showed that factors such as gender, age, BMI, work experience and farm size influence MSDs' occurrence, and pain severity in one or more body regions ($p < 0.05$).

Originality/value – Musculoskeletal injuries are a significant health problem in rice farmers. The study indicated that appropriate agricultural practices such as working posture, equipment size selection and carrying loads should be recommended to prevent MSDs. Thus, the occupational health and safety services in agricultural workers are needed.

Keywords Occupational health, Musculoskeletal disorders, Rice farmers, Agricultural work, Thailand

Paper type Research paper

Introduction

Agriculture is generally recognized as a hazardous occupation, as shown by the high number of occupational accidents and health problems occurring in the agricultural sector[1]. Musculoskeletal disorders (MSDs), which are the most common cause of short-term and long-term pains as well as physical disability, affect millions of people throughout the world[2]. Basically, agricultural characteristics involving heavy physical activities and high levels of manual labor increases the risk of developing MSDs in rice farmers[3]. The farmers have faced various problems in the following working conditions: lifting and carrying heavy loads,

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repetitive tasks, frequently working with a flexed back area, chance of injuries produced and experience of vibrations from village automobiles and mechanical hand tools[4]. These issues may contribute to a potential risk of MSDs such as osteoarthritis of the hip and knee, lower back pain, neck and upper limb complaints, and hand-arm vibration syndrome[5]. Particularly, the pain in the upper extremity area is becoming progressively frequent in Asian agricultural workers[6]. Ministry of Public Health (Thailand) identified MSDs as the key priority issue for occupational and environmental health problem surveillance[7].

Many studies were completed abroad regarding to MSD prevalence and risk factors related to MSD occurrence[5,6,8–10]. A number of research studies have been conducted on Thai farmers[11–13] who are informal workers, self-employed and temporary workers[14]. Focusing on rice farmers, a prior study reported high exposure levels of ergonomic MSDs in shoulders (96.7 percent), back (94.4 percent) and neck (83.3 percent)[15]. Another study showed that the 12-month prevalence of lower back pain in rice farmers was 73.31 percent[16]. Moreover, previous study revealed the high frequencies of MSDs in all process of paddy cultivation, and has reported on factors associated with total MSDs among rice farmers[17]. Demographic and work characteristics such as gender, age, body mass index (BMI), workload, farm size and working years have been found to be risk factors affecting MSDs[18–23]. However, the association between some farming characteristic factors and MSDs in Thai farmers is still unclear. Therefore, the researcher interested in studying the prevalence of MSDs and the factors associated with pain in different parts of the body among rice farmers.

Methods

Study design and participants

This cross-sectional study was conducted among 156 rice farmers from February 2017 to March 2017. The sample size was calculated using the formula for estimating a population prevalence[24]. The Tarnlalord sub-district, one of 12 sub-districts in Phimai district, was purposively selected because this area constantly produces crops throughout the year and it is one of the most suitable land areas for growing rice in Nakhon Ratchasima[25], the biggest province of Thailand. The participants were recruited from 14 villages of Tarnlalord sub-district by proportional random sampling. Inclusion criteria of population were: male or female rice farmers; aged 18–65 years old, the range of age in farmer population[26]; grow rice by themselves; be involved in every farming activity; have more than one year of work experience; and without operational history of musculoskeletal systems reevaluated by medical records. All participants received the written consent form to provide their permission for participating in this study. The study protocol was approved by the Ethics Review Committee for Research Involving Human Research Subjects, Health Sciences Group, Chulalongkorn University, with the certified code COA No.045.1/2017.

Instrument and tool

The content of the survey was acquired in the form of a structured questionnaire adapted from a set of standardized Nordic questionnaires[27]. All questions were captured through face-to-face interviews in 2017 (February–March). Demographic and work characteristics included gender, age, weight, height, BMI, work experience and farm size. Asian BMI criteria was used to classify the group of participants in this study[28]. Rice farmers were asked musculoskeletal pain in the six months prior to the interview in fourteen different body regions (neck, shoulders, upper arms, elbows, lower arms, wrists, hands, upper back, lower back, thighs, knees, legs, ankles and feet). The pain was classified into four levels consisting of “0 = no pain: no obvious signs and symptoms of pain,” “1 = mild pain: slight pain,” “2 = moderate pain: very pain – endurable” and “3 = severe pain: most intense pain possible – can’t stand this pain anymore.” The content validity of this questionnaire

was scored by experts at 0.99. A pilot study was carried out among 30 farmers in Naimuang sub-district, Phimai district, Nakhon Ratchasima province for investigating the psychometric properties (i.e. reliability) of the questionnaire which showed the Cronbach's α coefficient value of 0.756.

Statistical analysis

The data analysis was facilitated through a licensed IBM SPSS software (version 22). The study variables were described by frequency, percentage, mean, standard deviation (SD), minimum (min) and maximum (max). Binary logistic regression with enter method was used to determine the odds ratio (OR) of various risk factors influencing MSDs among rice farmers. Spearman's rank correlation was also used to test the association between independent variables and pain level. A p -value < 0.05 was considered as statistical significance.

Results

Demographic and work characteristics

The participants in this study included 156 rice farmers with the split of 78 men and 78 women (Table I). The average (SD) age of them was found to be 45.5 (11.4) years. The mean (SD) of weight and height was 63.0 (11.0) kg and 159.0 (8.1) cm, respectively. BMI was found at the mean (SD) of 24.9 (4.0) kg/m². The average number of years worked in farming and farm size were 23.7 (11.3) years and 30,154 (23,644) m², respectively.

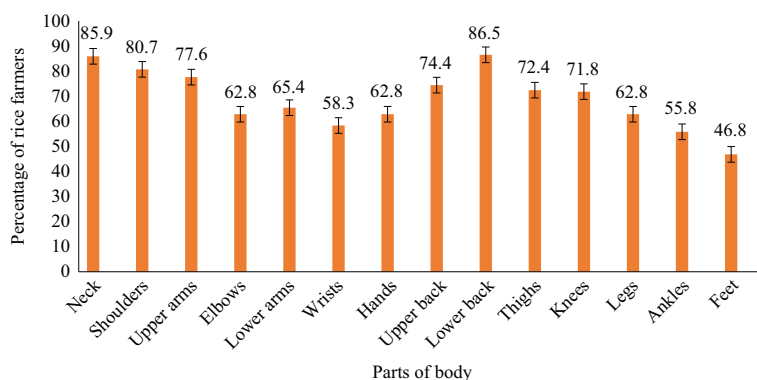
Prevalence of MSDs

All rice farmers reported MSDs in one or more body regions during the last six months. The highest prevalence of MSDs were found to be pain (mild, moderate and severe levels) in the lower back (86.5 percent), followed by neck (85.9 percent) and shoulders (80.7 percent). Prevalence of MSDs in 14 parts of body is presented in Figure 1. In terms of the intensity of pain, the body region with the highest prevalence of mild pain was the lower back

Factors	<i>n</i>	Percentage
<i>Gender</i>		
Male	78	50.0
Female	78	50.0
<i>Age (years) (mean(SD) = 45.5(11.4), min-max = 18-65)</i>		
18-50 years	93	59.6
51-65 years	63	40.4
<i>BMI (kg/m²) (mean(SD) = 24.9(4.0), min-max = 17.2-34.9)</i>		
Underweight (< 18.5 kg/m ²)	5	3.2
Normal (18.5-22.9 kg/m ²)	48	30.8
Overweight (23.0-24.9 kg/m ²)	33	21.1
Obese (\geq 25.0 kg/m ²)	70	44.9
<i>Work experience (years) (mean(SD) = 23.7(11.3), min-max = 1-50)</i>		
Less than or equal 20 years	63	40.4
More than 20 years	93	59.6
<i>Farm size (m²) (mean(SD) = 30,154(23,644), min-max = 8,000-160,000)</i>		
Less than or equal 16,000 m ²	59	37.8
More than 16,000 m ²	97	62.2

Table I.
Demographic and work characteristics among rice farmers

Note: $n = 156$



Note: $n = 156$

Figure 1. MSDs occurrence of rice farmers during the 6 months

(66.0 percent). The moderate and severe pain were highest in the shoulders (28.2 percent) and the neck (5.1 percent), respectively. The levels of musculoskeletal pain in different parts of the body are presented in Table II.

Association between factors and MSDs

The association between factors and MSDs in body regions is presented in Table III. The multivariate model showed that gender was majorly associated with six-month MSDs in upper arms (OR = 0.23, 95%CI = 0.07–0.70), elbows (OR = 3.09, 95%CI = 1.28–7.45), lower arms (OR = 5.63, 95%CI = 2.23–14.24), thighs (OR = 3.47, 95%CI = 1.36–8.87), ankles (OR = 4.07, 95%CI = 1.73–9.58) and feet (OR = 3.15, 95%CI = 1.33–7.49). Besides, wrists pain was positively related to work experience (OR = 2.15, 95%CI = 1.01–4.60) and farm size (OR = 2.78, 95%CI = 1.22–6.37). However, age and BMI were not significant in the binary logistic regression.

The correlation between factors and pain levels in body regions is presented in Table IV. The Spearman's test showed that gender was the most influencing factors for severity of MSDs in almost all body regions except neck, shoulders, hands, back and legs ($p < 0.05$).

Body part	Pain level							
	No		Mild		Moderate		Severe	
	<i>n</i>	(%)	<i>n</i>	(%)	<i>n</i>	(%)	<i>n</i>	(%)
Neck	22	(14.1)	86	(55.1)	40	(25.6)	8	(5.1)
Shoulders	30	(19.2)	80	(51.3)	44	(28.2)	2	(1.3)
Upper arms	35	(22.4)	99	(63.5)	19	(12.2)	3	(1.9)
Elbows	58	(37.2)	87	(55.8)	11	(7.0)	0	(0.0)
Lower arms	54	(34.6)	83	(53.2)	18	(11.5)	1	(0.6)
Wrists	65	(41.7)	80	(51.3)	11	(7.0)	0	(0.0)
Hands	58	(37.2)	88	(56.4)	8	(5.1)	2	(1.3)
Upper back	40	(25.6)	91	(58.3)	23	(14.7)	2	(1.3)
Lower back	21	(13.5)	103	(66.0)	29	(18.6)	3	(1.9)
Thighs	43	(27.6)	98	(62.8)	15	(9.6)	0	(0.0)
Knees	44	(28.2)	84	(53.9)	25	(16.0)	3	(1.9)
Legs	58	(37.2)	79	(50.6)	18	(11.5)	1	(0.6)
Ankles	69	(44.2)	72	(46.2)	14	(9.0)	1	(0.6)
Feet	83	(53.2)	63	(40.4)	6	(3.7)	4	(2.7)

Note: $n = 156$

Table II. Level of pain in different parts of body

Table III.
Association between factors and musculoskeletal disorders; multivariate analysis by binary logistic regression

Factor	Neck			Shoulders			Upper arms			Elbows			Lower arms		
	OR	95%CI	p	OR	95%CI	p	OR	95%CI	p	OR	95%CI	p	OR	95%CI	p
Gender ^a	1.19	0.36-3.89	0.77	0.48	0.16-1.46	0.20	0.23	0.07-0.70	0.01*	3.09	1.28-7.45	0.01*	5.63	2.23-14.24	0.000**
Age ^b	1.41	0.50-3.93	0.51	1.49	0.61-3.67	0.38	0.66	0.28-1.54	0.33	1.18	0.54-2.54	0.68	1.84	0.83-4.07	0.13
BMI ^c	0.63	0.22-1.77	0.38	1.53	0.65-3.61	0.33	0.80	0.33-1.94	0.62	0.69	0.32-1.49	0.34	1.34	0.63-2.86	0.44
Work experience ^d	1.08	0.40-2.94	0.87	1.12	0.46-2.73	0.81	1.41	0.57-3.49	0.46	2.06	0.96-4.39	0.06	1.07	0.50-2.31	0.86
Farm size ^e	1.66	0.54-5.10	0.37	1.94	0.67-5.60	0.22	1.74	0.59-5.11	0.31	1.80	0.78-4.17	0.17	0.80	0.33-1.92	0.62
				Hands			Upper back			Lower back			Thighs		
Factor	OR	95%CI	P	OR	95%CI	P	OR	95%CI	P	OR	95%CI	P	OR	95%CI	P
Gender ^a	1.72	0.73-4.04	0.21	2.13	0.91-4.96	0.08	0.82	0.32-2.10	0.68	0.66	0.17-2.53	0.55	3.47	1.36-8.87	0.000**
Age ^b	0.62	0.29-1.31	0.21	1.26	0.61-2.58	0.54	0.80	0.36-1.74	0.57	2.11	0.67-6.60	0.20	1.02	0.46-2.25	0.97
BMI ^c	0.80	0.38-1.71	0.57	0.79	0.38-1.63	0.52	1.05	0.48-2.31	0.89	1.92	0.72-5.13	0.19	0.90	0.41-1.97	0.79
Work experience ^d	2.15	1.01-4.60	0.03*	1.38	0.67-2.83	0.38	1.44	0.64-3.21	0.38	1.71	0.61-4.80	0.31	1.05	0.47-2.31	0.91
Farm size ^e	2.78	1.22-6.37	0.01**	0.64	0.28-1.47	0.29	1.24	0.50-3.09	0.64	2.89	0.81-10.29	0.10	1.10	0.47-2.61	0.82
				Legs			Ankles			Feet					
Factor	OR	95%CI	p	OR	95%CI	p	OR	95%CI	p	OR	95%CI	p	OR	95%CI	p
Gender ^a	1.30	0.52-3.22	0.57	1.58	0.69-3.65	0.28	4.07	1.73-9.58	0.000**	3.15	1.33-7.49	0.000**			
Age ^b	1.07	0.50-2.30	0.86	1.62	0.79-3.34	0.19	0.85	0.41-1.77	0.66	0.97	0.47-1.98	0.92			
BMI ^c	1.60	0.76-3.37	0.21	0.84	0.41-1.71	0.62	1.42	0.69-2.93	0.34	1.20	0.58-2.46	0.62			
Work experience ^d	1.02	0.47-2.22	0.96	0.93	0.45-1.91	0.84	0.90	0.43-1.92	0.79	1.81	0.87-3.77	0.11			
Farm size ^e	1.27	0.53-3.04	0.59	0.98	0.43-2.21	0.95	1.08	0.47-2.49	0.85	0.71	0.30-1.68	0.43			

Notes: OR, odds ratio; CI, confidence interval, ref. = reference group; ^a0 = male, 1 = female; ^b0 = 18-50 years, 1 = 51-65 years, ^c0 ≤ 22.99 kg/m², 1 ≥ 22.99 kg/m²; ^d0 ≤ 20 years, 1 ≥ 20 years; ^e0 ≤ 16,000 m², 1 = > 16,000 m². p = significant value (*p < 0.05, **p < 0.01)

Body part	Gender		Age		BMI		Work experience		Farm size	
	r_s	p	r_s	p	r_s	p	r_s	p	r_s	p
Neck	–	ns	–	ns	–	ns	–	ns	0.26	***
Shoulders	–	ns	–	ns	–	ns	–	ns	–	ns
Upper arms	–0.21	*	–0.20	*	–	ns	–	ns	–	ns
Elbows	0.38	***	0.16	*	–	ns	0.20	*	0.25	***
Lower arms	0.35	***	0.17	*	–	ns	0.19	*	–	ns
Wrists	0.28	***	–	ns	–	ns	–	ns	0.25	**
Hands	–	ns	–	ns	–	ns	–	ns	–	ns
Upper back	–	ns	–	ns	–	ns	–	ns	–	ns
Lower back	–	ns	0.18	*	–	ns	0.20	*	0.17	*
Thighs	0.25	**	–	ns	–	ns	–	ns	0.22	**
Knees	0.17	*	–	ns	0.19	*	–	ns	0.18	*
Legs	–	ns	–	ns	–	ns	–	ns	–	ns
Ankles	0.38	***	–	ns	0.17	*	–	ns	0.24	**
Feet	0.25	**	–	ns	–	ns	–	ns	–	ns
All	0.43	***	–	ns	0.16	*	0.23	**	0.39	***

Notes: ns, not significant. Variables: 0 = male and 1 = female for gender; continuous data for age, BMI, work experience, farm size. r_s = Spearman's rank correlation coefficient; p = significant value (* p < 0.05; ** p < 0.01; *** p < 0.001)

Table IV. Correlation between factors and pain levels by body regions

Increased age, and work experience was correlated to levels of pain in elbows, lower arms and lower back (p < 0.05), whereas a negative correlation between age and degree of upper arm pain was found (p < 0.05). A positive correlation between BMI and degree of pain in knees and ankles was observed (p < 0.05). There was a significant positive correlation between farm size and severity of pain in neck, elbows, wrists, lower back, thighs, knees and ankles (p < 0.05). In addition, gender, BMI, work experience, farm size showed being the influencing factors when the pain levels in fourteen different parts of body were summed.

Discussion

The present study showed the prevalence of MSDs in one or more body regions among rice farmers during the process of paddy cultivation at 100.0 percent. The highest prevalence for six-month MSDs was observed in lower back (86.5 percent), followed by neck (85.9 percent), shoulder (80.7 percent), upper arms (77.6 percent) and upper back (74.4 percent). In addition, these body regions were found to be moderate and severe pain which could possibly lead to long-term problems, including chronic MSDs. This may be due to repetitive and awkward postures, heavy carrying and lifting during crop cultivation, resulting in excessive pressure on the back, neck, and upper limbs, as well as developing work-related MSDs. The findings are similar to the study of ergonomics problems and risk of MSDs in rice farmers conducted in Sakon Nakhon province of Thailand[18] which have pointed out the prevalence of body pain in the rice farming process at approximately 99.7 percent. Likewise, a prior study showed that the prevalence of lower back pain during rice transplanting process in Thai farmers was 83.1 percent[29]. The variation on discomfort in various body regions may be from the difference in the nature of the posture adapted or repetitive movements done by farmers (5). Especially, the workers who use traditional equipment for rice farming can be exposed to risk factors in different farming processes, resulting in work-related injuries. Many studies reported high frequencies of body pain in rice farmers using manual and traditional equipment, mainly shoulder, hip, upper and lower back[9,13,17,30,31]. Furthermore, the current study absolutely demonstrated the association of several factors of MSDs.

For demographic information, the results indicated that gender, age and BMI were significantly associated with MSDs. Women were more likely to experience MSDs than

male, except MSD occurrence in upper arms showed a significantly inverse relationship. Even though age and BMI were not significant in analysis of the ORs, there was significance in the Spearman's rank correlation. Age was observed as a likely factor increasing the intensity of MSDs in elbows, lower arms and lower back, whereas a negative correlation with upper arm pain was found. BMI was also positively correlated with degree of pain in knees and ankles. The findings are similar to the studies of Nopkesorn and Supasit[12] and Jo *et al*[20], showing more likely to develop symptoms of MSDs than in female. Musculoskeletal symptoms in wrists and hands including aching fingers were more common among women[19]. Regular basis on housework activities of women may possibly explain more reported discomfort from work. From our observation, there are differences in work characteristics between both farmers, notably heavy workload in young male farmers, such as tractor driving, fertilizer bag lifting and pesticide sprayer carrying, which may cause upper arm pain, and light to moderate workloads with repetitive tasks in female farmers such as rice sowing and seedling, and manual harvesting, which may result in the upper extremity. Besides, the results are consistent with a previous study observed number of work-related musculoskeletal complaints with increased age in farmers[32]. Another study found that age was associated with MSDs[33]. High severity of MSDs in older farm workers might be due to physiological deterioration and chronic musculoskeletal pain from a prolonged experience, especially workers aged greater than 50 years and physically demanding jobs[34–36]. BMI factor is consistent with previous study that overweight and obesity were associated with an increase in occurrence of musculoskeletal symptoms and/or decrease in recovery[21]. Similarly, another study noted that BMI is a major factor influenced MSDs[37]. The workers with excessive weight may be at greater risk of body pain because the burden on their bones, muscles and joints will increase[38].

For work characteristics, farm size was the most influencing factors for severity of MSDs in many body regions, including neck, elbows, wrists, lower back, thighs, knees and ankles. It was also significant in analysis of the ORs indicated higher prevalence of wrist pain in farmers with farm size $\leq 16,000 \text{ m}^2$ (vs $> 16,000 \text{ m}^2$). The findings are consistent with a previous research reported that the size of farmland had a clearly surprising impact of injury incidence rates among farmers[39]. This could be explained by the fact that farm size related to the amount of work increased fatigue, leading to MSDs. Moreover, years of farming experience was positively correlated with levels of pain in elbows, lower arms and lower back. The prevalence of wrist pain was significantly higher in farmers working in farming > 20 years (vs ≤ 20 years). The results are similar to a prior study showing the risk of rice farming for persistent neck and shoulder complaints increased from years of working[40]. Other studies found a higher risk of neck and lower back pain in rice farmers from longer work experience[13,41]. Most farmers suffered from occupational health risk for a long period of time[42]. This can occur when parts of the body are subjected to the same high workload due to continuous repetitive tasks, high force, athletic movements, without proper treatment and rehabilitation[43].

The findings of the present study highlighted characteristics such as gender, age, BMI, workload, farm size and working year, affecting MSDs. When compared with the findings of previous study in rice farmers[17], age and farm size become significant risk factors associated with MSDs in the current study. This may due to the adjusted variables and using the occurrence of MSDs and pain severity in different body regions instead of total body pain score of MSDs. Moreover, the findings of previous and present study pointed out that the prevalence of MSDs among rice farmers were still high. Limitations of this study included: rice farmers, who were asked to score their body pain, produced subjective symptoms; recalled bias from the interviews regarding MSDs in the past six months may occur and affect the results; and several factors related to MSDs such as personal factors (exercise, smoking, leisure-time, hobbies, etc.)

and working conditions (work duration, posture, vibration, tool and machine design, etc.) are not included in this study. However, this study provided useful information about ergonomic problems for promoting occupational health and safety among rice farmers. For further research, other risk factors contributing to MSDs with frequency of body pain should be considered. A specific physical examination test for MSDs to reduce information bias is recommended.

Conclusion

The study emphasized that MSDs are a significant occupational health problem in rice farmers. Personal and work-related factors such as gender, age, BMI, work experience and farm size influenced the elevated risk of musculoskeletal pain in different parts of body. These factors suggest a training program to prevent and reduce musculoskeletal complaints for rice farmers. MSD issue should be raised in the agricultural setting.

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