PREVALENCE AND RISK FACTORS ASSOCIATED WITH MUSCULOSKELETAL DISORDER IN MAINTENANCE WORKERS OF LIGNITE POWER PLANT IN THAILAND

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ABSTRACT:

Background: Musculoskeletal disorder is one of the most hazardous agents in the work place. It is the common health problem of workers, as well as a major cause of occupational disease. The purposes of this study were to find out the prevalence of musculoskeletal disease among maintenance worker of lignite power plant in Lampang Province, Thailand and to identify risk factors associated with musculoskeletal disorder (MSD).

Methods: A cross-sectional study was conducted with structured face-to-face interview questionnaire among 317 workers working in maintenance for at least 12 months. The Nordic Musculoskeletal Standard questionnaire was used to find the prevalence of MSDs. Chi-square analysis was used to analyze association between independent and dependent variables with statistical significant of $p < 0.05$ and odds ratio with 95% CI was applied to explore the risk factors of MSDs.

Results: Among the participating workers, 66.4 % reported MSDs in past 12 months and 57.7 % reported MSDs in past 7 days. The strong relationships between reported MSDs in past 7 days and education level ($p = 0.01$), working areas ($p = 0.02$), and overtime work ($p = 0.01$) were found. Postures of trunk slightly flexion ($p = 0.022$), prone ($p = 0.01$), standing ($p = 0.03$) had strong relationships with MSDs in past 12 months. Furthermore, lifted bent down trunk increased risk of neck pain (OR = 2.071, 1.089-3.940), shoulder pain (OR = 1.935, 1.108-3.379), wrist pain (OR = 2.619, 1.361-5.041) and knee pain (OR = 2.523, 1.129-5.635) significantly.

Conclusion: High prevalence of musculoskeletal disorder among maintenance workers was noted and exposure to ergonomic factors were significantly associated with MSDs. Installation of appropriated ergonomics design was suggested and ergonomics training are required for the maintenance workers.

Keywords: Musculoskeletal disease, Maintenance worker, Work-related injury, Thailand

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INTRODUCTION

Occupational health disease and work-related injuries have been increased in employees, employers and governmental working units. This increasing trend of diseases put a big impact on worker's health and productivity. In previous 12 months, 10.8 million of cases were reported as work-related injury or illness in Australia [1]. More than 600,000 workers in the US, suffer work-related musculoskeletal disorders in every year. The leading hazardous agent is the musculoskeletal disorder [2]. It is the most common worker's health problems and the largest contributor of work related illness and occupational disease. In 2007, World Health Organization [3] disclosed the multifactorial influence of work-related musculoskeletal diseases(WMSD) and showed a number of risk factors contributed and its intervention plan. In Thailand prevalence of MSDs ranked in the top 5 diseases of all patient [4]. In 1995, the cost of WMSD in US was 215 billion dollars and 26 billion

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dollars in Canada [5], showing that WMSD is the most expensive of work related illness. Iranian welders in factory had the high prevalence in musculoskeletal symptoms (88.3%). The most MSDs was found at wrist joint, lower back, neck and knee [6]. Maintenance workers are conducted in all sectors such as protecting in failure, managerial actions during the life cycle of the item, testing, or restore. The tasks of maintenance workers are not exclusive, therefore they can expose to wide range of hazards. Musculoskeletal disorder is one of the high risk factors, throughout carrying load, working in awkward postures and unappropriated or unsuitable environment condition [7]. Maintenance workers specific in welder and turner are concerned in this study. From European study found that 15-20% of injuries at work happened during welding and turnering [8]. Nordic standard musculoskelatal questionnaire can be used for assessing history of MSDs from 7 days (acute phase) and 12 months (chronic phase) at nine body region; neck, wrist, elbow, shoulder, hip, lower back, upper back, knee and ankle [9].

Electricity Generating Authority of Thailand (EGAT), Lampang province or Mae Moh power plant. This power plant is the biggest lignite power plant in Thailand, contains of 13 generators with the total generating capacity of 2,625 MW [10]. It also had about 4,000 workers to support in wide variety of working area such as engineering, fireman, maintenance worker, and official workers

The risk factors that significantly associated with MSDs were individuals, the work experience as welder or other position in maintenance workers, physical factors and psychosocial factors are also known to be important predictive variables [11].

Therefore, this study aim to find out the prevalence in 317 maintenance workers in lignite power plant, Lampang province, Thailand and find the associated risk factors that develop MSDs.

MATERIALS AND METHODS

Research population and data collection

By using Yamanae's method, 317 participants were chosen in maintenance worker with at least 12 working months in lignite power plant Lampang province, Thailand, during May 2015. A cross-sectional study was conducted with structured face-to-face interview questionnaire.

Questionnaire design

The questionnaire consists of 5 parts, personal characteristic including age, gender, education level, health problem, exercise, smoking, drinking. Part 2, job characteristics including work exercise, work duty (welder and turner), work place, break time, duration of work, weight holding. Part 3, physical of work that separate to frequency of work postures and duration in each postures [12]. Part 4 is psychosocial exposure [13]. Part 5 is Nordic Standard questionnaire [9], acute stage of MSDs is defined within 7 days and chronic MSDs is regarded as 12 months.

Pilot test

This pilot test was conducted with 30 participants from EGAT, Nonthaburi Province during 21-30 April, 2015 to address the reliability and validity of the questionnaire. Validity was reviewed by 3 experts. The Cronbach's Alpha < 0.9 indicates the reliability for the item. Physical of work (52 items) with Cronbach's Alpha = 0.830; Psychosocial (10 items) = 0.846.

Data analysis

Data entry and analysis was done by SPSS version 22 (University licensed). First, frequency distributions of personal characteristics and job characteristics of participants were explored. Categorical variables were expressed as number (percent, %). The prevalence of musculoskeletal disorder in maintenance workers were described by figures as percentage.

The factors associated between the musculoskeletal disorders were determined by chi-square test and crude odd ratio. P-value of equal or less than 0.05 was considered as the significance level.

Ethical consideration

This study was approved by the ethical consideration from Research Involving Human Research Subject, Health Sciences Group, Chulalongkorn University with the certified code no. 0.71.1/58. All respondents were informed about this study before participating. The consent form was signed by participants before reporting questionnaire.

RESULTS AND DISCUSSION

Prevalence of musculoskeletal disorder symptom among maintenance worker in EGAT, Lampang

Figure 1 presented the past 12 months MSDs in the body part with highest occurrence; neck pain (31.9%), shoulder pain (28.7%), and lower back pain (28.1%). The result was consistent with the previous study in Thai construction-related work [4] had the highest incidence in shoulder pain (46.0%) , back pain (46.0%), and neck pain (40.1%). In China [1] among factory workers the most frequency affected parts were lower back (28.0%), neck

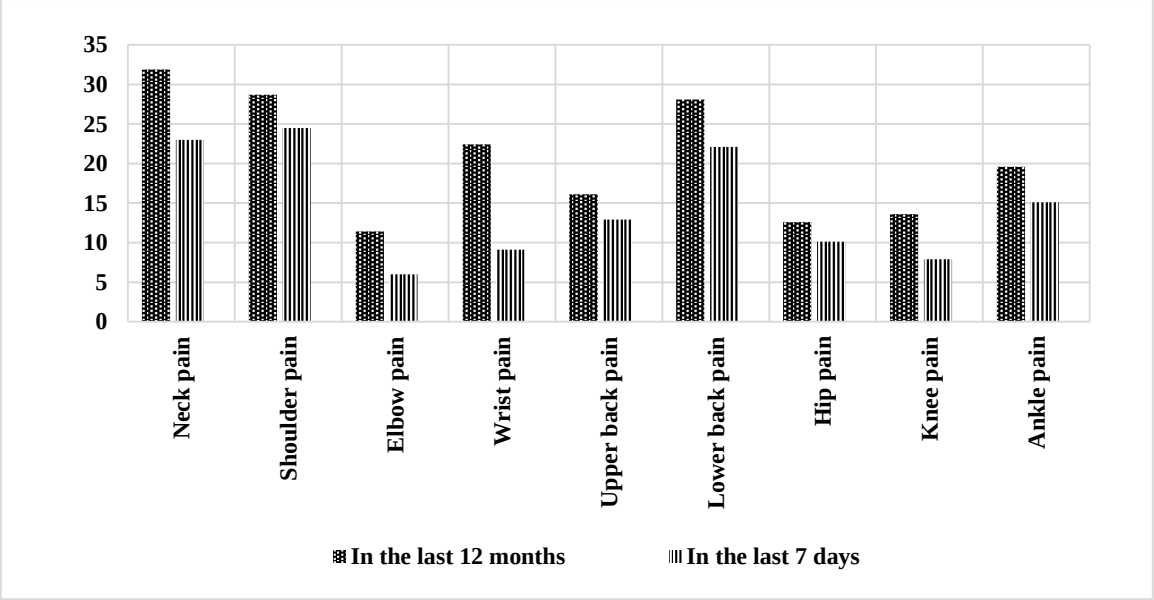

Figure 1 Percent of musculoskeletal disorder symptom among maintenance worker at EGAT, Lampang

Table 1 Personal characteristics associated with MSDs among maintenance worker

Factors	Worker		MSDs in past 12 months		*p-value*	MSDs in past 7 days		*p-value*
	n	%	n	%		n	%	
Age (years)								
<30	79	24.9	57	18	0.671	50	15.8	0.407
31-40	12	3.8	8	2.5		7	2.2	
41-50	63	19.9	40	12.6		31	9.8	
>50	163	51.4	106	33.4		95	30	
Gender								
Male	307	96.8	204	64.4	0.815	176	55.5	0.425
Female	10	3.2	7	2.2		7	2.2	
BMI								
Underweight	9	2.8	7	2.2	0.719	6	1.9	0.539
Normal	84	26.5	57	18.0		52	16.4	
Overweight	224	70.7	147	46.4		125		
Education level								
Under graduated	243	76.7	170	53.6	0.020*	149	47.0	0.019*
Above graduated	74	23.3	41	12.9		34	10.7	
Income (Bath)								
< 20,000	80	25.2	56	17.7	0.759	50	15.8	0.672
20,000 – 30,000	15	4.7	11	3.5		8		
30,000 – 40,000	8	3.5	4	1.3		3	0.9	
40,000 – 50,000	33	10.4	22	6.9		18	5.7	
> 50,000	181	57.1	118	37.2		104	32.8	
Smoking								
Past smoker	122	38.5	83	26.2		75	23.7	
Never smoke	132	41.6	84	26.5		71	22.4	
Health problems								
Hypertension	80	62.8	58	18.3	0.193	50	15.8	0.318
Heart disease	2	0.6	2	0.6	0.315	2	0.6	0.225
Diabetic	19	6	15	4.7	0.238	15	4.7	0.053
Others	38	12	30	9.5	0.085	28	8.8	0.034*

* Statistics significant difference at p<0.05, Chi-square test

Table 2 Job characteristics associated with MSDs among maintenance worker

Factors	Workers		MSDs in past 12 months		*p-value*	MSDs in past 7 days		*p-value*
	n	%	n	%		n	%	
Year in maintenance years								
< 5	81	25.6	57	18	0.667	49	15.5	0.367
6 – 15	34	10.7	23	7.3		19	6.0	
> 15	202	63.7	131	41.3		115	36.3	
Job duty								
Welder	130	41	90	28.4	0.401	75	23.7	0.991
Turner	187	59	121	38.2		108	34.1	
Work area								
Ground	190	59.9	116	36.6	0.06	97	30.6	0.017*
Height working area	38	12.0	28	8.8		24	7.6	
Narrow space	48	15.1	34	10.7		31	9.8	
Air confine space	41	12.9	33	10.4		31	9.8	
Duration/work (minutes/work)								
< 10	25	11.7	17	5.4	0.977	15	4.7	0.893
11 – 30	55	17.4	37	11.7		33	10.4	
> 30	237	74.8	157	49.5		135	42.6	
Over time (hours/day)								
< 10	58	18.3	30	9.5	0.012*	27	8.5	0.019*
11 - 30	103	32.5	67	21.1		54	17	
> 30	156	49.2	114	36.0		102	32.2	

(24.0%) and shoulder (18.6%). Among the UK oil and gas industry, the result measured by Nordic Musculoskeletal Questionnaire revealed the most commonly parts of body were taken together neck, shoulder and upper back MSDs[14]. In past 7 days [15], construction worker suffered MSDs in elbow (100%), back (90%),hip (61%), wrist and forearm (88%)that results were different with this study. There had MSDs in elbow only 6%, lower back 22.1%, hip (12.6%) and wrist 9.1%.The similar percentage of ankle pain was found in the veterinarians that had MSDs about 20% due to the nature of their work and involvement of the long hours of working [16].

The association between risk factors and musculoskeletal disorder symptom

The association between personal characteristics and MSDs

Table 1 presented personal characteristics of participants were significant with educational level associated with MSDs in past 12 months ($p = 0.020$) and MSDs in 7 day ($p = 0.019$). Taiwan workers showed the same result, the education was related to MSDs ($p < 0.01$). High education level was commonly low risk of back pain [17]. The education is related to the job characteristic and the workers with lower education levels have to work harder and taking risks to the MSD. From the study in Norway, musculoskeletal pain and a low level of educational level was associated with increased risk of MSD. Generally education can change the personal perception of health, it increases awareness of health and health promotion [18]. In condition of tasks in the workplace, welder and turner had the high risk of MSDs. For example; limitation of work area, repetitive motion, heavy workload and high weigh of tools [19].

Others health problem associated with MSDs in past 7 day ($p = 0.034$). 38 Maintenance workers were noted with health problem, including gout (15), hypotension (9), dyslipidemia (8), anemia (4) and lung cancer (1). The study regarding health problems lead to considerable productivity loss, found the association with increased MSDs in industrial worker lead to health problems [20].

The association between job characteristics and MSDs

The first job characteristics that significant difference was work area ($p = 0.017$), including 4 areas, ground area, work in height area, narrow space and confine space. Other was working overtime ($p = 0.012$) showed in Table 2. They were limited of movement (static posture) can compress nerve, reduce blood flow and contribute to muscle fatigue [21].

In addition to their standard working hour (8 AM – 4 PM) was 40 hrs/week, majority of the workers in the study worked overtime more than 30 hr/month. Showing that most of them have long working hours in each week. Other study also found the risk in long duration of working, 41-45

Table 3 Association between psychosocial and MSDs

Psychosocial exposure	n (%)	MSDs in past 12 months		*p-value*	MSDs in past 7 days		*p-value*
		n	%		n	%	
Uninteresting work	67 (21.1)	36	14.5	0.439	42	13.2	0.125
Boring work	32 (10.0)	22	6.9	0.273	20	6.3	0.078
No encouraging organization culture	36 (11.4)	34	7.6	0.923	36	11.4	0.352
No psychosocial support from superior	66 (20.8)	47	14.8	0.415	44	13.9	0.064
No psychosocial support from fellow workers	30 (9.4)	20	6.3	0.899	19	6.0	0.326
No psychosocial support from system if trouble at work	42 (13.2)	26	8.2	0.509	23	7.2	0.618
Cannot control at work	27 (8.6)	19	6.0	0.750	18	5.6	0.469
Cannot meet the quantitative demand from work (number of tasks done)	31 (9.7)	19	6.0	0.514	18	5.7	0.422
Cannot meet the qualitative demand from work (quality of jobs done)	29 (9.2)	19	6.0	0.627	18	5.6	0.477
Feel anxiety about changing work position	83 (26.1)	58	18.3	0.065	55	17.3	0.022*

hour/week, had odd ratio with 95%CI in 1.42 (1.02 - 1.96) and *p-value* 0.037 [1], so the long duration of working can be one of the risk factors in MSDs.

The associated between work postural and MSDs

The findings found frequency of trunk slightly flexion (p = 0.022), prone (p = 0.011), stand (p= 0.028), lifted/carried with bent down trunk in light weight (p = 0.034), lifted/carried with bend down trunk in medium weight (p = 0.019) and lifted/carried with upright trunk in light weight (p = 0.037) had significant difference with MSDs in past 12 months. And in past 7 day had significantly with trunk slightly flexion (p = 0.012) and stand (p = 0.026).The risk factors were up to the task of working and physical factors such as weight. The importance factors related to MSDs were bending back, carrying and lifting and working with arm above shoulder [15] that consistency in this study. The difference of MSDs in past 12 months and MSDs in past 7 days were repetitive motion in work-activity. If the workers got MSDs in short time like 7 days, it mean had more repetitive motion and more severity[22].

In Australians safety and compensation (council) identified the most hazards in industry workers inherent in specific work tasks are high duration in the posture; how extreme or awkward [23] that support that duration of work postural may cause of MSDs, in past 12 months the most participants had not associated except trunk slightly flexion (p = 0.044), trunk twist (p = 0.035), cylindrical grasp (p = 0.009), lifted/carried with bend down trunk in light weight (p = 0.042). And in past 7 days, there had significant difference in tripod grasp (p = 0.042).These physical task factors can directly damage body tissues.

The association between psychosocial and MSDs

Table 3 showed the result in changing work position was significantly associated with MSDs in past 7 days (p = 0.02). The previous study also showed relationship between back pain and job satisfaction, repetitive work, interpersonal relationships in the workplace, and work demand stress[24, 25]. And other finding showed the specific psychosocial factors on the development of MSDs in neck, shoulder, lower back pain. It can be assumed that the experience of psychosocial workplace stressors like changing workplace has an influence on worker' physiological response [26] and negative psychological perceptions may lead to physical problems [27]. Evidence from biomechanics studies points to a mechanism whereby psychosocial stress contributes to increases in spine loading. There is a result of psychosocial stressors may result in MSD [25].

Physical risk factors in body location of MSDs

In past 12 months and 7 days can be found the posture that cause of musculoskeletal disorder symptom in each parts, because of repetitive working and personal physical factors [28]. Slightly flexion of trunk was risky for neck pain (OR=1.959, 95%CI? 0714-5.379) wrist pain (OR = 7.568, 1.006-56.953). Lifting while bending down trunk was high risk for neck pain (OR = 2.071, 1.089-3.940), shoulder pain (OR = 1.935, 1.108-3.379), wrist pain (OR = 2.619, 1.361-5.041) and knee pain (OR = 2.523, 1.129-5.635). Lifted upright trunk was core risk of wrist pain (OR = 2.695, 1.169-6.212). Prone position is the main risk factors of wrist pain (OR = 2.053, 1.171-3.601) and hip pain (OR = 2.653, 1.249-5.637), elbow pain (OR = 2.283, 1.025-5.086), knee pain (OR = 2.156, 1.084-4.286), Twist

is risk in upper back (OR = 3.888. 1.165-12.975)

While maintenance workers are welding in the narrow area, they are limited of movement (static posture) can compress nerve , reduce blood flow and contribute to muscle fatigue [21]. In the trouble task activities being affected, or necessitating absence from work, stratified by work activity and work load that were shown to be significantly in the proportions for nerve, half and full categories within MSDs.

CONCLUSION

This cross-sectional survey indicated that work related musculoskeletal disorders are prevalent among maintenance worker at Lampang, Thailand. The work postural risk factors should be taken into ergonomics intervention and ergonomics training. The more general, observation based assessments appear to be best matched to the needs of occupational safety.

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