



Musculoskeletal diseases of heavy industrial workers

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Objective: The purpose of this study was to investigate the musculoskeletal diseases (MSDs) that occur in heavy industrial workers according to the occupational category, prevalence, environment, and number of physical therapy visits.

Design: Retrospective cohort study.

Methods: For this study, data was collected of workers who were engaged in heavy industry in Korea and who visited the company physicians and received physical therapy in 2016. Data was collected from 855 subjects and was analyzed. With the data collected, analysis of the type and prevalence of MSDs and the number of physical therapy visits that have occurred according to the occupational category and environment was performed.

Results: The most common MSDs were lumbar sprains and spasms (31.1%), and shoulder sprain and spasm (19.4%). In addition, the most common type of MSDs according to the occupational category and environment (occupational type) were lumbar sprain and spasms in 11 occupations, including white collar workers, and in milling, inspection, crane operation, and finishing jobs, shoulder muscle sprain and strain were the most common disorders. Also, the prevalence of MSDs according to occupational category and environment (occupational type) was the highest in workers involved with welding, which was 29.7%.

Conclusions: Through this study, the type and prevalence of MSDs according to the occupational category and environment of heavy industrial workers have been confirmed. Further studies are necessary to study the future types of the work patterns of industrial workers and to develop a system for preventing and managing MSDs that may occur.

Key Words: Job description, Musculoskeletal diseases, Work, Workplace

Introduction

Problems related to musculoskeletal diseases (MSDs) arising from working environments are emerging worldwide and is thus perceived as one of the biggest problems encountered by workers [1,2]. Work-related MSDs (WMSDs) are the MSDs caused by these work-related factors. These disorders refer to damage to the musculoskeletal system of the body, such as muscles, tendons, ligaments, joints, nerves, and blood vessels [1]. It has been reported that workers have the potential risk of developing MSDs since their bodies undergo repetitive physical movements and assume uncomfortable postures during work, which can cause pain and various MSDs [3,4]. These WMSDs reduce the health

and labor force of workers, which results in increased costs due to low work productivity [5]. It has also been reported that labor reduction and high cost of treatment most commonly occur in occupational MSDs [6].

Problems with MSDs are continuously being reported. According to recent studies, four out of five construction workers were reported to have MSDs [7], while another study reported that 59.4% of workers had MSDs. In addition, Aghilinejad *et al.* [8] reported a high rate of MSDs in the aluminum industry, and there are also reports of the types of work that can increase the risk of developing MSDs, such as brick-laying [9].

As such, the high prevalence of WMSDs according to occupational category and work environment is being reported

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continuously and there is a growing interest in this area. Accordingly, it is necessary to investigate the types and prevalence of MSDs according to the work classification and environment of the Korean industry. However, since the type and prevalence of MSDs can vary depending on the industry, occupational category, and environment, it is necessary to investigate the prevalence and characteristics of MSDs according to the occupational categories and environments of individual industries.

Therefore, based on the data collected from heavy industry workers in Korea who have visited the company clinic and have received physical therapy in 2016, this study investigated the prevalence and type of MSDs according to the occupational category or environment.

Methods

Study subjects and data collection

This was a retrospective cohort study. Data was collected of 893 heavy industry workers in Korea who have visited the company medical center and received physical therapy that consisted of electrotherapy and simple exercise therapy in 2016. Of the data collected, 38 workers were excluded due to subjects having non-WMSDs that were not associated with the occupational category and environment, leaving data from total of 855 workers available for analysis. Prior to the study, approval of use of data and its contents were provided by the heavy industry manager and the research plan was approved by the bioethics committee of Kyungnam University (IRB No. 1040460-A-2016-035).

Research procedure

With the final data, the types and prevalence of MSDs according to the type of work and the number of physical therapy visits per MSD had been analyzed. Based on the health insurance corporation disease classification table, the MSDs were classified into 13 categories from those who received physical therapy from the company clinic. The categories of the diseases were brachial plexus syndrome, cervical disc protrusion with neuropathy, shoulder muscle sprain and spasm, shoulder impingement syndrome, tennis elbow, wrist joint sprain and spasm, unspecified finger sprains and spasm, shoulder impingement syndrome, tennis elbow, wrist joint sprain, unspecified finger sprain, sciatic nerve pain due to lumbar disc disorders, lumbar sprain, unspecified knee arthropathy, ankle sprain, Achilles tendon rupture, ankle or toe fracture.

The occupational category and environment (environmental classification) of workers was classified into 35

different occupations registered in heavy industry. Of the 35 occupations in heavy industry, workers from 15 occupational categories had visited the company physical therapy clinic, including inspection, metal material processing, finishing (metal surface processing), milling (metal forming), office workers, lathe, welding, machine maintenance, signalman, heat treatment, drivers (general cars), cutting (large metal cutting), assembly, molding (metal mold making), and crane operators. Also, data of workers who received physical therapy from the company clinic in 2016 were analyzed for the treatment frequency of a specific disorder.

All data collected in this study were analyzed using IBM SPSS Statistics ver. 18.0 (IBM Co., Armonk, NY, USA). The types and prevalence of MSDs according to the work classification and environment, and number of physiotherapy visits per MSD were analyzed using descriptive statistics.

Results

Types of musculoskeletal diseases

The most common type of MSDs that were presented in workers were lumbar sprain and spasm in 265 patients (31.0%), shoulder muscle sprain and spasm in 166 patients (19.4%), scoliosis caused by disc problems in 70 patients (8.2%), brachial plexus syndrome in 69 patients (8.1%), cervical disc protrusion with neuropathy in 67 patients (7.8%), unspecified knee arthrodesis in 54 patients (6.3%), ankle

Table 1. Types of musculoskeletal diseases (N=855)

Disease	No. of musculoskeletal disease (person)	Occurrence rate (%)
Brachial plexus syndrome	69	8.1
Cervical disc protrusion with neuropathy	67	7.8
Shoulder sprain and spasm	166	19.4
Shoulder impingement syndrome	7	0.8
Tennis elbow	29	3.4
Wrist joint sprain and spasm	27	3.2
Unspecified finger sprains and spasm	16	1.9
Lumbar sciatica due to intervertebral disc failure	70	8.2
Lumbar sprain and spasm	265	31.0
Unspecified knee arthropathy	54	6.3
Other ankle sprains and strains	47	5.5
Achilles tendon rupture	25	2.9
Other ankle and toe fractures	13	1.5

Table 2. Types of musculoskeletal diseases according to occupation category and environment (job type) (N=855)

Occupation	Cervical											
	Brachial plexus syndrome	Shoulder sprain and spasm	Shoulder impingement syndrome	Tennis elbow	Wrist joint sprain	Unspecified finger sprain	Intervertebral disc herniation	Lumbar sprain and spasm	Unspecified knee arthropathy	Other ankle sprain/tension	Achilles tendon rupture	Ankle/toe fracture
Inspection	2	11	1	2	2	1	10	10	1	0	2	1
Processing	2	9	0	3	2	1	1	17	2	1	1	0
Finishing	0	3	0	0	1	0	1	2	0	0	0	0
Milling	5	15	0	1	1	2	4	12	5	3	3	1
Office work	36	53	2	10	5	4	28	120	18	17	8	5
Lathe	0	7	0	3	3	1	4	11	3	2	2	0
Welding	4	19	2	4	6	2	7	20	7	6	4	3
Maintenance	4	6	1	0	0	0	3	9	1	2	3	1
Signaling	2	1	0	0	2	0	1	5	0	0	0	0
Heat management	1	6	0	1	0	1	2	8	2	0	1	1
Driving	0	2	1	0	0	0	0	3	1	0	0	0
Metal cutting	1	8	0	2	1	0	2	18	6	4	0	0
Assembling	4	11	0	2	3	3	3	15	3	6	1	0
Molding	4	8	0	1	0	1	1	10	1	3	0	1
Crane operation	4	7	0	0	1	0	3	5	4	3	0	0

Values are presented as number only.

sprain and strains in 47 patients (5.5%), tennis elbow in 29 patients (3.4%), wrist joint sprain in 27 patients (3.2%), Achilles tendon rupture in 25 patients (2.9%), unspecified finger sprain and strains in 16 patients (1.9%), and shoulder impingement syndrome in 7 patients (0.8%), as listed in Table 1.

Type of musculoskeletal diseases according to work classification and environment

Of the occupational categories and environment, there were 120 office workers, 20 welders, 18 cutting, 17 processors, 15 assemblers, 11 lathe, 10 molders, 9 working in mechanical maintenance, 8 heat treatment, 5 signalman, and 3 drivers. And out of the 15 occupations, 11 occupations were found to have the highest incidence of lumbar sprain and spasm. The other 4 occupations were milling (15), inspection (11), crane operation (7), finishing (3), and the most frequent disorders were shoulder muscle sprain and spasm. Overall, 15 occupations were reported to have the highest number of physically treated workers due to lumbar sprain and spasm and shoulder muscle sprain and spasm (Table 2).

Prevalence of musculoskeletal diseases according to occupational category and environment

The prevalence of MSDs according to the occupational category and environment (occupational type), 87 welders

Table 3. Prevalence of musculoskeletal diseases according to occupational category and environment (N=855)

Occupational category	Total no. of persons by occupation (person)	Musculoskeletal diseases by occupation (person)	Prevalence (%)
Inspection	323	45	13.9
Processing	207	46	22.2
Finishing	58	7	12.1
Milling	231	55	23.8
Office work	3,000	338	11.3
Lathe	174	38	21.8
Welding	292	87	29.8
Maintenance	156	34	21.8
Signaling	57	11	19.3
Heat management	100	24	24.0
Driving	25	7	28.0
Metal cutting	184	48	26.1
Assembling	197	55	27.9
Molding	107	30	28.0
Crane operation	105	30	28.6

(29.8%), 30 crane operators (28.6%), 30 molders (28.0%), 7 drivers (28.0%), 55 assemblers (27.9%), 48 metal cutters (26.1%), 24 heat treatment (24.0%), 55 millers (23.8%), 46 processors (22.2%), 38 lathe (21.8%), 338 workers in maintenance (11.3%) have been investigated, and although the highest number of workers who received physical therapy was the white-collar workers, occupations with the highest prevalence rate of MSDs was present in welders (Table 3).

Discussion

This study analyzed data collected from 855 heavy industry workers on the prevalence of MSDs present according to occupational category and environment. The most common type of MSDs among the workers was lumbar sprain and spasm. In addition, depending on the occupational category and environment (occupational type), lumbar sprain and spasm was the most common in the 11 occupations, including office worker, welders, cutting, processing, assemblers, lathe, molders, machine maintenance, heat treatment, signalmen, and drivers, and shoulder muscle strain and spasm was the most common in milling, inspection, crane operation, and finishing. In addition, the prevalence rate of MSDs according to occupational category and environment (occupational type) was the highest amongst the welders. The highest frequency of physical therapy visits and the average number of physical therapy treatments by disorder was also the highest for cervical disc protrusion with neuropathy.

The MSDs that arise from workers are closely related to exposure to repetitive tasks along with individual risk factors [10]. In particular, repetitive tasks with physical work may lead to development of MSDs of the body and may be one of the greatest causes of functional loss [2]. In addition, inadequate physical working conditions are also considered to be the greatest risk factors for MSDs [11,12]. In adequate working conditions include working against forces and vibrations, excessive working speeds, uncomfortable head and arm movements, and awkward posture [11,12]. According to the occupational category and environment, the MSDs were present among workers involved in welding (87, 29.8%), crane operations (30, 28.6%), molding (30, 28.0%), driving (7, 28.0%), assembling (55, 27.9%), metal cutting (48, 26.1%), heat treatment (24, 24.0%), milling (55, 23.8%), processing (46, 22.2%), lathe (38, 21.8%), and maintenance (34, 21.8%) in this following order, and the prevalence rate of MSDs was greater than 20% in 11 occupa-

tions, and among them, the highest prevalence rate was amongst welders (Table 3). The welding positions are classified into different viewing postures, such as below, vertical, horizontal, and upper view postures.

Previous studies have reported that the performance of similar repetitive operations as used in welding may lead to trauma to the joints and surrounding tissues [11,12]. Welders engaged in heavy industry have to maintain a certain posture for a period of time before welding is completed. This type of work appears to be a major cause of the high rate of MSDs. Therefore, it is considered that work that requires workers to maintain of a certain posture for a period of time, strong and repetitive use of the lower back, upper, and lower limbs may be the main causes of MSDs such as lumbar sprains and spasm, shoulder muscle sprain and spasm, unspecified knee arthrodesis, and wrist joint sprain. In addition, office workers showed the highest number of MSDs according to surveys. Although the prevalence rate was 11.3%, a relatively large number of MSDs were encountered in the work environment. Previous epidemiologic studies have shown that even though the amount of physical labor may be small, clerical work, repetitive work, fixed overload, and maintaining uncomfortable postures may be a risk factor for developing MSDs [13]. Repetitive use of the keyboard and clicking on the mouse, viewing a monitor on a desk has been characterized by persistent fatigue with constant load [14], thus MSDs can occur when excessive and physical stresses are applied to the musculoskeletal system due to the work classification and environment. Workload has a large impact, but if the posture required for the task is fixed for a long time, this repeated posture can reduce blood circulation and increase muscle tension, leading to MSDs [14]. Also, performing repetitive tasks without rest or recovery time can lead to musculoskeletal injuries [1]. This leads to decrease in work capacity and productivity of the workers, which can lead to economic and social losses. Therefore, it is important to develop a system to prevent MSDs that can occur among the workers or manage the disorder effectively. However, the risk factors for MSDs vary from country to country, and there are other risks associated with workplaces in different sectors, and the causes of injuries and diseases also vary [15]. In addition, personal as well as physical and psychological factors may also play a role in the development of MSDs [16]. Therefore, each of the worker's type and characteristics are identified, and it is necessary to establish a systematic system to prevent MSDs that may occur in the future and to manage them efficiently.

However, although the type and prevalence of MSDs were examined according to occupation, the characteristics of each occupation were not understood in detail and the personal, physical, and psychological factors have not been fully considered. Due to these limitations, this study may not be sufficient to prevent MSDs and to establish an efficient management system. In addition to the work classification and environment, further studies should investigate factors such as vibration, contact stress, inadequate attitudes and relationships with supervisors, psychological factors, conflicts with colleagues, pressure to achieve high performance associated with MSDs by body parts, and personal characteristics of sex, age, education level, smoking habits, alcohol consumption, and a variety of other factors that may lead to WMSDs, such as years of work experience.

Conflict of Interest

The authors declared no potential conflicts of interest with respect to the authorship and/or publication of this article.

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