

Review

Association between Upper Extremity Musculoskeletal Disorders and Psychosocial Factors at Work: A Review on the Job DCS Model's Perspective

Jung-Keun PARK and Seung-Hee JANG

Center for Occupational Disease Research, Occupational Safety and Health Research Institute, KOSHA, Incheon, Korea

Over years it has been increasingly concerned with how upper extremity musculoskeletal disorders (UEMSDs) are attributed to psychosocial job stressors. A review study was conducted to examine associations between UEMSDs and psychosocial work factors, and to recommend what to consider for the associations. For studies in which the job demand-control-support (DCS) model or its variables were specifically employed, published papers were selected and reviewed. A number of studies have reported relationships between UEMSDs symptoms and psychosocial exposure variables. For example, the findings are: higher numbness in the upper extremity was significantly attributed to by less decision latitude at work; work demands were significantly associated with neck and shoulder symptoms while control over time was associated with neck symptoms; and the combination of high psychosocial demands and low decision latitude was a significant predictor for shoulder and neck pain in a female working population. Sources of bias, such as interaction or study design, were discussed. UEMSDs were shown to be associated with psychosocial work factors in various studies where the job DCS model was addressed. Nonetheless, this review suggests that further studies should be conducted to much more clarify the association between UEMSDs and psychosocial factors.

Key Words: UEMSDs, Psychosocial work factors, Job DCS model

Introduction

Upper extremity musculoskeletal disorders (UEMSDs) have been frequently reported for elevated risks in workers exposed to psychosocial work factors in different countries. Disorders or economic cost issues due to MSDs have been increasing, making work-related musculoskeletal problems one of the most serious health problems over past decades [1-7].

According to a report presented by an International Labor Office (ILO) researcher [1], musculoskeletal complaints are a

major cause of absence due to sickness in developed countries. The researcher reported that the cost of work-related MSDs, based on a NIOSH report in 1996, was estimated at about US\$ 13 billion in the United States, and it ranged from 2.7% to 5.2% of the gross national product in Nordic countries in 1991. Up to 60% of people on early retirement or long-term sick leave claimed MSDs as a reason in Sweden. In Korea, MSD cases accounted for 68%, 74% and 77%, respectively, of non-fatal occupational illness cases approved in workers' compensation claims for the years of 2006, 2007 and 2008 [2,8].

During recent decades, the contribution of psychosocial stressors to the occurrence of UEMSDs has become increasingly clear. Fig. 1 shows possible associations between UEMSDs and psychosocial factors. Researchers stated that the psychosocial factors, particularly low work content and poor social support, increased the risk for UEMSDs and that

Received: May 18, 2010, **Accepted:** July 29, 2010

Correspondence to: Jung-Keun PARK

Center for Occupational Disease Research, Occupational Safety and Health Research Institute, KOSHA, 34-4, Gusan-dong, Bupyeong-gu, Incheon 403-711, Korea

Tel: +82-32-510-0826, **Fax:** +82-32-502-7197

E-mail: ergo.jkpark@gmail.com

a combination of poor psychosocial work environment and exposure to ergonomic variables (e.g., monotonous work with awkward posture) became a highest risk factor [4,9,10].

The job demand-control-support (DCS) model is a well-known job strain model which consists of three psychosocial factors (i.e., job demand, job decision latitude, and social support) as basic dimensions [11-13]. Information including overview or criticisms of the job DCS model is provided in a study [14] although the model has been documented in a large number of studies. Using the job DCS model, numerous studies have been reported how psychosocial work factors are associated with musculoskeletal symptoms [15-19].

However, in epidemiologic research on musculoskeletal injuries or disorders, individual capacity has mainly been interpreted as physical capacity (e.g., muscle strength, range of movement), whereas little attention has been given to psychological coping capacity or relationships between UEMSDs and psychosocial factors at work. Compared to the studies on low back pain, there are still few research studies that provide for clear understanding of the role of psychosocial stressors in the development of UEMSDs. Thus, there is a need to review how psychosocial work factors contribute to the occurrence of UEMSDs.

This study, focused on studies with respect to the job DCS model, was to examine associations between UEMSDs and psychosocial work factors, and to recommend what to consider for the corresponding associations in the future.

Methods

Since this study was primarily concerned with the association between UEMSDs and occupational psychosocial factors, it was necessary to examine information on how UEMSDs were

associated with psychosocial variables and what relationships between UEMSDs and psychosocial factors were documented in published studies.

We sought studies in which the above study questions were primarily dealt with in the literature. Study papers were gathered using an automatic search from online data bases such as PubMed and ScienceDirect. Some papers were collected from author's (JKP) data bases [20] and the library of Korea Occupational Safety and Health Agency. When searched through the online data bases, a combination of 'musculoskeletal disorders' and 'psychosocial factors'/'job stress factors' was used as keywords. Once paper lists were obtained, we selected study papers in which the job DCS model or its variables were specifically employed in a cross sectional or longitudinal study. The study papers were reviewed to achieve the objectives of this study while three (2 cross sectional and 1 prospective) of them were exemplified in the section of 'UEMSDs and psychosocial factors at work.' It was assumed this approach could reflect characteristics of associations between UEMSDs and psychosocial work factors on a basis of the job DCS model's perspective. When a study didn't address either MSDs for upper extremity body parts or psychosocial exposure variables, it was excluded.

We intended to describe the findings, such as risk estimates or descriptive statements, on associations between UEMSDs and psychosocial work factors. Definitions of UEMSDs and psychosocial variables were somewhat closely examined. If a term, for instance, was specified in peer-reviewed literature, it was assumed to be objectively used. Information on interaction or bias among study variables was also documented and extensively discussed, expecting that this could lead to better understanding or recommendations for future research.

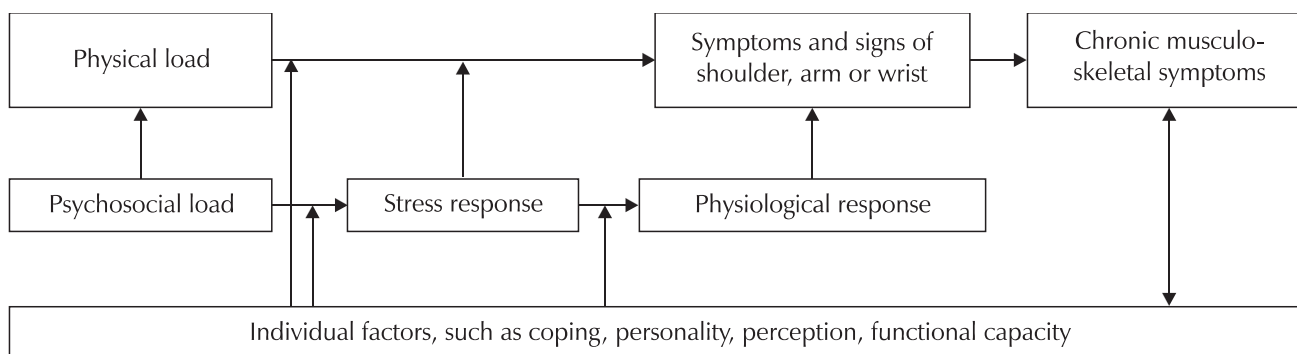


Fig. 1. Interaction between upper extremity musculoskeletal disorder symptoms and psychosocial load, physical load, or individual factors [4].

Musculoskeletal Disorders of the Upper Extremities

UEMSDs refer to soft tissue disorders in the neck, shoulders, arms, wrists, hands and fingers. The soft tissues include nerves, tendons, ligaments, muscle and fascia. Frequently, the disorders are documented as carpal tunnel syndrome, epicondylitis, neck tension syndrome, tendinitis, tenosynovitis, thoracic outlet syndrome, or white finger [4,21,22]. The symptoms of UEMSDs, depending on the type of disorders, are generally characterized by pain, aches, discomfort, numbness, stiffness, and/or weakness.

UEMSDs are prevalent in jobs such as video display terminal (VDT) operators, food processors, automobile and electronics assemblers, carpenters, garment workers, and grocery store cashiers. For example, VDT operators have often reported musculoskeletal symptoms primarily in the upper extremities, neck and shoulders [15]. Moreover, highest incidence rates of UEMSDs have occurred in industries where a substantial amount of repetitive, monotonous, and forceful exertion exists at work [21].

UEMSDs affect the soft tissues of the upper extremity in different ways. UEMSDs can be temporary if a rate of work vs. rest is appropriately provided. They, however, can become permanently disabling when exposures to ergonomic risk factors or poor work conditions are prolonged. Repetitive exertions, awkward posture, and mechanical pressure have been recognized as important etiological factors for chronic UEMSDs. For example, long hours of sitting in a static posture and repetitiously keying are considered to influence the development of musculoskeletal symptoms among VDT operators [15]. In particular, the etiologic significance of psychosocial factors impacting musculoskeletal problems has been reported [8,15-19].

Psychosocial Work Factors

Psychosocial work factors generally describe the subjective aspects of work conditions or work organization, and how they are perceived by workers [23]. With the job DCS model, psychosocial exposure variables have been differently classified and addressed, depending on the studies' objectives (Table 1). Still, classification or terminology regarding psychosocial factors is incompletely established. For example, Bongers et al. [5] classified those factors into two categories in one study whereas Bongers et al. [4] classified them in different way in another study. Skov et al. [16] divided them into four categories

Table 1. Psychosocial factors reportedly associated with musculoskeletal symptoms

Category/ factor	Reference
Demand and control	5
Monotonous work	
Time pressure	
High concentration	
High responsibilities	
High work load	
Few opportunities to take breaks	
Lack of clarity	
Low control and little autonomy	
Social support	
Poor social support from colleagues	
Poor social support from superiors	
Demand	16
Job demands (especially items like high demands for concentration and speed in the work)	
Perception of competition	
Control	
Control over the content of the job	
Control over time aspects of the work (items like deciding working hours, holidays)	
Support	
Social contact and support from colleagues	
Support from superiors	
Psychosocial work environment	
Uncertainty of employment prospects (being concerned that one may become unemployed, transferred to another job, etc.)	
Conflicts with colleagues	
Work role ambiguity (unclearly defined demands in the work)	
Work role conflict (conflicting demands in the work)	
Variation in the work	

when they assessed the psychosocial job characteristics.

In this study, job demand, job decision latitude and social support are regarded as primarily psychosocial factors although other psychosocial variables are addressed as well.

UEMSDs and Psychosocial Factors at Work

Different papers showed a variety of findings on associations between UEMSDs and psychosocial factors. Associations between UEMSDs and psychosocial factors were assessed by researchers who conducted a cross sectional study for VDT

Table 2. Multiple regression analyses of upper extremity symptom severity among newsroom employees (adapted from [15])

Step	Dependent variable (n = 70)					
	Pain severity			Numbness severity		
	R ² change	sr ²	CUM R ²	R ² change	sr ²	CUM R ²
Step 1. VDT use	0.01		0.01	0.01		0.01
Step 2. Work posture	0.11		0.12	0.15		0.16
Step 3. JCI scales*	0.03		0.15	0.12 [§]		0.28
Decision latitude					0.06 [§]	
Interaction steps						0.41
DecLat × Relkybd [†]				0.07 [§]		
JobInsc × Relkybd [‡]				0.06 [§]		

*Job Content Instrument (JCI) subscales used at step 3.

[†]DecLat × Relkybd = Decision latitude × Relative keyboard height.

[‡]JobInsc × Relkybd = Job insecurity × Relative keyboard height.

[§]p < 0.05.

^{||}p < 0.01.

operators in a large newspaper [15]. Karasek's Job Content Instrument (JCI) was used for self-reported measures of psychosocial stress factors. The JCI variable like decision latitude was a significant risk factor for potential UEMSDs. For example, Higher numbness in the upper extremity was significantly attributed to by less decision latitude (Table 2). There were also interaction effects, showing that associations between symptom severity and work posture variables were modified by psychosocial factors. Higher numbness in the upper extremity was shown to be associated with keyboard heights above the elbow. For employees reporting high decision latitude, the association between numbness and keyboard heights was quite small.

Various factors including the job DCS model variables were shown to be related to UEMSDs in another cross sectional study (Table 3) [16]. In multivariate analysis of the study, work demands were significantly associated with neck and shoulder symptoms [odds ratios (OR): 1.43 to 1.47]. Control over time at work was also significantly associated with neck symptoms (OR: 1.44). These findings are consistent with those of other researchers [5,19]. On the other hand, an interaction between perceived competition and control over time was found in the study, showing that only the combination of high demands and low control was associated with an increased risk of neck symptoms.

In a prospective study [19], the combination of high job demands and low decision latitude (i.e., job strain) was statis-

Table 3. Significant factors in final models of a multivariate analysis for neck and shoulder body region (adapted from [16])

Factor	Neck	Shoulder
Demands in the work	*	*
Perceived competition	*	
Control over time	*	
Variation in the work	*	
Uncertain employment prospects		*
Sex	*	*
Driving distance	*	
Sedentary work	*	
Time spent in the car		*
Smoking		*

*p < 0.10

tically significant [OR: 1.73, 95% confidence interval (CI) of 1.29-2.31] for shoulder and neck pain in female workers. However, the job strain was not significant in male workers (OR: 1.22, 95% CI of 0.84-1.79). High job demands, low decision latitude, and low support were not associated with elevated risk for developing neck and shoulder pain during follow up in male or female working populations. Additionally, in an analysis

examining effect modification between job strain factor and mechanical exposure factor, the study found evidence which increased the risk of shoulder and neck pain among female but not male workers.

Discussion and Recommendations

A variety of information on associations between UEMSDs and psychosocial factors at work was found in studies where the job DCS model was addressed. Those studies have commonly shown that UEMSDs, independently or in a combined manner, were associated with psychosocial factors at work. In addition, there were shown to be interactions between different sets of variables for UEMSDs and psychosocial factors.

Since it has been received attention to understand relationships between UEMSDs and psychosocial stressors, it is desirable to review, on the basis of the job DCS model's perspective, the extent to which or how UEMSDs are associated with psychosocial work factors. While the three psychosocial variables in the job DCS model are related to musculoskeletal symptoms, they, together with physical factors, are reported to increase work-related stress [15,16,18,19,24]. Also, it has been documented that musculoskeletal symptoms are affected by other psychosocial work factors such as time pressure, low job satisfaction, monotonous work, and job insecurity [5,19,25].

Furthermore, a study has comprehensively reviewed associations between UEMSDs and psychosocial work factors [5]. For psychosocial factors regarding job demand and control, a number of the cross-sectional studies reported there were relationships between psychosocial variables and symptoms of the neck or shoulders. Longitudinal studies also provided a positive relationship between neck pain and time pressure. Yet, there is evidence that high work demands increased the prevalence of neck or shoulder symptoms.

There still seem, however, to be contradictions in findings among studies. It was recognized that researchers didn't present conclusive evidence due to complex correlations between UEMSDs and psychosocial factors, and difficulties in measuring work/ nonwork factor variables [4,5,22]. Westgaard [9] also stated difficulty obtaining consistent results on association between psychosocial strain and musculoskeletal pain for both the conceptual and operational variables.

MSDs are predicted to be the most prevalent of the major diseases among United Kingdom workers over the coming 20 years [26]. Researchers document that pain appears to occur more frequently from the shoulder and neck although low back pain has been the dominant problem for a long time [19].

Thus, it is necessary to more sufficiently assess the association between UEMSDs and psychosocial stressors since UEMSDs increasingly account for the economic costs as well as occupational illness cases. For a study on relationships between UEMSDs and psychosocial work factors, it is necessary to assess both musculoskeletal symptom duration/ type from self-reports and musculoskeletal signs from physical examinations [5,17]. Moreover, a clear distinction between sets of UEMSD physical risk factors, symptom persistence, or disability prediction appears to be important.

This study restrictively dealt with questions on association between UEMSDs and psychosocial work factors. In fact, there are other aspects of questions related to UEMSDs or psychosocial work factors. Many researchers have reported that workers with jobs characterized by psychosocial factors have a high risk of other endpoints such as cardiovascular diseases or burnout syndrome [13,14,27], which adversely affect musculoskeletal symptoms. The present study may encompass sources of bias in that the reviewed studies include the cross-sectional study design. Longitudinal studies can provide clearer relationships between UEMSDs and psychosocial work factors [14]. Thus, future studies on UEMSDs and psychosocial factors should be longitudinal, directed towards the analysis of symptom development or persistence. Such studies may provide further useful information on correlations or interactions between biomechanical load, psychosocial factors, and stress symptoms at work. At least, those studies would provide stakeholders with better insight to set priorities in the prevention of UEMSDs and psychosocial stress at work.

References

1. Niu S. Ergonomics and occupational safety and health: An ILO perspective. Proceedings of 17th World Congress on Ergonomics (CD), International Ergonomics Association. Beijing, China, August 2009.
2. Park JK, Kim KS, Kim JY, Kim JY. Effects of factors on low back pain symptoms in Korean hospital workers, Proceedings of 17th World Congress on Ergonomics (CD), International Ergonomics Association, Beijing, China, August 2009.
3. Kim YC, Lee KS, Chang SR, Choi EJ, Hong CW. Economic analysis of work-related musculoskeletal disorders in Korea. Proceedings of 15th World Congress on Ergonomics (CD), International Ergonomics Association, Seoul, Korea, July 2003.
4. Bongers PM, Kremer AM, ter Laak J. Are psychosocial factors, risk factors for symptoms and signs of the shoulder, elbow, or hand/wrist?: A review of the epidemiological literature. *Am J Ind Med* 2002;41:315-42.

5. Bongers PM, de Winter CR, Kompier MA, Hildebrandt VH. Psychosocial factors at work and musculoskeletal disease. *Scand J Work Environ Health* 1993;19:297-312.
6. National Institute for Occupational Safety and Health (NIOSH). Musculoskeletal disorders and workplace factors, A critical review of epidemiologic evidence for work-related musculoskeletal disorders of the neck, upper extremity, and low back, 2nd printing, US Department of Health and Human Services, NIOSH Publication 1997: No. 97-141.
7. Brogmus GE, Sorock GS, Webster BS. Recent trends in work-related cumulative trauma disorders of the upper extremities in the United States: an evaluation of possible reasons. *J Occup Environ Med* 1996;38:401-11.
8. Park JK, Kim DS, Seo KB. Musculoskeletal disorder symptom features and control strategies in hospital workers. *Journal of the Ergonomics Society of Korea* 2008;27:81-92.
9. Westgaard RH. Work-related musculoskeletal complaints: some ergonomics challenges upon the start of a new century. *Appl Ergon* 2000;31:569-80.
10. Johansson JÅ, Kadefors R, Rubenowitz S, Klingenstierna U, Lindström I, Engström T, Johansson M. Musculoskeletal symptoms, ergonomic aspects and psychosocial factors in two different truck assembly concepts. *International Journal of Industrial Ergonomics* 1993;12:35-48.
11. Karasek RA Jr. Job demands, job decision latitude, and mental strain: implications for job redesign. *Administrative Science Quarterly* 1979;24:285-308.
12. Karasek R, Baker D, Marxer F, Ahlbom A, Theorell T. Job decision latitude, job demands, and cardiovascular disease: a prospective study of Swedish men. *Am J Public Health* 1981;71:694-705.
13. Karasek R, Theorell T. *Healthy work: stress, productivity, and the reconstruction of working life*. Basic Books, 1990.
14. Kristensen TS. The demand-control-support model: methodological challenges for future research. *Stress Medicine* 1995; 11:17-26.
15. Faucett J, Rempel D. VDT-related musculoskeletal symptoms: interactions between work posture and psychosocial work factors. *Am J Ind Med* 1994;26:597-612.
16. Skov T, Borg V, Orhede E. Psychosocial and physical risk factors for musculoskeletal disorders of the neck, shoulders, and lower back in salespeople. *Occup Environ Med* 1996;53: 351-6.
17. Toomingas A, Theorell T, Michélsen H, Nordemar R. Associations between self-rated psychosocial work conditions and musculoskeletal symptoms and signs. Stockholm MUSIC I Study Group. *Scand J Work Environ Health* 1997;23:130-9.
18. MacDonald LA, Karasek RA, Punnett L, Scharf T. Covariation between workplace physical and psychosocial stressors: evidence and implications for occupational health research and prevention. *Ergonomics* 2001;44:696-718.
19. Ostergren PO, Hanson BS, Balogh I, Ektor-Andersen J, Isacson A, Orbaek P, Winkel J, Isacsson SO; Malmö Shoulder Neck Study Group. Incidence of shoulder and neck pain in a working population: effect modification between mechanical and psychosocial exposures at work? Results from a one year follow up of the Malmö shoulder and neck study cohort. *J Epidemiol Community Health* 2005;59:721-8.
20. Park JK. An association between psychosocial work factors and musculoskeletal disorders of upper extremities, a course report (unpublished), Work Environment Department, University of Massachusetts Lowell, 2001.
21. DiNardi SR. *The occupational environment-its evaluation and control*. Fairfax: AIHA press, 1997.
22. Lundberg U. Psychophysiology of work: stress, gender, endocrine response, and work-related upper extremity disorders. *Am J Ind Med* 2002;41:383-92.
23. Hagberg M, Silverstein B, Wells R, Smith MJ, Hendrick HW, Carayon P, Perusse M. *Work related musculoskeletal disorders (WMSDs): a reference book for prevention*. London: Taylor and Francis, 1995.
24. Sim J, Lacey RJ, Lewis M. The impact of workplace risk factors on the occurrence of neck and upper limb pain: a general population study. *BMC Public Health*, 2006; 6:234 Available from: <http://www.biomedcentral/1471-2458/6/234>
25. Warming S, Precht DH, Suadicani P, Ebbelhøj NE. Musculoskeletal complaints among nurses related to patient handling tasks and psychosocial factors--based on logbook registrations. *Appl Ergon* 2009;40:569-76.
26. Vaughan-Jones H, Barham L. *Healthy work - Challenges and opportunities to 2030*, Bupa, <http://www.bupa.co.uk> at accessed [February 10, 2010]
27. Jaworek M, Marek T, Karwowski W, Andrzejczak C, Genaidy AM. Burnout syndrome as a mediator for the effect of work-related factors on musculoskeletal complaints among hospital nurses. *International Journal of Industrial Ergonomics* 2010; 40:368-75.