

## **CHAPTER II**

### **LITERATURE REVIEWS**

#### **2.1 Definition of work-related musculoskeletal disorders**

The National Institute for Occupational Safety and Health, NIOSH [32] defines that Musculoskeletal disorders as a group of conditions that involve the nerves, tendons, muscles, and supporting structures such as intervertebral discs. They represent a wide range of disorders, which can differ in severity from mild periodic symptoms to severe chronic and debilitating conditions. Examples such as carpal tunnel syndrome, tenosynovitis, and tension neck syndrome, and low back pain.

Musculoskeletal disorder (MSDs) are disorders of the soft tissues and their surrounding structures not resulting from an acute or instantaneous event ( e.g., slips or falls).in the epidemiologic literature, MSD can be group as 3 types [33]:

- a. Clinically well-defined disorders (such as tendonitis, carpal tunnel syndrome, and hand-arm vibration syndrome)
- b. Less clinical well-defined conditions (such as tension neck syndrome)
- c. Nonspecific (such as repetitive strain injury, cumulative trauma disorders, overuse syndrome, and cervicobrachial disorders).

In the etiology of the musculoskeletal disorders, there are a number important to be considered: 1- physical, organizational, and social aspect of work and the workplace, 2-physical and social aspects of life outside the workplace (sports, exercise programs, etc), economical incentives and cultural values, the physical and psychological characteristics of the individual [34].

When attributed to or exacerbated by the work environment, musculoskeletal disorders are also referred to as work-related musculoskeletal disorders (WMSD) which can cause symptoms such as pain, numbness, and tingling, as well as reduced worker productivity, lost time from work, temporary or permanent disability [32].

## **2.2 Magnitude of work-related musculoskeletal disorders**

A total of 1,537,600 injuries and illness that required recuperation away from work beyond the day of the incident were reported in private industries workplaces during 2001 in the United States, according to a survey by the Bureau of Labor Statistics [35]. During this year, over 582,000 musculoskeletal disorders (34.25%) were reported, accounting for more than one of the injuries and illness with days away from work. Although both, total injuries and illness with days away from work by musculoskeletal disorders have decreased since 1992, these disorders continue to account for more than one in three of the total work-time cases.

According to the National Research Council and the Institute of Medicine, musculoskeletal disorders account for nearly 70 millions physician-office visits in the United States annually and an estimate 130 million total health care encounters including outpatients, hospital and emergency room visits. In 1999, nearly one million people took time away from work to treat and recover from work-related musculoskeletal pain or disability in the low back and upper extremities [36].

Musculoskeletal disorders are commonly reported work-related health problem by European workers: 30% complain of backache; 17% complain of muscular pains in the arms and legs. For example, 10,444 cases of musculoskeletal diseases in the workplace were reported in Sweden during 1998, nearly 67% for all reported work-related diseases [36]. Heavy lifting was the cause most frequently given (4,600 cases), following by one-side/ monotonous work (2,700 cases) and hectic working pace and stress (1,000 cases).

Wester and Snook, 1994 cited by Bernard, estimated that the mean compensation cost per case of upper-extremity, work-related musculoskeletal disorders was \$8,070 in 1993 [37]; the total U.S. compensable cost for upper extremity, work-related MSD was \$563 million in 1993. For example, the State of Washington averaged 44,648 work-related MSD claims, with an average total cost of \$166.8 million/year for the period 1992–94.

The only routinely collected national source of information about occupational injuries and illnesses of U.S. workers is the Annual Survey of Occupational Injuries and Illnesses conducted by the Bureau of Labor Statistics (BLS) of the U.S. Department of Labor [37]. The survey, which BLS has conducted for the past 25

years, is a random sample of about 250,000 private sector establishments and provides estimates of workplace injuries and illnesses on the basis of information provided by employers from their Occupational Safety & Health Administration (OSHA) Form 200 log of recordable injuries and illnesses. For cases involving days away from work, BLS reports that in 1994 (the last year of data available at the time this report was prepared) approximately 705,800 cases (32%) were the result of overexertion or repetitive motion. Specifically, there were:

- 367,424 injuries due to overexertion in lifting (65% affected the back); 93,325 injuries due to overexertion in pushing or pulling objects (52% affected the back); 68,992 injuries due to overexertion in holding, carrying, or turning objects (58% affected the back). Totaled across these three categories, 47,861 disorders affected the shoulder.

- 83,483 injuries or illnesses in other and unspecified overexertion events.

- 92,576 injuries or illnesses due to repetitive motion, including typing or key entry, repetitive use of tools, and repetitive placing, grasping, or moving of objects other than tools. Of these injuries or illnesses, 55% affected the wrist, 7% affected the shoulder, and 6% affected the back.

Data for 1992 to 1995 indicate that injuries and illnesses requiring days away from work declined 19% for overexertion and 14% for repetitive motion. The incidence rate of overexertion (in lifting) declined from 52.1 per 10,000 workers in 1992 to 41.1 in 1995; the incidence rate for repetitive motion disorders declined from 11.8 per 10,000 workers in 1992 to 10.1 in 1995. These declines are similar to those seen for cases involving days away from work from all causes of injury and illness [37].

### 2.3 Physical factors and work-related musculoskeletal disorders

Repetitive, forceful or prolonged exertions of the hands; frequent or heavy lifting, pushing, pulling ,or carrying of heavy objectives; prolonged awkward postures; and vibration contribute to musculoskeletal disorders. Job or working conditions that combine risk factor will increase the risk for musculoskeletal problems. According to Hagberg et al [38], the generic risk factors for musculoskeletal disorders are grouped in operational way that is useful in explaining the work relatedness of musculoskeletal disorders that has biological plausibility and has a strong connection with workplace environment. Eight categories are recognized by Hagberg (See table 1). Several studies (meta- analysis) have been developed in the world showing important evidence between the musculoskeletal disorders and different physical and psychological work factors and individual factors [37].

**Table 1** Generic risk factor groups for work-related musculoskeletal disorders

<b>Generic Risk Factor Groups for Work-related Musculoskeletal Disorders</b>
Cold, vibration local mechanical stress
Postures
Musculoskeletal load
Static load
Task invariability
Cognitive demands
Organizational and psychosocial work characteristics

**Source:** Work-related musculoskeletal disorders (WMSD): a reference book for Prevention [38]

Physical factors include frequent or prolonged repetitive movements, forceful exertions, awkward postures, static muscle loads, and cold temperatures, local or segmental vibrations, and contact stresses. Exposure to these factors typically occurs in some combination [37] (See table 2).

**Table 2** Evidence for causal relationship between physical work factors and MSD

<b>Body part Risk factor</b>	<b>Strong Evidence (+++)</b>	<b>Evidence (++)</b>	<b>Insufficient Evidence (+/0)</b>	<b>Evidence of No Effect (-)</b>
<b>NECK and NECK / SHOULDER</b>				
Repetition		++		
Force		++		
Posture	+++			
Vibration			+/0	
<b>SHOULDER</b>				
Posture		++		
Force			+/0	
Vibration		++		
Repetition			+/0	
<b>ELBOW</b>				
Repetition			+/0	
Force		++		
Posture			+/0	
Combination	+++			
<b>HAND / WRIST</b>				
<b>Carpal tunnel syndrome</b>				
Repetition		++		
Force		++		
Posture			+/0	
Vibration		++		
Combination	+++			
<b>Tendonitis</b>				
Repetition		++		
Force		++		
Posture		++		
Combination	+++			

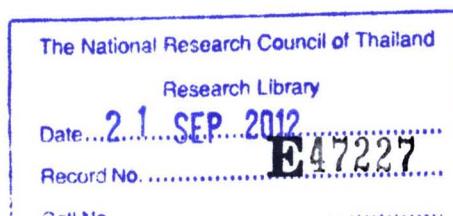
**Table 2** Evidence for causal relationship between physical work factors and MSD (Cont.)

<b>Body part Risk factor</b>	<b>Strong Evidence (+++)</b>	<b>Evidence (++)</b>	<b>Insufficient Evidence (+/0)</b>	<b>Evidence of No Effect (-)</b>
<b>Hand-arm vibration syndrome</b>				
Vibration	+++			
<b>BACK</b>				
Lifting/forceful movement	+++			
Awkward posture		++		
Heavy physical work		++		
Whole body vibration	+++			
Static work posture			+/0	

**Source:** Bruce P. Bernard (1997). A Critical Review of Epidemiologic Evidence for Work-Related Musculoskeletal Disorders of the Neck, Upper Extremity, and Low Back [37]

#### 2.4 Psychosocial factors and work-related musculoskeletal disorders

In general, four plausible types of explanations have been suggested to account for associations between work-related psychosocial factors and MSD. First, psychosocial demands may produce increased muscle tension and exacerbate task-related biomechanical strain. Second, psychosocial demands may affect awareness and reporting of musculoskeletal symptoms, and/or perceptions of their cause. Within this second explanation may fall the “perverse incentive” view, in which societies may provide workers with systems (such as workers' compensation) that may lead to over reporting of MSD symptoms. Third, initial episodes of pain based on a physical insult may trigger a chronic nervous system dysfunction, physiological as well as psychological, which perpetuates a chronic pain process. Finally, in some work situations, changes in psychosocial demands may be associated with changes in physical demands and biomechanical stresses, and thus associations between psychosocial demands and MSD occur through either a causal or effect-modifying relationship.



One of the most recognized and most frequently tested models of work stress, the Demand-Control-Support model (DCS) and, assumes that employees who perceive high job demands, low job control (i.e., work strain), and low social support are likely to develop many health problems. This is a conceptual model of the interaction between job demands and job control (decision latitude) and its effect on ill health. High demands in combination with low decision latitude i.e., “job strain” are hypothesized to have especially adverse health effects. Social support is assumed to moderate this relationship, Job strain, workplace social support, and cardiovascular disease: a cross-sectional study of a random sample of the Swedish working population, *American Journal of Public Health*), such that insufficient levels of social support will enhance the adverse health effects of job strain (isolation strain termed ‘iso-strain’). In a recent review of risk factors for neck and upper limb symptoms Bongers et al conclude that high work demands or low job control often are related to such symptoms, but that this relationship is neither very strong nor very specific. In that review, it was also found that most studies investigating job strain report a relationship between the combined effects of high demands and low control and neck and shoulder symptoms. Another review found modest support for the hypothesis that the combination of high demands and low control is especially related to poor health and well-being in general.

Some models of stress suggest unidirectional relations between social support and job demands or control (or other work stress dimensions) or no direct relations between these constructs. For example, the Michigan model hypothesizes that social support affects perception of work stress characteristics. It is also possible that the relations between social support and job demands or job control are bidirectional. The transactional perspective on stress emphasizes the interaction between person and environment and reciprocity of the person-environment relation. In line with this approach high perceived social support may affect perceiving high job control or low job demands.

The majority of the research analyzing relations among work characteristics focused on effects of support on work strain characteristics. Social support from different sources predicted perception of lower work stress and. Workers with high support from managers were less likely to report role conflict, role ambiguity, or work

overload. Academic managerial support predicted job control but not job demands among nurses during academic training. However, opposite relations were also found: high task related-overload predicted a lower level of social support 12 months later.

### **Mental demand**

Job characteristic was decided by workload. Moreover, worker' attention, memory, and concentration can influence the working efficiency. To some degree, responsibility and deadline time is playing important role on job, which will make workers to get depressed.

### **Job control**

Any participation can design or distribute to control routine works, including putting the job, decision, and time and process controlling or making authority.

For the assessment of job control, workers answered 6 questions referring to cognitive and behavioral aspects of control, such as “you are able to control various job-management”, “you are able to deal with the important job”, “and you are able to handle time-management”.

### **Social support**

Limited social support from supervisors and coworkers has been found to be positively associated with a variety of upper extremity symptoms [24].

## **2.5 Individual factors and work-related musculoskeletal disorders**

### **Age**

The prevalence of MSD increases as people enter their working years. By the age of 35, most people have had their first episode of back pain [32, 39]. Once in their working years (ages 25 to 65); however, the prevalence is relatively consistent [39]. Musculoskeletal impairments are among the most prevalent and symptomatic health problems of middle and old age. Nonetheless, age groups with the highest rates of compensable back pain and strains are the 20–24 age group for men, and 30–34 age group for women. In addition to decreases in musculoskeletal function due to the development of age-related degenerative disorders, loss of tissue strength with age may increase the probability or severity of soft tissue damage from a given insult.

Another problem is that advancing age and increasing number of years on the job are usually highly correlated. Age is a true confounder with years of employment,

so that these factors must be adjusted for when determining relationship to work. Many of the epidemiologic studies that looked at populations with a wide age variance have controlled for age by statistical methods [32].

### **Gender**

Some studies have found a higher prevalence of some MSD in women [33, 39]. Hagberg and Wegman [40] reported that neck and shoulder muscular pain is more common among females than males, both in the general population and among industrial workers. In the Silverstein study of Carpal tunnel syndrome (CTS) among industrial workers [41], no gender difference could be seen after controlling for work exposure. Ulin et al [42] noted that significant gender differences in work posture were related to stature and concluded that the lack of workplace accommodation to the range of workers' height and reach may, in part, account for the apparent gender differences. The reporting bias may exist because women may be more likely to report pain and seek medical treatment than men [33, 43]. The fact that more women are employed in hand-intensive jobs and industries may account for the greater number of reported work-related MSD among women.

### **Smoking**

Several papers have presented evidence that a positive smoking history is associated with low back pain, sciatica, or intervertebral herniated disc [44, 45]; whereas in other, the relationship was negative [46]. Boshuizen et al [47] found a relationship between smoking and back pain only in those occupations that required physical exertion. In their study, smoking was more clearly related to pain in the extremities than to pain in the neck or the back. Deyo and Bass [48] observed that the prevalence of back pain increased with the number of pack-years of cigarette smoking and with the heaviest smoking level. Heliovaara et al [49] only observed a relationship in men and women older than 50 years. The Viikari-Juntura et al [50] prospective study of machine operators, carpenters, and office workers, current smoking [OR 1.9 (95% CI: 1.0, 3.5)], was among the predictors for change from "no neck trouble" to "severe neck trouble." However, the anti-smoking campaign in Thailand was very effective so that there was infrequent to see smokers. The smokers were rare among the Thai nurses.

## **Weight / Height**

Weight, height, body index (BMI, a ratio of weight to height squared), and obesity have all been reported to be potential risk factors for CTS. Most of studies examining anthropometric risk factors in relationship to CTS have been hospital-based populations; Werner et al estimated obese individual (BMI >29) were 2.5 times more likely than slender individual (BMI <20) to be diagnosed with CTS. Study using multiple liner regression models found that BMI accounted for only 5% and 8.6% of the variance of the nerve conductions tests.

## **2.6 Nurses and work-related musculoskeletal disorders**

Disorders of the musculoskeletal system are common among health care workers, with the nursing population at particularly high risk. Studies have found that the lifetime prevalence of back pain among hospital and nursing home direct care staff ranges from 43% to 80%. In a study of home health nurses, Knibbe and Friele [51] found lifetime prevalence for back pain of 87%, while 67% of nursing staff reported back pain in the previous 12 months. Leighton and Reilly [52] found a point prevalence of 24% and an annual prevalence of 59%, which figures were not statistically different from the prevalence rates for the same time periods for the general population (N=315).

Although nurses represent just 33% of the hospital work force, they account for 60% of the reported occupational injuries [53]. Occupational back pain is an especially frequent complaint. Harber et al [54] reported that 52% of nurses reported experiencing work-related back pain within a 6-month period. Lifting patients in bed, transferring patients out of bed, and lifting patients from the floor were the job activities most commonly reported as sources of back pain among nurses [55].

When taking patient weight as risk factors, Owen et al [56] studied nursing home personnel to identify and rank order high-risk nursing tasks. They used a 50th percentile for weight patient in their back compressive force model and found the mean compressive force on the L5/S1 disc was 4800 N for several types of patient transfer tasks. In their later study, Owen and Garg [57, 58] used a nine point exertion/stress scale to measure the ranks for stressfulness on patient handling tasks (See table 3).

Nancy N et al [59] had studied that association between the performance of high-risk patient-handling tasks and self-reported musculoskeletal discomfort in 113 nursing staff members in a veterans' hospital within the United States. 67% of subjects reported a 7-day prevalence of moderately severe musculoskeletal discomfort. There was a significant association between wrist and knee pain and the number of highest-risk patient-handling tasks performed per hour interacting with the load lifted. In their research, they focused on physical workload factors, which are the causes of musculoskeletal disorder during working. For patient-handling and working tasks, they adopted Nelson's hazard ranking categories [60] (See Table 4).

**Table 3** Patient handling tasks ranked for stressfulness

<b>Client Handling Task</b>	<b>Rank Order</b>
Transferring client from toilet to chair	1
Transferring client from chair to toilet	2
Transferring client from chair to bed	3
Transferring client from bed to chair	4
Transferring client from bathtub to chair	5
Transferring client from chairlift to chair	6
Weighing client	7
Lifting client up in bed	8
Changing absorbent pad	11
Making bed with client in it	12
Undressing client	13
Tying supports	14
Feeding bed ridden client	15
Making bed when client not in it	16

**Source:** Owen and Garg (1991) [58]

**Table 4** Patient-handing tasks by risk category

<b>Category I (High Risk)</b>	<b>Category II (Higher Risk)</b>	<b>Category III (Highest Risk)</b>
<ul style="list-style-type: none"> <li>- Pushing patient in a wheelchair</li> <li>- Transporting patient in a shower trolley/Stretcher</li> <li>- Bathing patient in a shower chair/shower trolley</li> </ul>	<ul style="list-style-type: none"> <li>- Transferring patient from bed to wheelchair using a mechanical lift</li> <li>- Repositioning a patient in bed (moving to head of bed)</li> <li>- Repositioning patient in bed (side to side)</li> <li>- Weighing patient using sling lift/bed scale</li> <li>- Lifting patient from floor using a mechanical lift</li> <li>- Manually transferring a patient from bed to shower trolley</li> <li>- Bathing patient in bed</li> </ul>	<ul style="list-style-type: none"> <li>- Wheelchair/bathtub to toilet/bed or from toilet/bed to wheelchair/bathtub</li> <li>- Repositioning a patient a dependency chair or wheelchair</li> <li>- Making an occupied bed</li> <li>- Dressing a patient (clothing)</li> <li>- Manually transferring a patient from bed to stretcher</li> <li>- Performing neurogenic bowel care in bed</li> <li>- Transferring a patient from bed to chair using a stand-assist lift</li> </ul>

**Source:** Nelson's hazard ranking categories [60]

## **2.7 Standardized Nordic questionnaire**

The symptom-survey section was a modification of the standardized Nordic Questionnaire [26] and consisted of questions referring to nine body areas. A simple body figure with 9 body areas highlighted (3 upper limb, 3 lower limb, and 3 trunk) was incorporated to help the respondents answer "yes" or "no" to the question, "During the last 12 months, have you had a job-related ache, pain, discomfort, and so on (in any of 9 different body segments)?"

## **2.8 Job content questionnaire**

As part of this continuing research was the development of the Job Content Questionnaire (JCQ), based on the demand-control model of job strain, in which those workers who have high psychological demands but low decision authority are considered to be in a high-strain job. Workers in high-strain jobs have an increased risk for the development of cardiovascular diseases. Later, another dimension, social support, was added to the theory. Studies regarding job demands, job control, and musculoskeletal symptoms reported associations not only between musculoskeletal symptoms and psychological job demands, but also found that psychological job demands were related to high levels of physical exertion on the job. Araújo et al evaluated psychosocial aspects of the work performed by female nurses. Results showed a significant association between job control and psychological distress.