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Review Article

The Prevalence, Causes and Prevention of Occupational Musculoskeletal Disorders

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Abstract: Musculoskeletal disorders (MSDs) are collectively referring to an array of conditions affecting the human locomotor system, such as muscles, nerves, joints, tendons and spinal discs. MSDs related to work are called occupational MSDs and are typically caused by physical factors consisting of repetitive tasks, forceful exertions, awkward positions, vibration due to use of vibrational tools and prolonged staying in the same positions. These physical factors are often complicated by psychosocial factors comprising job demand, job control, social support, job satisfaction, job security, work arrangement, etc. which can aggravate the biomechanical loading imposed by physical factors, thus resulting in more severe outcomes. Besides, individual factors such as health conditions, age, education level and medical history could lead to highly variable physiological responses and internal tolerances, hence outcomes. As the physical and psychosocial risk factors vary widely in different workplaces, the prevalence of MSDs tends to vary with sectors, occupations and even regions. Generally, healthcare sector has been reported to have relatively high occupational MSDs cases in multiple nations. To prevent occupational MSDs, priority should be given to elimination of the associated risks through job and workplace designs and management. Where elimination is not practical, the risks could be reduced through modification of workplace layout, work environment, work systems and tools as well as the use of mechanical aids. Provision of information, instruction and training, and other administrative controls such as job rotation which do not target at reducing the risks would have lower priority and should be used together with other control measures of higher priority.

Keywords: Locomotor, physical, psychosocial, elimination, administrative.

1. INTRODUCTION

'Musculoskeletal disorders' (MSDs) is a collective term for a wide range of conditions affecting the human locomotor system [1]. MSDs can be short-lived due to strains and sprains or lasting as a result of bodily injuries which impose limitations and disability [1]. Individuals with MSDs often experience persistent pain in one or multiple parts of their bodies, such as neck and lower back which constrains their mobility and dexterity. This affects their ability to perform certain work or their working ability generally [2].

MSDs comprise conditions related joints such as gout, rheumatoid arthritis and osteoarthritis, bones such as fractures and osteoporosis, muscles such as lower back pain, as well as spine such as degenerative disc [3]. MSDs could affect multiple parts of the body leading to widespread pain. MSDs can be caused by numerous factors which are largely categorized as individual-related and work-related [4]. Individual-related factors include incorrect ergonomic practices either at or beyond work which are characterized by inappropriate lifting techniques, incorrect postures and body mechanics which exert stress on the body, thus increasing fatigue and delaying recovery [5]. Besides, poor health habits such as a lack of exercise, smoking and excessive drinking could increase the risk of MSDs [6]. Inadequate rest might delay recovery or aggravate existing MSDs while poor nutrition and hydration slow down the recovery from MSDs and put people at higher risk of MSDs [7]. Malnutrition not only affects developing nations where accessibility to food of the people therein could be limited by income, it also affects developed nations due to selective food intake and consumption of food with low nutrition values [8]. Medical history and existing medical conditions, in addition to demographic factors such as age, are likely to predispose an individual to MSDs [6].

Work-related factors of MSDs, on the other hand, are directly linked to the occupation of an individual and MSDs resulted from work-related factors are often also called occupational MSDs [9]. Work-related factors of MSDs include repetitive tasks which demand quick cycles of repeating a task, as well as forceful exertions which require high muscular effort to produce high force [9]. More detailed causes of occupational MSDs will be discussed in a subsequent section. Occupational MSDs have significant implications on cost and productivity. Taking the European Union (EU) for instance, MSDs are the major cause of working days lost and individuals with MSDs are significantly more likely to be absent from work than those without [10]. Production loss associated with MSDs amounted to EUR 17.2 billion in Germany in 2016, equivalent to 0.5% of its gross domestic product (GDP) [10]. Occupational MSDs accounted for 12% and 23% of total burden of disease and injury, and non-fatal burden of Australia respectively, in 2011. The cost associated with occupational MSDs in Australia exceeded $24 billion in 2012-13. In 2015-16, serious claims for occupational MSDs and injuries made up 58% of total serious claims [11].

In view of the implications of occupational MSDs on a nation's economy and productivity, it is necessary to understand the underlying causes of MSDs and effective ways to prevent them. This review illustrates the prevalence of occupational MSDs, their causes as well as prevention.

2. Prevalence of Occupational MSDs

The prevalence of occupational MSDs varies among countries, sectors and demographics. While it is crucial to know the prevalence of occupational MSDs to understand the risks associated with particular sectors and demographics, the related data are scarce. Many nations do not have published data on the prevalence of occupational MSDs, and where these data are available, they are often published by developed nations.

2.1. United States (US)

In the US, MSDs constituted 30% (272,780 cases) of the total 900,380 days away from work (DAFW) cases in the private sector reported as of 2018. This yielded an incidence rate of 27.2 per 10,000 full time workers in comparison to 35.4 in 2011. Incidence rates show a gradual downtrend from 2011 to 2018 (Table 1) [12]. Of the total MSDs cases, 50% came from the retail trade, manufacturing as well as healthcare and social assistance sectors (Table 2). The healthcare and social assistance sector contributed the highest case number of 56,360 among all sectors reported. However, in 2018, it was the information sector which had the highest median DAFW of 33, followed by 26 of the transportation and warehousing sector [12].

Table 1: Occupational MSDs case number, incidence rate and median DAFW in the private sector of the US, 2011-2018 [12]

Year	Case Number	Incidence Rate	Median DAFW
2011	311,840	35.4	11
2012	316,740	35.1	11
2013	307,640	33.5	11
2014	298,460	31.9	13
2015	286,350	29.8	12
2016	285,950	29.4	12
2017	282,750	28.6	13
2018	272,780	27.2	12

Table 2: Occupational MSDs case number, incidence rate and median DAFW by selected sectors in the US, 2018 [12]

Sector	Case Number	Incidence Rate	Median DAFW
Healthcare and social assistance	56,360	38.4	8
Retail trade	41,070	34.8	10
Manufacturing	38,640	30.6	14
Transportation and warehousing	38,350	77.1	26
Construction	19,380	28.9	10
Wholesale trade	18,190	32.2	11
Financial activities	6,330	8.3	21
Information	5,210	20.1	33
Agriculture, forestry, fishing and hunting	2,910	28.5	11

In terms of occupations, 40% of the MSDs cases in the US private sector came from the 10 occupations in Table 3 in 2018. Of the 10 occupations, laborers and freight, stock and material movers reported 25,110 cases, followed by nursing assistants with 15,360 cases and heavy and tractor-trailer truck drivers with 14,810 cases. As far as age groups are concerned, those between 45 and 54 had the highest incidence rate of 31.5 cases per 10,000 full-time workers in 2018, closely followed by those between 55 and 64 with an incidence rate of 31.4 per 10,000 [12].

Table 3: Occupational MSDs case number and median DAFW by occupations in the US, 2018 [12]

Occupation	Case Number	Median DAFW
Laborers and freight, stock and material movers	25,110	13
Nursing assistants	15,360	7
Heavy and tractor-trailer truck drivers	14,810	21
Stock clerks and order fillers	10,150	15
Registered nurses	8,390	8
Light truck or delivery services drivers	8,380	16
Retail salespersons	7,900	8
First-line supervisors of retail sales workers	6,020	12
Maintenance and repair workers, general	6,010	14
Maids and housekeeping cleaners	5,740	12

2.2. United Kingdom (UK)

In the UK, in 2020/21, reports of MSDs were received from 470,000 workers, of which 45% were related to upper limbs or neck, 39% were related to back and 16% were related to lower limbs [13]. MSDs made up 28% of all work-related ill health cases. Similar to the US, MSDs incidence rates have been on a downtrend generally from more than 2,000 in 2001/02 to 1,420 in 2020/21 [13]. In the UK, for the period from 2018/19 to 2020/21, construction sector had the highest incidence rate of MSDs with 1,830 cases per 100,000 workers while the human health and social work sector came in second with 1,500 cases per 100,000 workers, unlike in the US where it topped the chart (Figure 1) [13]. For the same period, skilled trades occupations recorded the highest incidence rate of 2,060 cases per 100,000 workers, followed by caring, leisure and other service occupations with 1,690 cases per 100,000 workers, and process, plant and machine operatives with 1,710 cases per 100,000 workers (Figure 2) [13]. Demographically, the incidence rates of occupational MSDs of male and female workers in the UK did not show significant statistical difference. However, the age groups with significantly higher rates are males and females in the age groups of 45-54 and 55+ [13].

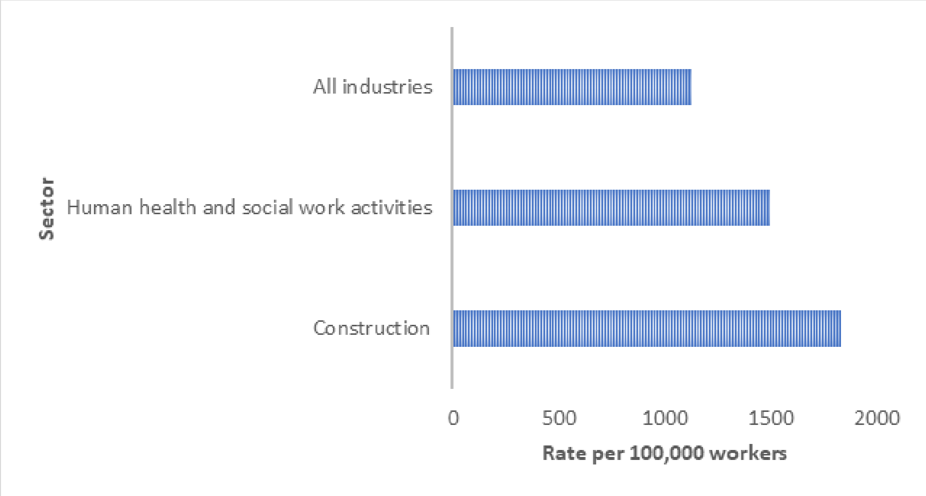

Figure 1: Average incidence of self-reported occupational MSDs in the UK by sector for 2018/19 – 2020/21 [13]

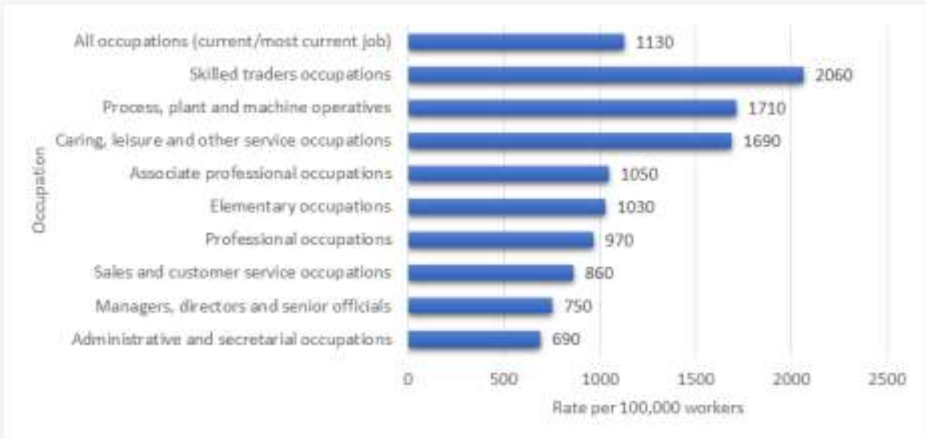

Figure 2: Average incidence of self-reported occupational MSDs in the UK by occupation for 2018/19 – 2020/21 [13]

2.3. Australia

In Australia, in 2014-15, 6.8 million people were affected by MSDs [11]. Occupational MSDs in Australia have been reported as number of claims. In 2015-16, the number of accepted compensation claims for occupational MSDs was approximately 125,000 and 50% or 62,420 of those were serious claims involving absence from work for one working week or more [11]. Of the total serious claims for MSDs made in 2015-16, 46,060 were related to traumatic joint/ ligament and muscle/tendon injury, while 16,365 were related to musculoskeletal and connective tissue diseases [11]. As with the UK and US, occupational MSDs claims in Australia had been on a downtrend from 2011-12 to 2015-16, as indicated by the declining frequency rates (number of serious claims per million hours worked). However, since 2011-12, there was an increase in the median time lost due to occupational MSDs from 5.0 5o 5.2 [11]. MSDs related to musculoskeletal and connective diseases recorded a rather consistent median lost-time of approximately 10 weeks [14].

Workers between 35 and 54 years of age made up 50% of serious occupational MSDs claims in 2015-16. Upon merging the age groups to form a larger age group of 35 to 64, the occupational MSDs claims totaled more than 60% (Table 4). Individuals aged 55-64 had the highest frequency rate (4.6 serious claims per million hours worked) and males generally had higher frequency rates of occupational MSDs claims [11].

Table 4: Serious occupational MSDs claims based on age groups for 2015-16 [11]

Age Group	Number of Claims	Percent	Frequency Rate
Under 25	6,265	10	2.6
25-34	11,835	19	2.5
35-44	13,985	22	3.3
45-54	17,190	28	4.2
55-64	11,700	19	4.6
65 and over	1,450	2	3.3
Total	62,420	100	3.4 (average)

Similar to the US, healthcare and social assistance sector constituted the largest number of serious occupational MSDs claims (11,370) in Australia in 2015-16, followed by the manufacturing sector (7,095) and construction sector (6,980) (Table 5) [11]. In terms of occupation, the highest number of serious occupational MSDs claims was recorded among the laborers. Community and personal service workers made 11,220 accepted claims whereas technicians and trade workers had 9,865 accepted claims (Table 6) [11].

Table 5: Serious occupational MSDs claims by sector, 2015-16 [11]

Sector	Number of Claims	Proportion against All Serious Claims (%)
Healthcare and social assistance	11,370	68.1
Manufacturing	7,095	53.5
Construction	6,980	53.3
Retail trade	6,115	64.7
Transport, warehousing and postal	5,520	64.1
Other industries	25,280	54.8

Table 6: Serious occupational MSDs claims by occupation, 2015-16 [11]

Occupation	Number of Claims	Proportion against All Serious Claims (%)
Laborers	15,610	57.9
Community and personal service workers	11,220	63.8
Technicians and trade workers	9,865	50.7
Machinery operators and drivers	9,725	63.5
Professionals	5,680	56.9
Other occupations	9,350	58.5

2.4. European Union (EU)

In the EU, 60% of workers reported MSDs in 2013, that was approximately 3 out of every 5 workers. Backache (43%) was the most common MSDs reported in 2015 while muscular pains in shoulders, neck and/or upper limbs came in second (41%) [10]. As with US, UK and Australia, there was a decrease in the number of occupational MSDs reported between 2010 and 2015, albeit slight. Similarly, the prevalence of occupational MSDs varied between sectors, and for the EU, differences were observed across the member states. Finland had the highest percentage (79%) of reported occupational MSDs in 2015, followed by France (75%) and Denmark (73%) [10]. Different occupations may differ in their most prevalent reported occupational MSDs. Among skilled agricultural, forestry and fishery workers, 57% of the occupational MSDs reported in 2015 were backache while muscular pains in shoulders, neck and/or upper limbs comprised 55% of the reported cases (Figure 3). Similarly, backache (55%) and muscular pains in shoulders, neck and/or upper limbs (47%) were also the most common MSDs reported among plant and machine operators and assemblers (Figure 3). However, muscular pains in lower limbs (31%) were more prevalent than muscular pains in shoulders, neck and/or upper limbs (26%) in the armed forces occupations. Most workers across all categories of occupation surveyed reported one or more MSD-related health problems in 2015 (Figure 3) [10].

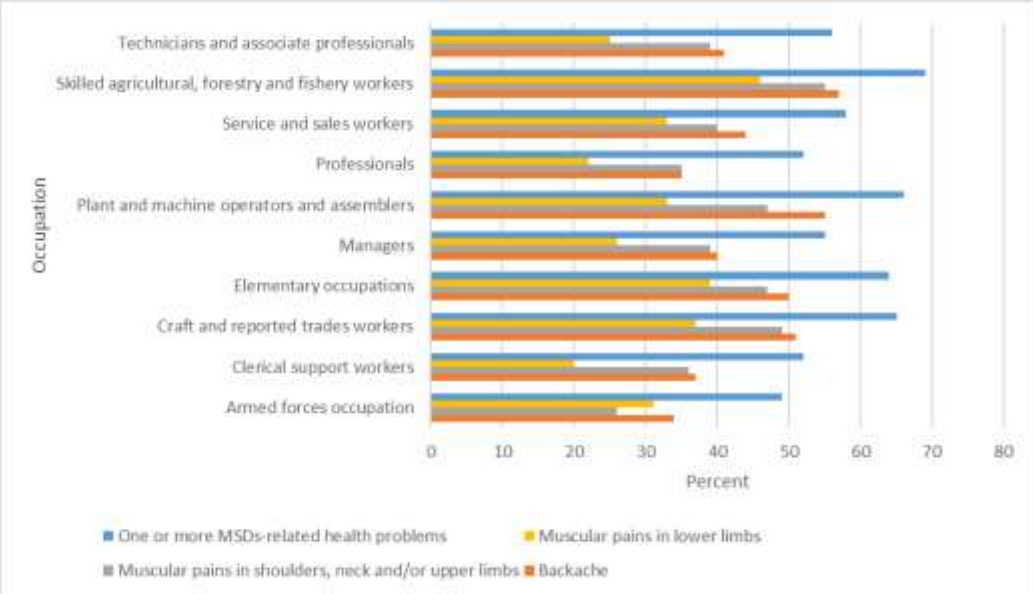

Figure 3: Percentage of self-reported MSDs by type and occupation in the EU, 2015

Like other nations, prevalence of MSDs in the EU differs across different sociodemographic segments. MSDs were more prevalent among female workers than male workers in 2015 with female workers reported higher occupational MSDs related to muscular pains in lower limbs, muscular pains in shoulders, neck and/or upper limbs, as well as backache. Positive correlation between occupational MSDs and age was also observed [10], In the EU, occupational MSDs also constituted the largest proportion of working day lost and resulted in considerably higher absence from work than workers without health problems [15].

3. Causes of Occupational MSDs

The causes of occupational MSDs are multi-faceted. In this section, the focus will be placed on the factors at workplaces that contribute to occupational MSDs instead of the sociodemographic factors consisting for instance of age, education level, gender, etc. At workplaces, the causes or risk factors of MSDs can be largely categorized into physical or biomechanical, organizational and psychosocial.

3.1. Physical/ Biomechanical Factors

Physical factors are related to postures, lifting, repetitive work, awkward positions as well as physically demanding work [16]. Workers who stay in awkward positions over long hours, who perform repetitive movements, who use vibrational hand tools and whose work involves carrying or moving heavy objects are therefore at greater risk of MSDs [6].

In the UK, out of the annual average incidence rate of 1,690 MSDs per 100,000 workers for 2009/10 – 2011/12, 740 were due to manual handling, 370 were due to awkward and tiring positions, 230 were due to keyboard work or repetitive action, 140 were due to workplace accident, 40 were stress related while 170 were associated with other reasons [13]. It is evident that most of the MSDs reported were linked to physical factors [17]. In Australia, more than 60% of the total severe occupational MSDs for 2015-16 by mechanism of injury were due to body stressing as a result of handling, lifting, carrying or putting down objects (Table 7) [11].

Table 7: Severe occupational MSDs claims by mechanism of injury for year 2015-16 in Australia

Mechanism of Injury	Number of Severe Claims	Percent of Severe Claims
Body stressing	**37,660**	**60.3**
Muscular stress while handling objects	15,915	25.5
Muscular stress while lifting, carrying or putting down objects	14,100	22.6
Muscular stress with no objects being handled	4,930	7.9
Repetitive movement, low muscle loading	2,720	4.4
Falls, trips and slips of a person	**14,845**	**23.8**
Falls from a height	3,485	5.6
Falls on the same level	9,635	15.4

Stepping, kneeling or sitting on objects	1,725	2.8
Being hit by moving object	**4,410**	**7.1**
Vehicle incidents and other	**3,835**	**6.1**
Hitting objects with a part of the body	**1,585**	**2.5**
Other mechanisms	**85**	**0.1**
Total	62,420	100

In the EU, different self-reported occupational MSDs have been associated with different physical risk factors. MSDs of the back were found to significantly correlated with vibrations from hand tools, working in awkward positions, carrying or moving heavy loads, and repetitive hand or arm movements [10]. MSDs of the lower limbs were linked to all the mentioned factors, in addition to exposure to low temperatures and sitting while MSDs of the upper limbs were linked to the same factors as those of lower limbs except sitting. Vibrations from hand tools, working in awkward positions as well as carrying or moving heavy loads were, therefore, the common factors contributing to the three types of MSDs [15].

However, there are contradictory findings on the relationship between sitting and MSDs. Holtermann *et al.*, found a lack of evidence which links occupational sitting to MSDs and attributed that to the difficulty of measuring prolonged sitting with self-reported surveys [18]. In terms of prevalence of risk factors, in the EU in 2015, most workers reported that their jobs required repetitive hand or arm movements, as well as working with computers, laptops, smartphones etc. 43% of the workers needed to work in awkward positions while 32% of them needed to carry or move heavy loads [10].

The regional studies above align with the review of longitudinal studies by da Costa and Vieira that the most common physical risk factors leading to occupational MSDs were repetitive actions, awkward postures and heavy lifting [6]. Repetitive motions repeatedly use the same group of muscles, tendons or joints, leading to their exhaustion [19]. Risk associated with repetitive motions are often complicated by the pace of work, recovery time for muscles and the variety of work tasks performed [20]. Awkward postures exert physical demand on a small group of muscles and hamper the larger and stronger muscle groups to perform optimally, thus causing fatigue [9]. Examples of awkward postures are reaching, twisting, bending and squatting. These postures may pose greater risk if they are repetitive and forceful [21]. Heavy loading, on the other hand, could produce internal biomechanical loading which could cause pain or discomfort when the loading exceeds the tolerance level of biological tissues [22]. The resulting musculoskeletal response depends on the internal load exceedance. Static posture such as sitting has low muscular demand but may be associated with stress and mental load which contribute to the development of MSDs, particularly of the shoulder [4].

3.2. Organizational and Psychosocial Factors

Organizational factors are related to how work is scheduled, arranged or organized. The risks encompass high workload, high pace of work, inadequate autonomy, role conflicts, social isolation, inadequate breaks, long working hours and night shifts [22]. These risks may make a worker more susceptible to external loads while increasing his or her possibility of experiencing chronic fatigue and stress [4]. Psychosocial factors are an overarching group which frequently encompasses the organizational factors. These factors are linked to the psychological health of workers [23]. Psychosocial factors could lead to fatigue, headaches, low productivity, absenteeism, sleep disturbance, edginess and inclination to injury [24]. The systematic review of da Costa and Vieira showed psychosocial factors as a contributor to the increased risks of occupational MSDs in the neck and low back [6]. Exposure to different psychosocial risks could cause MSDs in different parts of the body as shown in Table 8 below.

Table 8: Correlations between psychosocial factors and occupational MSDs of different body parts [25, 26]

Psychosocial Factor	Neck/ shoulders	Upper extremities	Low back
High job demands	√	√	√
Low job control	√	√	√
High job strain	√		√
Low social support	√	√	√
Low job satisfaction	-	√	√
Low job security	-	-	√

In addition, psychosocial risks consisting of high levels of role conflict, low safety-specific leadership and low job control were linked to manifestation of higher MSDs symptoms in the wrist/hand, shoulder and lower back [27]. In the EU, the relation between MSDs and psychosocial risks is presented below.

Table 9: Main psychosocial risk factors causing MSDs in different body parts [10]

Body Part Experiencing MSDs	Significant Risk Factor
Back	Anxiety Overall fatigue Sleeping problems Mental well-being Verbal abuse, undesirable sexual attention and harassment at work Feeling energized Clarity of work expectations Work pace in relation to 1) direct demands from customers, etc. 2) direct control by management
Lower limbs	Anxiety Overall fatigue Sleeping problems Mental well-being Verbal abuse and undesirable sexual attention at work Feeling energized Clarity of work expectations, particularly knowing how to choose or change order of tasks
Upper limbs	Anxiety Overall fatigue Sleeping problems Mental well-being Verbal abuse, threats and physical violence at work Employee's voice Job satisfaction Autonomy to take a break Fair treatment at work Hiding of feelings Work-related stress Fast-paced work

It can generally be seen that high job demand is a consistent factor contributing to all forms of occupational MSDs. While job control was identified as an important psychosocial factor (Table 8), it has not been clearly captured in the European study in Table 9 except the autonomy to take a break which is an aspect of job control [10, 25, 26]. Nonetheless, there is certain level of agreement that job satisfaction affects MSDs of the upper limbs.

3.3. Interactions between Physical and Psychosocial Factors

In fact, psychosocial factors have been associated with physical/ biomechanical factors. Bongers *et al.*, suggested that psychosocial factors heighten biomechanical load, leading to faster movements and uncomfortable postures [24]. Individual differences in capabilities and stress perception would give rise to difference musculoskeletal responses and disabilities (Figure 4) [28]. Bonger *et al.*, also suggested that workers tend to perceive psychosocial factors as potential threats, thus promoting their solution-seeking behaviors, which results in stress and physiological responses of the nerve, endocrine system and immune system. These responses raise muscular tones, decrease microcirculation in muscles and tendons and ultimately tire muscles [24].

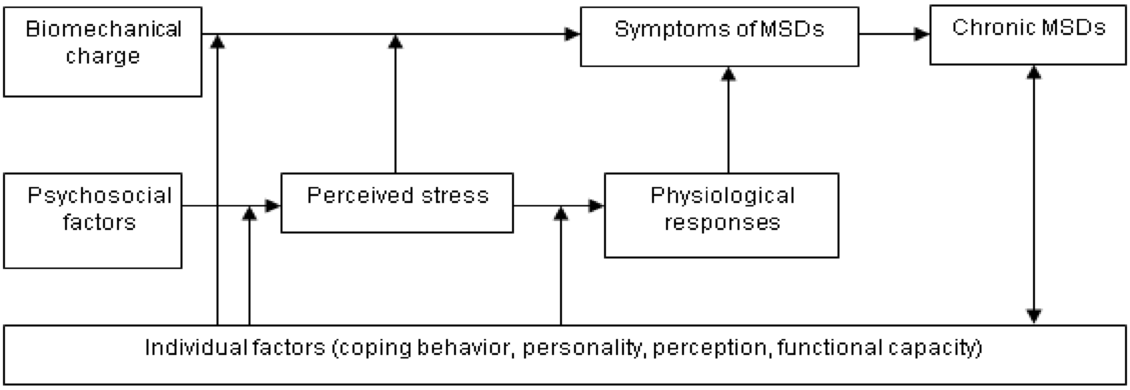

Figure 4: Interrelations between biomechanical, psychosocial and individual risk factors in MSDs development [24]

In addition, the US National Research Council proposed a model which shows the interrelation between physical and psychosocial factors through the relationship of workplace and worker as shown in Figure 5 [29]. The model categorizes the occupational MSDs risks at the workplace into 1) external loads or physical hazards, such as repetitive motions, awkward postures and heavy lifting, 2) organizational factors, such as workloads and shift arrangement, and 3) social context such as job support and recognition [29]. Personal factors comprise the biomechanical loading exerted upon a worker due to the external load, influenced by the organizational and social factors collectively called the psychosocial factor [29]. Similar to the model of Bonger *et al.*, (Figure 4) [24], the psychosocial factors could affect the biomechanical charge (Figure 5) [29]. This internal loads or charges arouse physiological responses. Mechanical strain may result from the physiological responses depending on the internal tolerance of the worker. Excessive mechanical strain could lead to fatigue which is subsequently manifested as pain and discomfort. Prolonged pain and discomfort without proper treatment and recovery would eventually cause impairment and disability. Individual factors, particularly the demographic factors such as age and physical fitness often determine the biomechanical loading, internal tolerances, hence the outcomes [29].

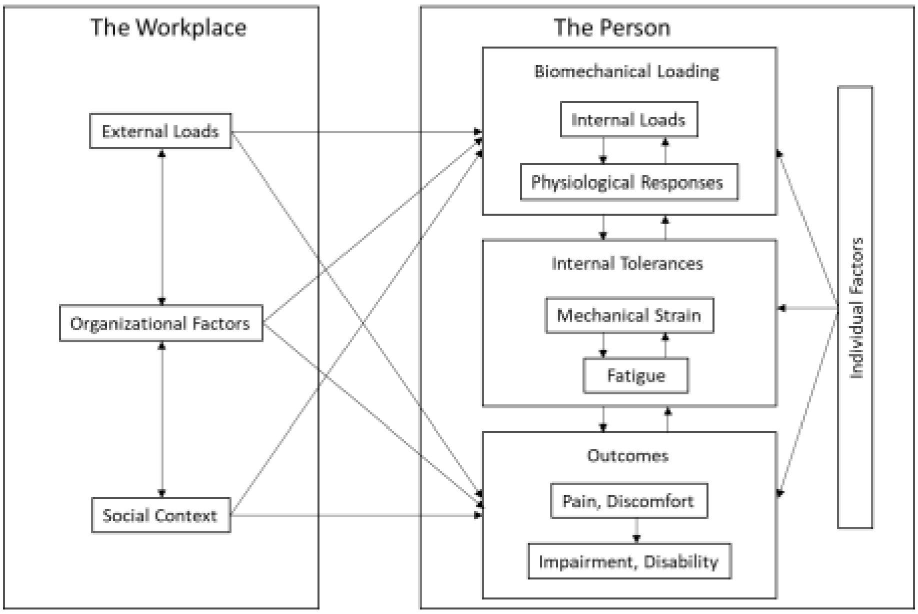

Figure 5: Interactions of workplace and personal risk factors of occupational MSDs [29]

4. Prevention of Occupational MSDs

Effective prevention of occupational MSDs involves elimination and minimization of the risks at workplaces, often in line with the hierarchy of control, i.e., elimination → substitution → engineering control → administrative control → personal protective equipment, from the highest to the lowest priority [30]. Having said that, and recognizing that MSDs are multifactorial, a comprehensive risk assessment should be conducted to identify the physical and psychosocial risks in a workplace leading to MSDs. Subsequently, intervention and control targeting at the risks are devised and implemented. A guide on the preventive measures is shown in Figure 6.

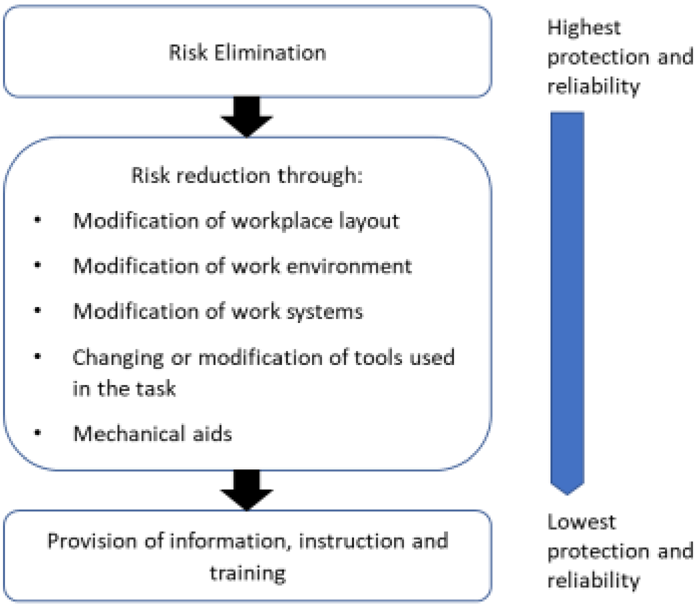

Figure 6: Hierarchy of controlling the risks of occupational MSDs [11]

Based on the hierarchy of control, providing information, instruction and training sits at the lowest level because it is a form of administrative control which does not remove the risks from the workplace [31]. Such control only changes a worker's behaviors in dealing with the risks and effectiveness of such control is subject to dispute [32]. Redesigning job, for instance by eliminating or reducing the need for heavy lifting should be the priority where possible. Besides, task modification by conferring workers the flexibility to plan and schedule their work so that large and difficult tasks could be broken up into small manageable tasks undertaken over a certain duration is better than training workers to complete a challenging task over a defined schedule [33].

Therefore, organizational interventions are crucial, and should be the priority in the control of MSDs risks. Organizational interventions involve planned actions aiming at improving employees' health and wellbeing. They typically focus on work design, organization and management to eliminate or reduce MSDs risks [34]. For instance, there are evidences which show that supplementary breaks are more effective than conventional break schedules in reducing symptoms of MSDs in different body parts [35]. Workstation design was found to be an effective intervention as it eliminates or reduces the risks associated with a work environment [36]. Workstation design might involve provision of sufficient working space with easy access to tools, adequate lighting and ventilation, and appropriate temperature [37, 38]. Organizational interventions also encompass the management domain to increase role clarity, job satisfaction, job diversification and autonomy of workers, while providing workers supports and rewarding them according to their performance. These would address the psychosocial risk factors of occupational MSDs [21].

Task-specific interventions could be beneficial to reduce the MSDs risks of a task. They involve providing workers with equipment or aids to reduce the physical loads. It could also involve new methods of performing a task [39], or redesigning equipment with ergonomic considerations and use of ergonomically designed equipment [40]. Typical examples are to replace conventional keyboards with ergonomically designed keyboards, and to use ergonomic chairs for working in front of computers. Besides, using trolleys could be helpful to reduce the muscular strains of moving heavy objects. Partial or full automation of a task permits the elimination of the risks related to the task. Task-specific intervention allows the loads and forces experienced by a worker to be reduced, thus, reducing the risks of occupational MSDs. For instance, by changing manual lifting to mechanically aided lifting which substantially reduces the need for manual handling, the prevalence of occupational MSDs associated with lifting could be reduced [41].

Where the above cannot be implemented due to financial or technical constraints, administrative control could be considered. Administrative control is frequently targeted at individuals. Training and education are examples of administrative control. During training, workers could be asked to demonstrate the correct techniques of manual handling. However, there are limited evidences pointing to the effectiveness of training in preventing occupational MSDs [42]. Similarly, job rotation, as an administrative control, has been revealed to be not so effective in reducing working days lost due to MSDs. While job rotation reduces the exposure of a worker to the MSDs risks associated with a task, it is not intended to remove the risks from the task [43]. Despite, there are also studies pointing to substantial reduction of occupational MSDs with administrative or other forms of intervention. Other administrative interventions include reduction of repetition frequency, task alternation and intentional pauses or interruption of tasks. These studies, somehow, suggest that any forms of well-planned intervention to reduce the risk factors of occupational MSDs are better than none, though they might face the constraints of intervention and outcome sustainability in the long run [38].

5. CONCLUSION

Occupational MSDs are prevalent in many workplaces across many nations. They have important implications on a nation's productivity and economy. In the UK, US and Australia, MSDs are most prevalent in the healthcare sector while in the EU, MSDs are most prevalent among skilled agricultural, forestry and fishery workers. The causes of occupational MSDs are broadly divided into two, namely physical factors encompassing postures, lifting of heavy loads, repetitive exertions and awkward positions, as well as psychosocial factors which include job arrangement, workload, autonomy, role clarify and job demand. Each workplace has a unique set of MSDs risk factors which prompts careful risk assessments to identify the risk factors. Both the factors could interact with each other to aggravate internal loads, thus, mechanical strains of muscles. Individual factors such as demographic factors might also need to be considered while assessing risks. Upon identifying the risk factors, the hierarchy of risk control could be implemented. According to the hierarchy, priority should be given to eliminating the risks of MSDs via work design, organization and management. Furthermore, reducing the risks through modification of workplace layout and work environment as well as the use of ergonomic tools and mechanical aids comes after the elimination of risks. Education and training are at the lower level of MSDs prevention as these are administrative interventions which change the behaviors and competence of workers when dealing with the risks instead of removing or reducing the risks associated with jobs.

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