Physical Risk Factors for Musculoskeletal Disorders

Humantech's Position

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INTRODUCTION

Musculoskeletal disorders (MSDs) are defined as injuries or dysfunctions affecting muscles, bones, nerves, tendons, ligaments, joints, cartilages, and spinal discs. They include sprains, strains, carpal tunnel syndrome (CTS), hernias, and connective tissue injuries of these structures. MSDs are among the leading causes of lost workdays and are associated with a large economic burden according to the American Academy of Orthopedic Surgeons (AAOS).

MSDs account for approximately one-third of all workplace injuries and illnesses in the United States (BLS, 2015). According to the Liberty Mutual Workplace Safety Index (2016), overexertion injuries (a particular type of MSD) are the leading cause of all non-fatal workplace injuries in the United States. Overexertion activities are defined as lifting, lowering, pushing, pulling, carrying, holding, or throwing. In 2013, overexertion injuries accounted for 24.4% of all non-fatal workplace injuries and amounted to $15.08 billion in direct costs (medical costs and indemnity payments). The indirect costs associated with workplace MSDs (production time lost by the injured employee, fellow workers, and supervisors; spoiled product; unhappy customers; cleanup time; schedule delays; training new employees; overhead costs; legal fees; and an increase in insurance costs) are also significant and can amount to a further 1.1 to 4.5 times that of the direct costs.

This statement provides background for Humantech's position on the primary physical risk factors in the workplace that lead to the development of MSDs.

Humantech's position is that forceful and prolonged exertions, awkward postures, and repetition are the primary physical risk factors in the workplace that are associated with the development of MSDs. Two of the risk factors, forceful exertions and awkward postures, seem to play a greater role in the development of MSDs, and there are complex interactions (interdependence) between certain risk factors that influence the development of MSDs.

PHYSICAL RISK FACTORS IN THE WORKPLACE AND MSDs

For over a century, an association between physical risk factors in the workplace and MSDs has been observed. In the late 1990s, The National Institute of Occupational Safety and Health (NIOSH) published the most comprehensive compilation of the epidemiological studies on the correlation of exposure to physical factors in the workplace and MSDs (NIOSH, 1997). NIOSH concluded that there is a large body of credible epidemiological research that shows a consistent relationship between certain physical risk factors in the workplace and MSDs. These physical risk factors include repetitive motion, excessive force, and awkward postures (including sustained postures, prolonged sitting, and standing).

Since the 1990s, there have been several excellent epidemiological studies (both case control and cohort studies) that have added to our understanding of the physical risk factors in the workplace that lead to the development of MSDs. These epidemiological studies have shown a reasonable causal relationship between physical risk factors in the workplace and the development of MSDs for a wide range of body areas and injuries/illnesses (CTS, lateral epicondylitis, tendinitis, low back pain, sciatica, and hip/knee osteoarthritis). Recent research examples of the causal or dose-response relationship between physical risk factors in the workplace and MSDs include the following:

- **Hand/wrist disorders.** Recently, in a large multi-site cross-sectional cohort study, Fan et. al (2015) found a strong dose-response relationship between jobs requiring high hand force and CTS; however, for jobs requiring either certain wrist postures or repetition, but not both, this same relationship did not exist. Also, Kapellusch et. al (2014) demonstrated that the ACGIH TLV for Hand Activity Level (HAL) is a strong predictor of Carpal Tunnel Syndrome.
- **Shoulder disorders.** Hoozemans et. al (2014) summarized high-quality cohort studies and showed there is strong evidence that pushing and pulling are related to upper extremity symptoms, specifically for the shoulder.
- **Low back disorders.** Garg et al. (2014) showed a statistically significant exposure-response relationship between both the NIOSH Lifting Equation peak lifting force (PLI) and peak composite lifting index (PCLI) and low back pain.

Overall, these excellent epidemiological studies have added to our understanding, and the primary risk factors in the workplace for each body area are summarized below:

	Biomechancial Risk Factors			
Body area	Awkward postures	High forces	Long durations	High frequency
Neck	•	•	•	•
Low back	•	•	•	•
Upper limb	•	•	•	•
Shoulder		•		•
Elbow/forearm	•	•	•	•
Wrist/hand	•	•	•	•
Lower limb	•	•	•	•

INTERACTION OF PHYSICAL RISK FACTORS IS KEY

For many years, it has been assumed that each physical risk factor in the workplace functioned as an independent factor, without any interdependence with other risk factors. Recently, Gallagher and Heberger (2013) addressed this assumption. Based on several high-quality studies, they showed that there is a strong interdependence between high force and high repetition across a wide range of joint disorders and symptoms, including low back disorders, carpal tunnel syndrome, hand-wrist tendinitis, wrist discomfort, lateral epicondylitis, shoulder tendinitis, shoulder discomfort, and knee discomfort. To summarize, they found that:

- Tasks that expose individuals to low force, at either a low repetition or high repetition, only nominally impact the risk of joint injury.
- Tasks that expose individuals to high force and low repetition have a low risk of joint injury.
- Tasks that expose individuals to high force and high repetition significantly increase the risk of joint injury.

In addition to finding that risk factors are interdependent, they also showed that certain risk factors, such as forceful exertion, play a greater role in the development of MSDs. Since awkward postures can alter the force capabilities of a joint, the relationship between force and joint posture also shows that the awkward postures play a more significant part in the development of MSDs. Thus, forceful exertions and awkward postures are two primary, and complimentary influences on the risk of joint injury.

CONCLUSION

Based on strong epidemiological evidence, there is a good understanding of the physical risk factors in the workplace that lead to the development of MSDs for several body areas and joints. Some risk factors, such as forceful exertion and awkward postures, seem to contribute more significantly to the development of MSDs. However, the development of MSDs is influenced by complex relationships among risk factors, meaning there is some interdependence. In summary, a valid MSD risk assessment tool should cover all of the main body areas, focus on measuring the primary physical risk factors in the workplace (such as forceful exertions and awkward postures), and should also capture the complex interaction between factors (such as repetition and duration).

ENDORSEMENT

This position statement was accepted by Humantech's Senior Leadership on October 24th, 2016.

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