



THE EFFECT OF LATERAL LIFTING TASKS ON HAND GRIP AND PINCH STRENGTH MEASUREMENTS

This report is submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for Bachelor Degree of Manufacturing Engineering (Hons.)

by

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is the result of my own research except as cited in references.

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APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of Universiti Teknikal Malaysia Melaka as a partial fulfilment of the requirement for Bachelor Degree of Manufacturing Engineering (Hons). The member of the supervisory committee is as follow:

.....
(Dr. Nadiah Binti Ahmad)

ABSTRAK

Pengangkutan barang atau bahan secara lateral amat biasa dalam industri, gudang dan sektor-sektor lain, dan kerja ini akan menyebabkan pekerja menghadapi penyakit gangguan muskuloskeletal berkaitan kerja (WMSDs) terutamanya di bahagian tangan. WMSDs yang melibatkan tangan dan jari menyebabkan pekerja mempunyai masalah kesihatan secara kekal dan mengalami kesakitan serta tidak-keselesaan. Secara tidak langsung, masalah ini telah mengurangkan prestasi mereka ketika bekerja. Syarikat terpaksa memberi bayaran yang tinggi kepada pekerja untuk kos perubatan and mengalami kerugian besar kerana pekerja yang tidak datang bekerja disebabkan penyakit tersebut. Jarak antara dua stesen kerja adalah faktor yang menyebabkan penyakit ini dihadapi oleh pekerja. Oleh itu, kajian diperlukan untuk mengkaji hubungan antara jarak dan kekuatan genggam tangan serta jari. Satu eksperimen yang melibatkan 30 orang lelaki responden telah dijalankan untuk mengenal pasti hubungan antara jarak dan genggam tangan serta jari. Hasil daripada eksperimen telah dikaji dan dianalisis dengan menggunakan MANOVA dan grafs. Hasil kajian telah membuktikan bahawa jarak dalam 1.0m, 1.25m dan 1.5m tidak membawa apa-apa kesan terhadap genggam tangan dan jari. Cara dan pergerakan responden adalah berbeza dan disebabkan oleh jarak, walaubagaimanapun, cara dan pergerakan responden tidak membawa sebarang kesan terhadap kekuatan genggam tangan dan jari mereka.

ABSTRACT

In lateral material handling tasks, which is very common in industries, warehouse systems, and other sectors, the workers can lead to work-related musculoskeletal disorder (WMSDs) because of the task and work designs, especially WMSDs in upper extremities. WMSDs in hand, wrist and fingers causes workers to have health problems, in pain and uncomfortable, hence decrease their working productivity and efficiency. Company had to pay for high medical costs and lost in sales during the workers' sick leaves due to WMSDs. The workstations distances are one of the factors that might affect workers when they perform manual material handling laterally, which can lead to WMSDs in hands. Hence, there is a need to research in the relationship of transfer distances with the hand grip and pinch strengths. An experiment was carried out with 30 male's participants to identify the relationship of lateral transfer distances with the hand grip and pinch strengths. The results obtained from the experiment were further investigated and analysed by using repeated measure one-way MANOVA and graphs. The results had proved that in the distances of 1.0m, 1.25m and 1.5m did not affect one's hand grip and pinch strengths. The postures and movements were varied based in different distances; however, this did not affect the hand grip and pinch strengths as well in these three distances.

DEDICATION

Only

my beloved father, Tan Chee Kong

my appreciated mother, Chan Kam Ling

my adored sister and brother, Tan Jun Yen and Tan Joe Ven

for giving me moral support, encouragement and also understandings.

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LIST OF ABBREVIATIONS

MCP	-	Metacarpophalangeal
MANOVA	-	Multivariate analysis of variance
MSD	-	Musculoskeletal disorder
NIOSH	-	National Institute for Occupational Safety and Health
U.S.	-	United State
USD	-	United State Dollar
WMSD	-	Work-related musculoskeletal disorder
WRULD	-	Work-relater upper limb disorder

LIST OF SYMBOLS

kg	-	Kilogram
cm	-	Centimetre
m	-	Metre
%	-	Percent
\$	-	US Dollar

CHAPTER 1

INTRODUCTION

This chapter had included the general background of this study, together with the problem statements related to this study, objectives and scope of the study.

1.1 Background

Work-related musculoskeletal disorders (WMSDs) are a group of painful disorders of muscles, tendons, and nerves, for examples, carpal tunnel syndrome, tendonitis, thoracic outlet syndrome, and tension neck syndrome (Canadian Centre of Occupational Health and Safety, 2018). WMSDs are also commonly called repetitive motion injury, repetitive stress injury and overuse injury, which had indicated that WMSDs are cause by a singular cause for damage to the musculoskeletal system, which is repetition and stress. Almost all work requires the use of the arms and hands. Therefore, most of the WMSDs affect the hands, wrists, elbows, neck, and shoulders. However, work using the legs can lead to WMSD of the legs, hips, ankles, and feet. Some back problems also result from repetitive activities (Middlesworth, 2018).

Work tasks that are high in frequency and involve repetitive movements or activities with awkward postures that cause WMSDs bringing the effects on human muscles which may be painful during work or at rest. However, the traumatic injuries of the muscles, tendons and nerves due to accidents are not considered to be WMSDs (Canadian Centre of Occupational Health and Safety, 2018). MSDs are cause by risk factors, where risk factors can be broken up into two categories: work-related (ergonomic) risk factors and individual-related risk factors. The examples of risk factors are as Figure 1.1 below.



Figure 1.1: Types of risk factors for MSD (Middlesworth, 2018).

Both ergonomics risk factors and individual risk factors will cause MSDs, however in this study will only mainly focus on discussion on those injuries resulting from ergonomics risk factors. According to Middlesworth (2018), WMSDs are associated with risk factors as below:

- Working postures and movements.
- Repetitiveness and pace of work.
- Force of movements.
- Vibration.
- Temperature.
- Lack of influence or control over one's job.
- Increasing pressure.
- Lack of or poor communication.
- Monotonous tasks.
- Perception of low support of workers (Middlesworth, 2018).

There are certain conditions and causes that bringing harm to workers body, for example the task design. Based on the survey carried out by Bureau of Labor Statistics (2018), the number of cases of WMSDs of laborers and freight, stock and material movers are the highest in 2017 (Bureau of Labor Statistics, 2018).

Nonfatal occupational injury and illness incidence rates and number of cases of musculoskeletal disorders by selected occupations, all ownerships, 2017

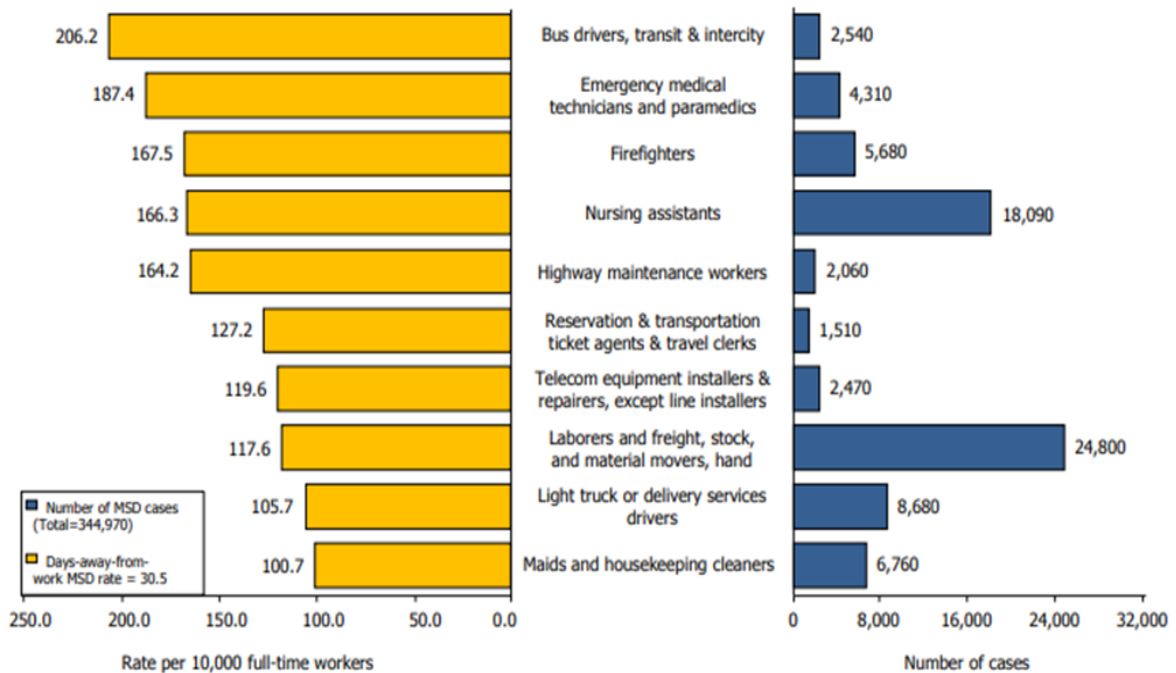


Figure 1.2: Nonfatal occupational injury and illness incidence rates and number of cases of musculoskeletal disorders by selected occupations, all ownerships, 2017 (Bureau of Labor Statistics, 2018).

Manual material handling is a task that required in almost all working environments, for examples workers in construction, agriculture, hotels, factories, warehouses, building sites, farms, hospitals, offices and restaurants, where the tasks are most likely to be exposed to heavy loads for a long period and repetitive works which lead to cumulative disorders due to gradual and cumulative deterioration of the musculoskeletal system (European Agency for Safety and Health at Work, 2018).

Lateral lifting tasks is considered one of the manual material handling tasks, which had indicated highly repetitive lifting movements. In lateral manual lifting tasks, the repetition of discomfort body postures and the overexertion of force of loads cause the contracted muscles squeeze the blood vessels and limit the flow of blood down to the working hand muscles. The reduced of blood supply causes muscles fatigue, making hands and fingers more prone to injury (CCOHS, 2018). The challenge faced by ergonomists are repetitive lifting tasks cannot be avoided, hence the range of the postural deviations and moments in forward flexion can be reduced by raising lift origins and destinations positions

(Kim *et al.*, 2014). However, the lateral transfer distances and the load weights are hard to control and determined.

The workplace design plays a crucial role in the development of an MSD. Certain workplace conditions, for example, the layout of the workstation, the speed of work especially in conveyor-driven jobs, and the weight of the objects being handled are important because these factors are highly influence the risk factors and the conditions of the workers (Canadian Centre of Occupational Health and Safety, 2018).

A workstation is the place a worker occupies when performing a job. The workstation may be occupied all the time, or it may be one of several places where work is done. The distances between workstations are very important because it is the factor that might causes WMSDs in workers. If the workstation is properly designed, the worker should be able to maintain a correct and comfortable body posture (International Labour Organization, 2018). Therefore, the distances between the workstations needed to be investigate and find out how distances can affect human hand activities and strengths.

The bending of fingers and force exerts onto the hand by the load when carry in certain distances repetitively will also bring the effect of WMSDs of hands and fingers. A longer time is needed to recover when extra forces are exerted onto the muscles. There is insufficient time for recovery during repetitive work, hence increasing in forceful movements increases muscles fatigue speed. (Canadian Centre of Occupational Health and Safety, 2018). Repetitive movements together with extra forces are dangerous and can lead to permanent WMSDs when involved the same joints and muscle groups over and over with the same motion for too long. The survey carried out by CPWR (2018) had been proved that rate of overexertion injuries resulting in days away from work in 2015 in transportation sectors is the highest (The Center For Construction Research and Training, 2018).

48d. Rate of overexertion injuries resulting in days away from work, selected industries, 2015

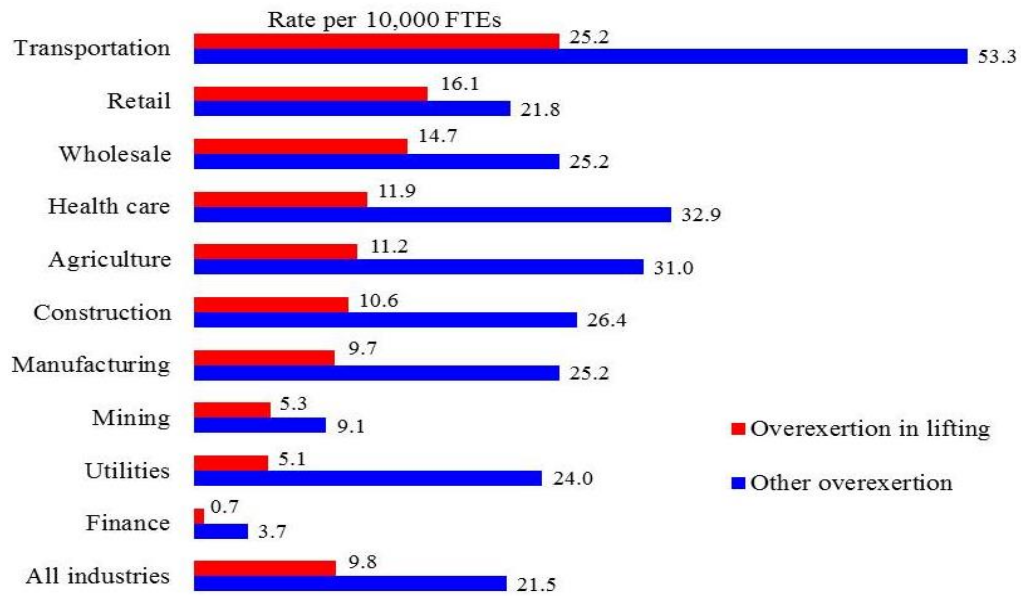


Figure 1.3: Rate of overexertion injuries resulting in days away from work, selected industries, 2015 (The Center For Construction Research and Training, 2018).

The costs of MSDs needed for employees for treatments are the highest among the others in 2013, which the annual costs are 80 billion USD for only workers in United State (Accurate Ergonomics, 2013).

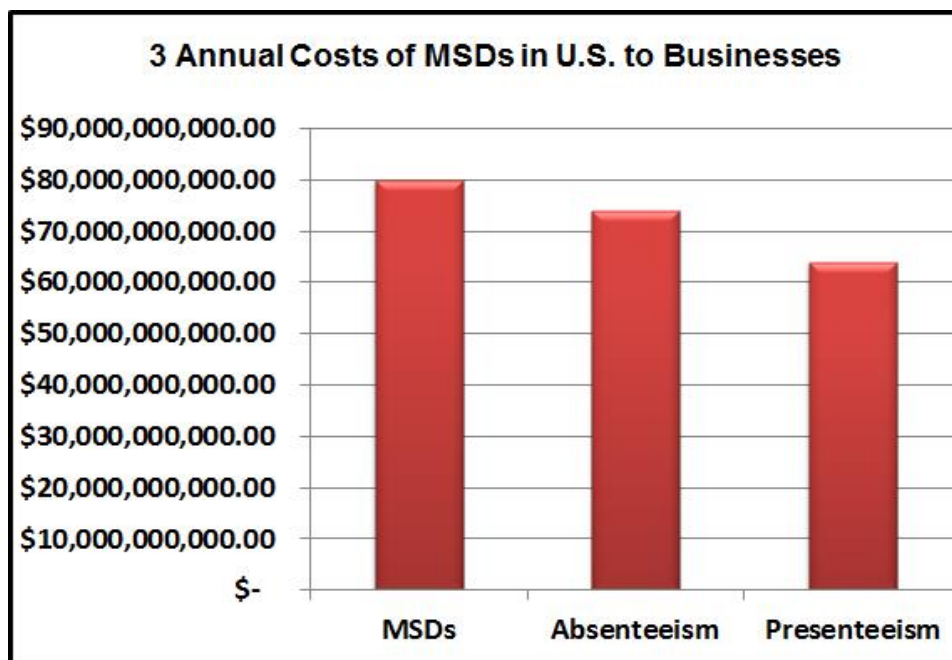


Figure 1.4: Annual costs of MSDs in U.S. (Accurate Ergonomics, 2013).

Based on the 2016 Liberty Mutual Workplace Safety Index, workplace injuries and accidents that cause employees to miss six or more days of work cost U.S. employers nearly \$62 billion in 2013. The injuries caused by overexertion involving outside sources are the highest with 24.4% of total cost of the most disabling workplace injuries or \$15.08 billion among others. This high cost paid by companies for overexertion injuries are consider too high and hence WMSDs that caused by overexertion should be decreased by preventions and improvements (Claims Journal, 2016).

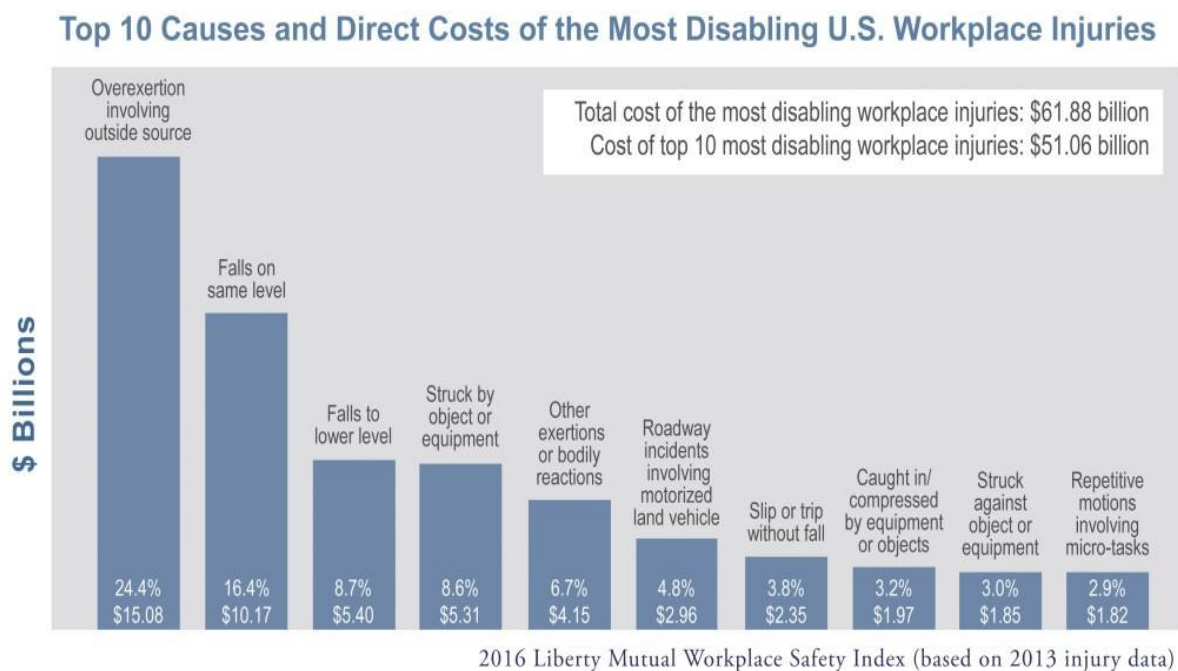


Figure 1.5: Top 10 causes and direct costs of the most disabling U.S. workplace injuries (Liberty Mutual, 2016).

WMSDs can be prevent and decrease if appropriate methods and preventions are done. Certain improvements and modification on lateral manual handling tasks in industries can be done to decrease the effect on hand grip and pinch strengths and improve efficiency. Therefore, studies and experiments can be carried out to identify the effect cause by the specific factors of transfer distances and load weights in lateral lifting task is essential and important.