
**Faculty of Mechanical and Manufacturing Engineering Technology**

# ERGONOMIC RISK ASSESSMENT ON WEIGHT LIFTER

**WOON JUN JET**

**Bachelor of Manufacturing Engineering Technology (Product Design) with Honours**

**2019**

# ERGONOMIC RISK ASSESSMENT ON WEIGHT LIFTER

**WOON JUN JET**

**A report submitted in fulfilment of the requirement for the Bachelor of Manufacturing Engineering Technology (Product Design) with Honours.**

**Faculty of Mechanical and Manufacturing Engineering Technology**

**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**2019**

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# DEDICATION

To my beloved parents, thank you for giving me the unconditional love and support along the way. Thank you again for teaching me that success is only earned when there is enough effort. It is also dedicated to my supervisor who is always patience and helpful. She is the one that taught me to have faith in myself and even the challenging task can be done with the proper approach and guidance.

# ABSTRACT

This research is all about analysing the hand grip force of weight lifter. Weight lifting is an exercise that requires large amount of strength and force of hands. This exercise will involve the hand grip of weight lifter and therefore it is fundamental. It is better to carry out weight lifting exercise ergonomically to prevent any injury. In the modern world nowadays, weight lifting which can also be said as gym activity, is becoming more and more popular and trendy. Modern human seeks for perfect appeal and healthy body. However, it is quite common to say that most of the people do not apply the correct ergonomics posture during gym exercises. Taking weight lifting or bench pressing as example, they do understand what it is and which part of muscle this exercise focuses on but they seem to lack of knowledge regarding incorrect working posture which may lead to musculoskeletal disorders. In this research, the ergonomic risk assessment will be focused and carried out by using Borg's CR-10 scale discomfort questionnaire. Jamar hand grip dynamometer will be used to obtain the hand grip force. Criteria of suitable gym equipment will be generated from the responses of respondents and the final selection of gym equipment for experiment will be done by using weighted decision matrix. CATIA V6 RULA analysis will be used to generate and propose the proper posture proven with best final grand score for experiment activity. The initial and final hand grip forces of 20 volunteers will be recorded in both experiments which are experiment with RULA analysis guideline and experiment without RULA analysis guideline. The results of experiment will be compared and analysed to observe the difference in hand grip force and effect of proper posture on hand grip force of weight lifter.

# *ABSTRAK*

*Kajian ini adalah tentang menganalisis daya pegangan tangan pengguna gim. Aktiviti gim adalah latihan yang memerlukan kekuatan tangan. Hakikatnya, adalah lebih baik untuk seseorang menjalankan aktiviti gim secara ergonomik untuk mengelakkan sebarang kecederaan. Pada era kini, aktiviti gim menjadi semakin popular. Masyarakat moden mengejar kesempurnaan fisikal dan badan yang sihat. Walaubagaimanapun, tidak boleh dinafikan bahawa kebanyakan masyarakat tidak menggunakan postur ergonomik yang betul semasa latihan gim. Sebagai contoh, masyarakat memahami setiap jenis aktiviti gim dan bahagian otot mana yang terlibat, tetapi mereka seolah-olah kekurangan pengetahuan tentang akibat postur aktivit gim yang salah akan menyebabkan gangguan muskuloskeletal. Dalam kajian ini, penilaian risiko ergonomik akan diutamakan dan dijalankan dengan menggunakan "Borg's CR-10 discomfort questionnaire". Dynamometer Jamar akan digunakan untuk mendapatkan daya pegangan tangan. Kriteria peralatan gim yang sesuai akan dijana daripada maklum balas responden dan pemilihan peralatan gim untuk eksperimen akan dilakukan dengan menggunakan "weighted decision matrix". "CATIA V6 RULA analysis" akan digunakan untuk menjana dan mencadangkan postur yang betul yang terbukti dengan skor terbaik untuk eksperimen. Daya pegangan tangan 20 sukarelawan untuk sebelum dan selepas akan direkodkan dalam kedua-dua eksperimen iaitu reksperimen dengan garis panduan analisis RULA dan eksperimen tanpa garis panduan analisis RULA. Hasil eksperimen akan dibandingkan dan dianalisis untuk melihat perbezaan dalam daya pegangan tangan dan kesan postur yang betul pada daya pegangan tangan pengangkat berat.*

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# LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

| | | |
|---|---|---|
| MSD | - | Musculoskeletal disorder |
| RULA | - | Rapid Upper Limb Assessment |
| IEA | - | The International Ergonomics Association |
| UK | - | United Kingdom |
| MRI | - | Magnetic Resonance Imaging |
| DBI | - | Distal biceps injury |
| kg | - | kilograms |
| LBS | - | pounds |
| ml | - | millilitres |
| N | - | Newton |
| ASHS | - | American Society for Hand Surgery |
| ASHT | - | American Society of Hand Therapists |
| BMI | - | Body Mass Index |
| EMG | - | Electromyography |
| PSI | - | Per square inch |
| NSAIDs | - | Nonsteroidal anti-inflammatory drug |
| ICT | - | Information and communication technology |
| OWAS | - | Ovako Working Posture Analysis System |

# CHAPTER 1

# INTRODUCTION

## 1.1 Background

Generally, ergonomics is research of workers while performing task which focuses on stress and injury depletion that are related to work. Examples of these are fatigue, bad position and MSD for more critical case. In order to maintain the welfare of employee, better work space, equipment, job and device should be developed, where this is why ergonomics is useful. In other words, task development that can ensure safer and more efficient task is the purpose of ergonomics. When workers are enjoying the working environment, their productivities will increase as well. This is why the application of ergonomics is so crucial. In an organization structure development, the elements of safety and systematic should be guaranteed by ergonomics.

One of the method to lesser the work injury is by assessing work environment or trying to learn and apply ergonomics. Ergonomics is so crucial because musculoskeletal system will be influenced if an individual is experiencing awkward position, intense temperature or repetitive motion. Then, human body will see signs of MSD including fatigue, stiffness and soreness. MSD is a sickness where human body's muscle, tendons, ligaments, joints and nerves are influenced. MSD may appear suddenly and spontaneously due to overuse. (Oregon OSHA, 2013)

Weight lifting is very fundamental for power and muscle training. The gravity is fully exploited in the case of bars with weight on it, dumb bells, and pile of weights as these will resist the force produced by users' muscle via concentric and eccentric contraction in a

totally opposite direction. Weight lifting exercises normally focus on particular muscles part and motion by using available apparatus and facilities. This exercise is so efficient that muscle development, strength, force, and tolerance can be activated. Weight lifting can be said as weight and endurance training.

Hand grip is a gesture where force is performed by the holding action of the hand. When human hand gets ahold of particular subjects, the strength exerted is known as grip force. Hand can cover the columnar object with suitable dimensions. One of the appropriate example of importance of contour and dimension is the handles on the stairs where human can grip easily if there is accident. There are many more grip force cases that are worth studying such as hammer and other equipment. Other than human, sports players that produce certain amount of muscle power and strength is also another form of grip strength. For the aspect of sport activities, rock climbers for example, apply grip force throughout the activity. In martial arts, grip force exercises are very fundamental while in other fields where workers use their hand, grip force is a core aspect.

MSD is a type of sickness where the patient experiences soreness and stiffness of muscle tissues. This sickness is caused by overuse of muscle, wrong position of usage and many more reasons. MSD is closely related to grip force as the patient suffers when the grip position is awful. However, there is an ideal solution by using Rapid Upper Limb Assessment (RULA). RULA methodology helps to prevent users from getting MSD because it explained and provided clearly the correct position of work.

## 1.2 Statement of the Purpose

This investigation intended to investigate or assess the ergonomic risk on weight lifter.

## 1.3 Problem Statement

Weight lifting involves muscular work and also hand grip force to be specific. Weight lifting is getting more popular from time to time and tends to be the latest trend of human sport activity. However, not everyone can carry out weight lifting with the correct posture. There are two main aspects that we will encounter which are weak hand grip force and getting fatigue or tired easily. The loss of hand grip force is mainly due to incorrect posture. Poor grip strength and incorrect working posture causes bad effect on weight lifter whether physically or ergonomically. The possible consequences may include musculoskeletal disorder and also other injuries. Weight lifting or gym activity is a common activity nowadays which is why it is significant to carry out with proper posture and maintain optimum grip force. Weight lifter often get fatigue easily in a short period of time which is not good in long term and can be fixed with proper postures.

## 1.4 Objectives

The objectives that will be achieved and fulfilled in this research are:

i. To identify ergonomic risks for activity related to musculoskeletal disorder (MSD) among weight lifter by using Borg's CR-10 scale discomfort questionnaire.

ii. To determine the hand grip force for weight lifter by using hand grip dynamometer.

iii. To analyze and compare the difference of hand grip force after using computer aided ergonomic analysis which is CATIA V6 RULA analysis.

## 1.5 Scope of study

To ensure that the objectives are achieved, some important elements must be considered in the range of the study such as:

i. The study will be started with questionnaire survey of 100 respondents together with discomfort questionnaire to assess ergonomic risk

ii. In this project, 20 volunteers will be invited to participate in experiment. Jamar hand grip dynamometer will be used to take the readings of hand grip force among 20 volunteers. The readings to be taken include initial and final for both before RULA analysis and after RULA analysis.

iii. To aid in the accuracy of the result, the knowledge of Rapid Upper Limb Assessment (RULA) will be applied to propose the correct posture guideline for experiment by using computer aided ergonomics analysis which is CATIA V6 RULA analysis.

## 1.6 Outline and significance of project

There are five main chapters in this project. First of all, introduction of the research will be written down in chapter one along with statement of problems, objectives and scope of research. In chapter two, literature review will be elaborating ergonomics, weight lifting, grip force, hand grip dynamometer, MSD, RULA, questionnaire survey, discomfort questionnaire, and Borg's CR-10 scale. In chapter three, all the data collection and analysis methods proposed to use are written down and explained thoroughly to prevent confusion. The outcome of the methods used in chapter three will be analyzed and discussed in chapter four mostly in the form of tables, figures and some description.

This project is significant because it brings beneficiaries to the scientific and also sport communities. The scientific community will gain a better knowledge in terms of the importance of proper working posture that will affect the hand grip force of weight lifte

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 Introduction

Chapter two focuses on discussing all the literature reviews of existing studies from journals, websites, papers and other sources. The literature review I have done based on previous researches will aid in improving my current methodology for this project and obtain the results successfully. These researches will do a favor in identifying the gaps in current knowledge after the information are being analyzed critically. The researches below are regarding ergonomics, weight lifting, hand grip, hand grip dynamometer, MSD, RULA, questionnaire survey method, discomfort questionnaire, and Borg's CR-10 scale.

## 2.2 Ergonomics and the types of ergonomics

Ergonomics in other word is 'fitting job to human'. Although simple, this interpretation gives the core direction for ergonomics. in order to fully utilise ergonomics, employees' capability should be identical to job needs. Another interpretations outline maintaining balance in human capabilities and work requests. The International Ergonomics Association (IEA) proposed a brand new description of ergonomics which stated that "Ergonomics or human factor is the scientific discipline concerned with the understanding of interactions among humans and other system elements, and the profession that applies theory, principles, data and methods to design in order to optimize condition of human and performance of system." The description shows that ergonomics is a branch of scientific knowledge that utilizes applied sciences in order to discover the relationships between task

or job and potentials of workers. Furthermore, development and assessment of job, action, object and workspace are all very important in ergonomics to ensure the requirement, potential and constraint are all equitable. The new version interpretation proposed by IEA classifies ergonomics in interdisciplinary sector, formed through gap of classic fields like engineering, medical and others. This modern definition is some sort of base for civil and ambience fitness. IEA also stated 3 fundamental ergonomics territory which are physical ergonomics, cognitive ergonomics and organizational ergonomics. These classic fields are always treated separately. The brand new interpretation provided by IEA allows us to understand ergonomics better. (Dennerlein, 2016)

### 2.2.1 Physical ergonomics

Ergonomics' basis is all about development of job or task and making it compatible to human worker's physical capabilities. The development of job or task addresses certain task requests and design of work place. The substantial competence stated above include power, muscle endurance and system potential. Generally, reduction of substantial weight on human body via development of job is the main objective of physical ergonomics. However, the application should not influence the accomplishment and fulfilment.

### 2.2.2 Cognitive ergonomics

This type of ergonomics is all about user friendly system. The aim of this type of ergonomics is to understand deeper about the information observation potential of human, convert the information, and respond to the given information. Roadway signage is a very suitable example. This is because drivers have to be alert with road patterns while driving cars in the road. Roadway signage delivers important message

to users before experiencing particular pattern. As the result, drivers can predict and prepare for the forthcoming pattern that improves vehicle's trip. Signage should be designed in such a way that they can deliver information accurately to driver.

### 2.2.3 Organizational ergonomics

Organizational Ergonomics or macro ergonomics, is concerning effects of approach, plan, and system routines towards individual's performance and wellbeing. Organization structure can actually regulate the exposure to individual workers' physical factors and affecting them through social structure. There are two types of mechanism in manufacturing which are automatic job and manual job. This is why the system design of manufacturing is crucial here so that the risk of involving in MSD is lower. Hence, the system of manufacturing will indirectly decide the accomplishment of individuals.

### 2.2.4 Ergonomics as element of process and production optimization

Nowadays, other concern is exposed to companies' working organizations. It is observed that the mean period of illnesses of employee becomes higher when they are older. In this case, about one quarter of workers will apply leave due to sickness relating to MSD. One of the method to cut down the leave taken by workers is to figure out solution that can reduce work strain. Experts apply assessment methods for work stations analysis and evaluation based on what they gained in specific trainings. The solution is a standardized checklist for investigation of enhancement to identify potential and possibility of enhancement. Reduction of leave taken due to sickness seems to be possible through ergonomics procedure. (Labuttis, 2015)