INVESTIGATING THE EFFECT OF UPPER ARM POSTURES ON THE HAND GRIP STRENGTH REQUIREMENT FOR FEMALE MALAYSIAN YOUNG ADULT

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

by

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DECLARATION

I hereby, declared this report entitled “Investigating the Effect of Upper Arm Postures on the Hand Grip Strength Requirement for Female Malaysian Young Adult” is the result of my own research except as cited in references.

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Author’s Name : ROZIEANI BINTI ABDUL RAZIM

Date : 29 MAY 2019

APPROVAL

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

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(DR. RADIN ZAID BIN RADIN UMAR)

ABSTRAK

Dalam globalisasi dunia ini, kebanyakan industri pembuatan memerlukan pekerja untuk menggunakan kemampuan genggaman untuk menghasilkan atau melakukan tugas. Semua tugasan yang memerlukan genggaman ini mempunyai kekuatan yang berbeza bergantung pada postur lengan atas dan kekerapan tugas yang memerlukan mencengkam. Alat kuasa merupakan alat penting untuk digunakan dalam kebanyakan industry. Dengan mengetahui kekuatan genggaman, ia membantu untuk memahami dengan lebih baik bagi menjadikan tugas lebih cekap. Walau bagaimanapun, terdapat pangkalan data terhad yang berkaitan dengan kekuatan pegangan tangan yang berkaitan dengan postur lengan atas untuk wanita muda Malaysia wanita. Bukan hanya itu, jurutera atau jurutera reka bentuk merasa sukar untuk menyediakan alat yang sesuai untuk wanita muda Malaysia wanita. Selain itu, terdapat kajian terhad mengenai kesan kadar frekuensi untuk menguatkan kekuatan cengkaman apabila menggunakan alat kuasa sebenar yang memberi tumpuan kepada wanita sebagai subjek kajian. Objektif kajian ini adalah untuk melihat hubung kait postur lengan atas dan kekuatan genggaman yang menggunakan kajian literatur yang menunjukkan bahawa terdapat hubungan antara postur lengan atas dengan kekuatan genggaman. Tujuan kedua kajian ini adalah untuk membuat pangkalan data kekuatan genggaman untuk postur lengan atas pada 0°, 45°, 90°, 135° dan 180° bagi 185 wanita muda Malaysia yang menggunakan Jamar Hand Dynamometer untuk mengukur kekuatan genggaman yang menunjukkan bahawa kekuatan genggaman terkuat pada postur lengan atas pada 180° pada kumpulan umur 2 (25-30 tahun) dan kekuatan cengkaman tangan paling lemah adalah apabila postur lengan atas pada 45 ° pada kumpulan umur 4 (35 -39 tahun). Hubungan antara kadar kekerapan tugas kepada kekuatan genggaman tangan untuk 60 orang responden yang menggunakan alat kuasa sebenar menunjukkan bahawa semakin tinggi kekerapan tugas, semakin lemah kekuatan genggaman.

ABSTRACT

In this world of globalization, most of the manufacturing industry required its worker to use gripping ability to produce or to done a task. All this gripping task has different strength depends on the upper arm postures and how frequent the task required gripping. Power tools are the most crucial thing to be used in most of the industry, it is necessary make it more convenience the user. By knowing the maximum hand grip strength, it helps to a better understand on how to design or to make a task to become more efficient. However, there are limited databases that are related to hand grip strength that deals with upper arm posture for female Malaysian young adult. Not just that, engineer or design engineer find it difficult to design or to improve a tool that is suitable for female Malaysian young adult. Also, there are limited study about the effect of frequency rate to hand grip strength when using an actual power tool that focused on female as the subject of the study. Thus, the objective of this study is to explore the relationship between upper arm postures and hand grip strength which using the literature review that clearly showed that there is relationship between the upper arm posture to the handgrip strength. As the posture influenced the handgrip strength of a person. Not just that, the second objective of this study is to develop databases of handgrip strength for upper arm postures at 0°, 45°, 90°, 135° and 180° that is focused on 185 female Malaysian young adult that using the Jamar Hand dynamometer to measure the grip strength. The results showed that the strongest handgrip strength was when the upper arm postures at 180° at age group 2 (25-30 years old) and the weakest handgrip strength was when the upper arm postures at 45° at age group 4 (35-39 years old). Lastly, to study the relationship between the frequency task rate to the hand grip strength of 60 respondents using the actual power tool and the results showed that the higher the frequency of a task, the weaker the handgrip strength.

DEDICATION

For my beloved father, Abdul Razim bin Mambuai

My lovely mother, Rosminah binti Salleh

My adored brother and sister, Rozaimin and Rozieana

My partner, Mohd Syafiq Firdaus bin Mohd Ridzwan

For giving me support, cooperation and encouragement.

Thank you so much & I love you all.

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LIST OF ABBREVIATIONS

am	-	ante meridiem
ANOVA	-	Analysis of Variance
ASHT	-	American Society of Hand Therapist
EAWS	-	Ergonomic Assessment Worksheet
EMG	-	Electromyography
HAVS	-	Hand-Arm Vibrating Syndrome
MANOVA	-	Multivariate analysis of variance
REC	-	Research Ethics Committee
RPE	-	Rate of Perceived Exertion
Sec	-	Seconds
SOP	-	Standard Operating Procedure
SPSS	-	**S**tatistical **P**ackage for the **S**ocial **S**ciences
UIA	-	International Islamic University Malaysia
UTeM	-	Universiti Teknikal Malaysia Melaka

LIST OF SYMBOLS

%	-	Percent
◦	-	Degree angle

CHAPTER 1

INTRODUCTION

This chapter provides the background of study, problem statements, objectives, scope and significant of the study. The background describes briefly on the handgrip strength and the posture when using the power tool. The problem statements show the problems faced by the designer that is short of databases. In the objectives, the objectives of this study to analyze the effect of frequency to the handgrip strength in female Malaysian young adult when using power tool. The scope of the study is to define the limitations of the study. By the end of this chapter, the project significance is presented to state the importance of this study.

1.1 Background of Study

In this world of globalization, most of the work in the industry are using power tool that required gripping. Hand grip strength become the important indicator to measure the effectiveness when doing a task. Grip strength is a baseline to show how strong the muscular strength and how much force can be generated by one's arm muscles when gripping something. Muscle strength is a very important parameter to know how strong a person's grip as it can influence the productivity of person in different working environment. Grip strength also can be used as a screening tool to measure the upper body strength of a person. Not just that, grip strength also has few advantages such as grip strength is useful when taking multiple measurement for couple of time to determine the

performance of hand grip when completing a task and grip strength is a tool used to determine if a person has a good health. Figure 1.1 showed the illustration of hand grip strength activity while opening a jar.

Handgrip strength are highly related with sex and age of a person (Ianna et al., 2007) Hand grip strength of a person also decreases as the number of age decreases (Loh, 2006). Not just that, handgrip strength are also related with the dominant hand of a person. As many researcher states that, a person with a right dominant hand has higher grip strength compare to left handed person (Clerke & Clerke, 2001).

Handgrip strength is important as it helps the engineer to design a product or a tool that suitable for a human being in order to ease their task and to improve the efficiency of a task done by a person. However, handgrip strength also related with the posture of a person while doing a task. Posture is a position of a body while standing, sitting or lying down. A good posture is said that correlate with correct body parts alignment with right amount of muscle tension. There are differences in handgrip strength at difference angle of arm. This simply conclude that posture of a arm is highly related with handgrip strength of a person. Automotive final assembly work involves frequent gripping of variable intensity, various postures of the lower back (crouching and bending) and upper limb demands such as fixed postures of the shoulders, reaching with the arms and tasks requiring intricate manual dexterity. These postures and tasks increase the risk of musculoskeletal injuries/accidents for assembly workers. The most common injuries in automotive manufacturing are sprains/strains, accounting for 65% of all workdays lost, and 62% of work-related musculoskeletal injuries at automotive plants occur in assembly workers

Furthermore, handgrip strength of a female is much differ from the handgrip strength of a male. This is related to the muscle strength for different gender. Davies, Greenwood, & Jones (1988) states that female mean performance was much lower which is at 298N compare to males which 496N. Moreover, female maximum grip is 60% to 70% of a male.

Figure 1. 1: Handgrip strength activity while opening a jar

Frequency is the number of times something happens within a particular period or task is done for numerous of times. Overall, the study about the effect of frequency to the handgrip strength is important to optimize the uses of the power tool. There were many research and study has been done but there is limited study that emphasized on the effect of frequency related to female Malaysian young adult. Hence, the aim of this study is to study the effect of frequency while using power tool to handgrip strength at overhead reach posture.

1.2 Problem statement

In manufacturing environment, many of the task are requiring grip in order to perform a task. For example, in car manufacturing industries most of the task required gripping in order to assemble the parts of the car. Most of the task in the car manufacturing industry deals with different upper arm postures and these upper arm postures has various angle that the workers in the car manufacturing industry has to deal with. Figure 1.2 and Figure 1.3 shows a car assembly doing task at certain upper arm posture and using a power tool.

Figure 1. 2: Car assembly worker doing task at certain upper arm posture

Figure 1. 3: Car assembly worker doing task that required to grip the power tool

However, there are limited databases related to handgrip strength for female Malaysian young adult. There were a study conducted by Kamarul Zaman, Ahmad, & Loh (2006) that focused on the handgrip strength in adult Malaysian population. In his study the posture that being analyzed is the subject seated upright with shoulder in

adduction in which mean the elbow was flexed at 90◦. Also there is study about grip and pinch strength among Malaysian elderly population (Pertanika J. Sci. & Technol et al., 2011) that are mainly focused on Malaysian elderly.

All tasks with different upper arm angle position have the effects on the human body no matter if it is in the manufacturing industry or not. Work posture is important when doing a repetitive task since it can affect the effectiveness of a task to be done. Not just that, most of the research done is focused on the arm that flexed at 90° but there is limited study conducted that focused on different upper arm postures with extended arm.

Due to this shortness of database for Malaysian female young adult, engineer or design engineer find it difficult to design or to improve a tool that suitable with female Malaysian young adult. Most of the databases available to be used is too general which is worldwide database. These databases is not very applicable in Malaysia because of the strength of handgrip are differ for each world population. Also for Malaysian population, there is no specific study and databases are focused on female young adults.

Furthermore, there is limited study about the effect of frequency to hand grip strength when using a power tool that using female as a subject of the study. So far we do not know the effect of frequency to the grip strength of a person as in industry, when using a power tool a person will not only using the power tool for a short amount of time but they will use the power tool for a long period of time.

1.3 Objective

The objectives of this study are:

i) To explore the relationship between upper arm posture and handgrip strength.

ii) To develop databases of handgrip strength for upper arm posture at 0°, 45°, 90°, 135° and 180° that focused on Malaysian female young adult.

iii) To study the relationship between upper arm postures and frequency of a task to handgrip strength.

1.4 Scope of Study

This study are focused on the hand grip strength of dominant hand of female Malaysian young adult. There are few scopes that are listed so that the objective can be achieve.

The target participant is 185 female participant and only focused on female Malaysian young adult which is age at the range 20-39 years old. Not just that, this study only take account measurement from dominant hand and this study requires the participant to perform measurement of maximum hand grip strength in sitting position. Only a healthy participant is allowed to take the hand grip strength test.

This study also focus on the relationship between upper arm posture and frequency to handgrip strength. In order to identify the relationship of frequency of a task and handgrip strength, an experiment will be conducted in this study. The data from the experiment of the frequency when using the power tool will then be used to improve the hand grip strength and productivity in certain process while using the tool.

1.5 Significance of the study

This study is to measure the maximum hand grip strength of dominant hand among female Malaysia young adult at 0°, 45°, 90°, 135° and 180°. This databases can help the design engineer or engineer themselves to produce their product for their female Malaysian young adult worker to work in more efficient and optimum way. This database development can be used for the industry while they are doing a task related with these five angle and other frequency task.