Faculty of Mechanical and Manufacturing Engineering Technology

ANALYSIS OF ASSESSMENT ON THE MUSCLE FATIGUE ASSOCIATED TOWARDS MALE AND FEMALE DRIVERS

Danial Hafizuddin bin Azhanuddin

Bachelor of Manufacturing Engineering Technology (Product Design) with Honours

2018

ANALYSIS OF ASSESSMENT ON THE MUSCLE FATIGUE ASSOCIATED TOWARDS MALE AND FEMALE DRIVERS

DANIAL HAFIZUDDIN BIN AZHANUDDIN

A thesis submitted
in fulfilment of the requirement for the Bachelor of Manufacturing Engineering Technology (Product Design)

Faculty of Mechanical and Manufacturing Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2018

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

Tajuk: ANALYSIS OF ASSESSMENT ON THE MUSCLE FATIGUE ASSOCIATED TOWARDS MALE AND FEMALE DRIVERS

Sesi Pengajian: 2018

Saya **DANIAL HAFIZUDDIN BIN AZHANUDDIN** mengaku membenarkan Laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan (X)

☐ SULIT* — Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia sebagaimana yang termaktub dalam AKTA RAHSIA RASMI 1972.

☐ TERHAD*

Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan.

☒ TIDAK TERHAD

Yang benar,

.....

DANIAL HAFIZUDDIN BIN AZHANUDDIN

Alamat Tetap:

No. 4, Laluan 25, Bandar Baru Siputeh

31560, Pusing,

Perak

Tarikh: 8/1/19

Disahkan oleh penyelia:

.....

NURUL AIN BINTI MAIDIN

Cop Rasmi Penyelia

NURUL AIN BINTI MAIDIN
Pensyarah
Jabatan Teknologi Kejuruteraan Pembuatan
Fakulti Teknologi Kejuruteraan Mekanikal dan Pembuatan
Universiti Teknikal Malaysia Melaka

Tarikh: 8/1/19

*Jika Laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini perlu dikelaskan sebagai SULIT atau TERHAD.

DECLARATION

I hereby, declared this report entitled "Analysis of Assessment on the Muscle Fatigue Associated towards Male and Female Drivers" is the results of my own research except as cited in references.

Signature : .....

Name : DANIAL HAFIZYDDIN B. AZHARUDDIN

Date : 8/1/19

APPROVAL

This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Manufacturing Engineering Technology (Product Design) with Honours. The member of the supervisory is as follow:

Signature : .....

Supervisor Name : .....

Date : .....

NURUL AIN BINTI MAIDIN
Pensyarah
Jabatan Teknologi Kejuruteraan Pembuatan
Fakulti Teknologi Kejuruteraan Mekanikal dan Pembuatan
Universiti Teknikal Malaysia Melaka

8/1/19

DEDICATION

To my parents, En. Azhanuddin Bin Ahmad and Pn. Siti Padilah Binti Sulaiman, I dedicate this project for both of you. Thank you so much for passing on your faith in more noteworthy things that are altogether out of my control. And for always supporting me in this journey. There aren't sufficient words on the planet to express my gratefulness, however I think this is a decent begin. Not to forget my only sister, Dayini Shafiqah Izarti, who is always be my supporter and someone to laugh with.

ABSTRACT

Muscle fatigue is a situation where a person has difficulty recovering from muscle overtiredness, thus requiring medical attention. Many activities in daily life can cause muscle fatigue. Muscle fatigue in neck, shoulder, waist and back was experienced by the driver during long-term period driving. The scope of this project is focused on study area of muscle fatigue in musculoskeletal disorders among Malaysian driver. The main objective of this research writing is to investigate the muscle activity of male and female drivers. 14 respondents (7 male and 7 female) was participated in this research. One type model of national car is used in this experiment, which is Proton Saga FLX 1.3L. The road selection of every journey for this experiment was started from the roadside of SPA highway, Ayer Keroh, Melaka to Plaza Toll Tangkak Inbound, Johor. Delsys TRIGNO Wireless System device is used in order to detect the electrical signals from muscle activity. The electrodes from the device will be placed at the user's arm during test drive session. Two types of hand position at steering wheel will be used during test drive, 9 – 3 O'clock and 10 – 2 O'clock. The results are based on two genders and they are categorized into different range of Body Mass Index (BMI). In order to compute the electric signal from physical motion in the motor unit during muscle contraction, Root Mean Square (RMS) value has been used. As a conclusion, higher value of RMS are produced by male than female. Besides, men's muscle activity took less time to fatigue than women based on the recorded data.

ABSTRAK

Keletihan otot adalah keadaan di mana seseorang mengalami kesukaran pulih daripada kelebihan otot, dengan itu memerlukan perhatian perubatan. Banyak aktiviti dalam kehidupan seharian dapat menyebabkan keletihan otot. Keletihan otot di leher, bahu, pinggang dan belakang dialami pemandu semasa memandu jangka panjang. Skop projek ini difokuskan pada bidang kajian keletihan otot dalam gangguan muskuloskeletal di kalangan pemandu Malaysia. Objektif utama penulisan kajian ini adalah untuk menyiasat aktiviti otot pemandu lelaki dan perempuan. 14 responden (7 lelaki dan 7 wanita) telah menyertai kajian ini. Satu model jenis kereta kebangsaan digunakan dalam percubaan ini, iaitu Proton Saga FLX 1.3L. Pemilihan laluan setiap perjalanan untuk eksperimen ini bermula dari tepi jalan SPA, Ayer Keroh, Melaka ke Plaza Toll Tangkak Inbound, Johor. Peranti Sistem Delsys TRIGNO Wireless digunakan untuk mengesan isyarat elektrik dari aktiviti otot. Elektrod dari peranti akan diletakkan di lengan pengguna semasa sesi ujian. Dua jenis kedudukan tangan pada stereng akan digunakan semasa memandu ujian, 9 - 3 O'clock dan 10 - 2 O'clock. Hasilnya didasarkan pada dua jenis jantina dan mereka dikategorikan ke dalam pelbagai Indeks Massa Tubuh (BMI). Untuk mengira isyarat elektrik dari gerakan fizikal dalam unit motor semasa penguncupan otot, nilai Root Mean Square (RMS) telah digunakan. Sebagai kesimpulan, nilai RMS yang lebih tinggi dihasilkan oleh lelaki berbanding wanita. Selain itu, aktiviti otot lelaki mengambil sedikit masa untuk keletihan daripada wanita berdasarkan data yang direkodkan.

ACKNOWLEDGEMENT

My truthful thankfulness goes to Allah S.W.T who has provided all I need to complete this whole project. You indicated me from all the manners in which that weren't right and did you give me trust. I honestly acknowledge my supervisor, Pn. Nurul Ain binti Maidin for her support, inspiration and the confidence she had on me for this project. Also for providing me an opportunity to embark on this wonderful work.

Next, a special thanks to assistant engineers, En. Muhammad Zuhri for being helpful regarding special equipment from the laboratory. To Miss Noor'Ain Azizan, much thanks for offering your help. I truly value your eagerness to assist outside your current position.

To all of the colleagues that volunteer as my respondent, I thank you for requiring some investment from your bustling calendar to encourage me. To my course mates, Muhammad Hilmi, Lin Wei Lin, Lee Wen Jia, and Kek Shian Ghee much obliged to you for imparting your insight and experience to me. All of you have been greatly strong through this troublesome time.

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

BackPEI-A	-	Back Pain and Body Posture Evaluation Instrument for Adults
EMG	-	Electromyography
LBP	-	Low back pain
MSD	-	Musculoskeletal disorders
BD	-	Brachioradialis
RMS	-	Root Mean Square

CHAPTER 1

INTRODUCTION

This chapter will present the overview of the project. The overview consists of a background of the study, problem statement, objectives, scopes and organizations that considered in the project. The background describes the outline of the project. In the meantime, the problem statement states the purpose of conducting this project. The objectives will explain the aim of the study and the scopes would be the boundaries of the project application.

1.1 Research Background

Driving car is an exciting moment for some people. It is a freedom where one can go to every place and any time they want. Important to realize, cars or any other type of vehicles are now basic needs for most society nowadays. Significantly, it gives a level of accessibility. An average people spend about 2 hours per day for driving, depends on jobs and their desires. According to a study done by World Bank Malaysia Economic Monitor in June 2015, citizens of the great city of Kuala Lumpur spend more than two hundred and fifty million hours per year by caught in traffic. Thus, along distances driving can stimulate back pain and unpleasant feelings. Also, the accuracy of the drivers' operation will decrease and cause safety hazards. The reaction of muscle fatigue and its influence on body movement can affect the driver's strength of attention and the accurateness of the action. Subsequently, driving fatigue has to turn out to be one of the main influences that affect the road traffic safety.

Muscle fatigue is a situation where a person has difficulty recovering from muscle overtiredness, thus requiring medical attention. In the same way, fatigue or loss of quality as well as muscle continuance following strenuous movement related to the gathering of lactic acid in muscles. Failure to perform a task that human wants to do with a muscle and the muscle cannot work properly. Many activities in daily life can cause muscle fatigue. By way of example, physical exercise or workout is the most well-known activity as the main caused of this problem. Muscle fatigue is one of the reasons for musculoskeletal disorders (MSD).

In this project, respondents are driving using one type model of national car with engine capacity throughout a certain period of the driving session. The fatigue development on the back and upper body of the driver after a long journey is relatively important to study the level of driver's comfort and health.

The driver's muscle fatigue between male and female drivers are compared using data collected from a device called Surface Electromyograph. This process will read the motions into graphs, sounds or numerical values. The electrodes from electromyograph will be taped on to the skin called surface electrodes. It will measure the speed and strength of signals. The surfaces electrodes will be placed in a certain location on the skin where respondents likely to feel the pain. The collected data is viewed in numerical data using Microsoft Excel and visualize using a 3-D graphical method using the software. To summarize, collected data is compared based on gender difference.

1.2 Problem Statement

Car driver's comfort and health level has the biggest concern among people these days. Muscle fatigue in neck, shoulder, waist and back was experienced by the driver during long-term period driving. Moreover, the weight, age and sex of drivers may affect the reaction of

muscle fatigue and its impact on body movement. To the author knowledge, currently there are very less related study of analysis of assessment on the muscle fatigue.

1.3 Objective

To assess the knowledge of muscle fatigue among male and female drivers, it is essential to accomplish the work-study needed exactly and accurately so that an improvement in medical and engineering can be obtained. The objectives of this research writing are:

a) To investigate the muscle activity of male and female drivers.

b) To conduct and analyses experiment from different categories of respondent based on driver' Body Mass Index (BMI) and gender.

c) To find the correlation between roads condition and hands position at steering while driving the car with driver's comfort.

1.4 Scope

The scope of this project is focused on study area of muscle fatigue in musculoskeletal disorders among Malaysian driver that using national car, Proton Saga FLX 1.3L. There are 14 respondents from existing students of Faculty of Engineering Technology (FTK) Universiti Teknikal Malaysia, Melaka. They are all aged from 22 years old until 25 years old, male and female with each of them have different weight and height. Equally important, one type model of national car is used, which is Proton Saga FLX. This type of car using the standard seat with automatic transmission and standard specification. Furthermore, Surface type electromyograph device is used in order to detect the electrical signals originating from skeletal signals. The electrodes from the device will be placed at the user's arm during test drive session. Two types of hand position at steering wheel will be used during test drive session. 9 – 3 O'clock and 10 – 2 O'clock are the hand position that has been recognized.

The road is used for this experiment was started from the roadside of SPA highway to Plaza Toll Tangkak Inbound. Weather is considered on every trip, the experiment is terminated on a rainy day. In this case study, drivers need to maintain relax with comfortable driving posture during the whole journey. 80 km/h is the standard speed during the experiment journey.

1.5 Organization

Chapter 1: Introduction

This chapter will simply introduce the project. This chapter contains an introduction, problem statements, objectives and scopes of the project. Also to inform the reader about the reasoning behind the work, and to explain why the work is important in the arena.

Chapter 2: Literature Review

In this literature review studies about books, academic articles, and any other sources related to a specific issue, the area of research, or philosophy. In this connection, it offers description and assessment of these works that related to the research problem. The main concern about literature reviews is to deliver a synopsis of sources explored while studying a certain topic and to demonstrate to the person who reads how the research fits with the field of study. Besides, to describe the bond of each work to the others under certain consideration.

Chapter 3: Methodology

The discussion about specific methods chosen and used in this study are included in methodology. Here, this discussion similarly includes the theoretical concepts that deliver full information about the methods choice and its application. All theoretical concepts are connected together with methods in a knowledge context and describe relevance in inspecting the purpose, problem and questions of this study

Chapter 4: Results

The results section reviews the information that was collected and the numerical analyses that were performed. The objective of this section is to testimony the results, findings based on the application of the methodology to collect information.

Chapter 5: Discussions

This section plays an important role to explain all results from the previous chapter in details. Any unusual results also elaborate and the reason behind it. The importance of this chapter is to give chance for the researcher to evaluate and enlighten the findings and the importance of those findings to the subject matter regarding the main study.

Chapter 6: Conclusion

This chapter will talk about the summarization of the project and the major conclusion of the project.

1.6 Expected Result

At the end of this project, the expected results:

1. Ergonomics risk factor during driving is well recognized.
2. The relationship between hand position at the steering wheel and the muscle fatigue
3. The pattern of muscle fatigue difference between male and female drivers.

CHAPTER 2

LITERATURE REVIEW

This part fundamentally will talk about the past articles, websites and journals that identified with the primary task of the muscle fatigue associated male and female car drivers. From the title itself, there is some part we can consider to be looked into. Every one of them may have been examined yet in various circumstance. These literature reviews aided to understand and advance this study further by exposed useful information concerning to this study.

2.1 Musculoskeletal Disorders Among People

Musculoskeletal system consists of two major elements, muscular system and skeletal system (Musculoskeletal System, n.d.). Musculoskeletal disorders (MSD) are related to any damage, harm or sickness at the joints or other fleshy tissue in the back or upper or lower limbs. The musculoskeletal system contains from muscles, tendons, bones, ligaments to blood vessels. "Repetitive Motion Injury", "Musculoskeletal Injury" and "Repetitive Stress Injury" are common terms to describe MSD's. MSDs are a frequent health problematic and the main root of disability in the world (Karimi *et al.*, 2016). Three types of muscles in the human body:

a) Skeletal muscle

Skeletal muscles support and move the skeleton. These muscles are under human's control.

b) Smooth muscle

Smooth muscle, for the most part, frames the supporting tissue of veins and empty inward organs, for example, the stomach, digestive system, and bladder. The reason it is called as smooth muscle as it does not have the microscopic lines.

c) Cardiac muscle

Cardiac muscle has a special structure and constitutes the bulk of the heart. Skeletal muscles also have nerve endings, where sensations of pain can be felt. For present purposes it can be concluded that muscles are not just simple mechanical actuators like motors or springs – they are reactive tissues.

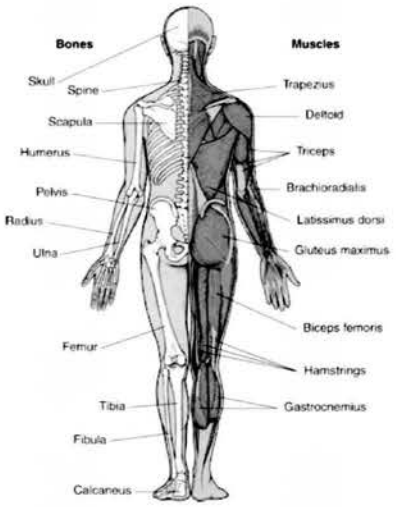

Figure 2.1: Musculoskeletal system in human body

(*Source: https://www.merckmanuals.com/home/bone,-joint,-and-muscle-disorders/biology-of-the-musculoskeletal-system/muscles 18/09/17*)

At the point when people are presented with MSD threat factors, they start to weakness. At the point when weariness surpasses their body's healing framework, they build up a musculoskeletal imbalance. Several risk factors can cause this disorders. These hazard variables can be separated into two classes:

a) Work-correlated risk factor

High task repetition happened when a job organized by in a certain period of time or day-to-day production goals. Basahel (2015) describes one of the common issues that can prompt to various human body problems are poor working posture. When similar movements or activities are being done over and over again by a human, it is called as "repetitive task". If sufficient recovery time occurs, the musculoskeletal system can activate the fatigue at the specific human's muscle. The danger of MSD is extended when joints are controlled outer of the middle range continually or for supported timeframes without sufficient healing period. Force is the quantity of energy applied by the muscles in order to complete a task. The superior the force that is required, the bigger the level of stress placed on the musculoskeletal system (Public Services Health & Safety Association, 2010).

b) Individual-related risk factor

This factor includes poor work performs, poor overall health behaviours, lack of rest and recovery also bad nutrition, fitness and hydration. Fatigue will eventually increase when faulty in practices create needless stress in the bodies. Thus, body's ability also declines to properly recover. Smoking, chronic alcoholic and obesity are factors that can shorten their life and health span, also putting themselves at risk for MSD (Koes *et al.*, 2006).

Vibration, contact stress and temperature are an example of additional hazards. Vibration can be differentiated into two category, whole body and segmental. Whole-body vibration is transmitted through the feet or bottoms to the rest of the body. Segmental