



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**HANDGRIP PRESSURE AND HAND MOVEMENT ANALYSIS
WHILE DRIVING ON PERODUA'S CAR STEERING WHEEL**

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

by

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I hereby, declared this report entitled “Handgrip Pressure and Hand Movement Analysis While Driving on Perodua’s car Steering Wheel” is the results of my own research except as cited in references.

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Date :

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Engineering Technology (Product Design) (Hons.). The member of the supervisory is as follow:

.....
(Project Supervisor)

ABSTRAK

Keletihan boleh menyebabkan ketidakselesaan kepada pemandu semasa memandu kereta. Ini kerana pemandu mengenggam stereng dengan kuat. Daya genggam yang tinggi boleh menyebabkan kesakitan dan ketidakselesaan kepada pemandu. Memandu dalam masa yang lama boleh menyebabkan sindrom terowongan/lorong karpall kepada pemandu. Tujuan projek ini adalah untuk menganalisis daya cengkaman tangan dan pergerakan tangan pada Perodua stereng. Eksperimen ini akan dilakukan ke atas dua buah kereta Perodua iaitu Perodua Myvi dan Perodua Alza. Sistem cengkaman Tekscan digunakan untuk mengambil data genggam pemandu semasa memandu. Kemudian, peranti disambungkan ke tangan pemandu dan ukuran akan diambil. Eksperimen ini akan dilakukan di Lebuhraya Utara Selatan iaitu dari Ayer Keroh ke Tangkak. Pemandu perlu untuk memandu kereta di jalan raya dengan mengekalkan kelajuan pada 80km / j. Jarak lebuhraya adalah kira-kira 30 kilometer yang mana ianya akan mengambil masa kira-kira 20 minit untuk sampai ke destinasi. Sukarelawan perlu memegang stereng di posisi 9 dan 3 pada kedudukan jam yang merupakan kedudukan yang paling selamat bagi memegang stereng. Hasil daya cengkaman tangan akan dibandingkan antara dua buah kereta dan hasil daripada daya cengkaman akan dikaitkan dengan pergerakan tangan semasa memandu.

ABSTRACT

Fatigue can cause discomfort to the driver while driving a car. This is because the driver grips the steering wheel hardly. The high handgrip force can cause a pain and discomfort to the driver. Driving in a long time can cause carpal tunnel syndrome to the driver. The purpose of this project is to analyze the handgrip force and hand movement on Perodua steering wheel. This experiment will be done on two Perodua cars which are Perodua Myvi and Perodua Alza. A Tekscan Grip System is used to take the handgrip data of the driver while driving. Then, the device is connected to the driver's hand and the measurement is taken. This experiment will be done at North South Highway which is from Ayer keroh to Tangkak. The driver needs to drive the car in the highway with maintain speed which is 80km/h. The distance of the highway is about 30km which is it will take about 20 minutes to reach the destination. The volunteer needs to hold the steering wheel in 9 and 3 o'clock position which is the safest position of holding the steering wheel. The result of the handgrip force will be compared between two cars and the result of the grip force will be related to hand movement while driving.

DEDICATION

To my beloved parents, Mr. Che Zakeria Bin Che Omar and Mrs. Fauziah Bt Abu Bakar thank you so much for your lifelong encouragement from the early of the project until the end of the project. Your encouragement made me more motivation to complete this project with full of diligence and patience. To my fellow friends, Hadi, Hakim, Izhar, Ikram, Adeera, Adibah, Ezzy, Ameerah and also Atiqah, thanks for all your support during this project. Not forgotten to my fellow classmates which contribute a lot of idea. Lastly, my special thanks to my supervisor, Sir Mohd Fa'iz Bin Wahid for his dull of patience in teaching me and guiding me from the early of the project until the end of the project.

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CHAPTER 1

INTRODUCTION

1.1 Background

Steering wheel, known as driving wheel or a hand wheels are commonly used to steer control in vehicles in most type of vehicles including ships and boats. Steering wheel have been used in decade until to the most modern land vehicles including all mass production automobile such as tractors, buses, light and heavy trucks. Currently, there are lot of steering wheel designs with their own functions but not for the comfort level of the driver while using it. This project will study about ergonomics design and analysis of the hand grip forces on specific Perodua's steering wheel models. The comfortable for driver during driving is very important especially for long journey. Any inconvenience during driving can cause dangerous situation to the driver and also to the others on the road. Driving can expose driver to the Musculoskeletal Disorders (MSDs) especially when driving for a long journey. One of the MSDs common examples is Carpal Tunnel Syndrome (CTS). CTS can happen when the drivers make the same hand and wrist motion over and over. Besides, Low Back Pain (LBP) also is one of the examples for MSDs. LBP can affect the health of the driver due to the back body posture during driving. Besides, the road conditions itself also can cause problems to the driver during a long journey.

Driving as a profession involves routine muscular effort such as holding steering wheel, awkward sitting postures, high body contact, and exposure to whole-body vibration. This project will analyze the hand grip pressures and hand movements on two different Perodua's car. High hand grip pressure and vibration can cause fatigue towards our hand muscles and can cause musculoskeletal disorders to the hand. Moreover, the drivers can be exposed to carpal tunnel syndrome (CTS) due to longer time of handling.

In this project, a comparison on analysis will be made based on currently steering wheels and ergonomics steering wheels.

1.2 Problem Statement

Based on users' experiences driving Perodua's Myvi, they have problem related to the steering wheel of the car. Drivers feel uncomfortable after long driving due to high hand grip force. Due to high hand grip force after a long time driving, there are a lot of vibrations which can cause carpal tunnel syndrome due to longer time of handling. In additions, inappropriate posture while driving can cause Musculoskeletal Disorders (MSDs) to driver's hand. Until today, there are no official data or studies for hand grip pressure involving Perodua's steering wheel. Besides, there are no data that state the relationship between hand movements during driving with hand grip pressure.

1.3 Objectives

The main objectives of this project are:-

- To determine the measurement data of gripping pressure when handling a steering wheel
- To find the ergonomics limitations of Perodua's steering wheel.
- To find the ergonomics risk factor of long term driving
- To find the relationship between hand movement during driving with hand grip pressure

1.4 Title

Handgrip Pressure and Hand Movement Analysis while Driving on Perodua's Car Steering Wheel.

1.5 Scope

The scope of this project will focus on the data from hand grip pressure and hand movement during driving analysis of Perodua's car steering. Two models which are Perodua Myvi Car and Perodua Alza will be used as a comparison. The equipment that will be used for this project is Tekscan Hand grip Pressure Measurement System with a laptop. The roads that will be used are North South Highway which is from Ayer Keroh to Tangkak in maintains speed which is 80km/h. The length from Ayer Keroh to Tangkak is about 35km which is it will take about 20 minutes for the drivers to complete the roads. In this case study, drivers need to handle the steering in 9 and 3 o'clock position from the start of the analysis until the end. Driver is allowed to change the radio for a while in order to make the drivers drive like normal. There will be 10 volunteer consists of 5 males and 5 females. The volunteer will drive the car in North South Highway from Ayeh Keroh to Tangkak in maintain speed which is 80km/h.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This research is related with the steering wheel, Tekscan Hand Grip System, ergonomics, Musculoskeletal Disorder System (MSDs), hand movements, and road conditions. The reference for literature review is taken from journals, books, articles and also from websites. The purpose of this chapter is to get more information about research study.

2.2 Ergonomics

Ergonomics can be defined simply as the study of work. More specifically, ergonomics is the science of designing the job to fit the worker, rather than physically forcing the worker's body to fit the job. Adapting tasks, work stations, tools, and equipment to fit the worker can help reduce physical stress on a worker's body and eliminate many potentially serious; disabling work related Musculoskeletal Disorders (MSD) [1]. Ergonomics draws on a number of scientific disciplines, including physiology, biomechanics, psychology, anthropometry, industrial hygiene, and kinesiology. These factors especially if coupled with poor machine design, tool, and workplace design or the use of improper tools create physical stress on workers bodies, which can lead to injury. A dramatic increase in MSD began in the 1970s when these disorders increasingly appeared on company injury and illness logs. Occupational Safety and Health Administration (OSHA) cited companies for hazardous workplace conditions that caused problems such as tendinitis, carpal tunnel syndrome, and back injuries [2]. The Bureau of Labor Statistics, an agency of the U.S. Department of Labor, recognizes

MSD as a serious workplace health hazard. These injuries now account for more than one third of all lost workday.

2.2.1 The Importance of Ergonomics

Industries increasingly require higher production rates and advances in technology to remain competitive and stay in business. As a result, jobs today can involve frequent lifting, carrying, and pushing or pulling loads without help from other workers or devices, increasing specialization that requires the worker to perform only one function or movement for a long period of time or day after day, working more than 8 hours a day, working at a quicker pace of work, such as faster assembly line speeds, and having tighter grips when using tools. If work tasks and equipment do not include ergonomic principles in their design, workers may have exposure to undue physical stress, strain, and overexertion, including vibration, awkward postures, forceful exertions, repetitive motion, and heavy lifting. Recognizing ergonomic risk factors in the workplace is an essential first step in correcting hazards and improving worker protection.

Ergonomists, industrial engineers, occupational safety and health professionals, and other trained individuals believe that reducing physical stress in the workplace could eliminate up to half of the serious injuries each year. Employers can learn to anticipate what might go wrong and alter tools and the work environment to make tasks safer for their workers. Expose to multiple risk factors that can cause or exacerbate the disorders, not from a single event or trauma such as a fall, collision, or entanglement. MSD can cause a number of conditions, including pain, numbness, tingling, stiff joints, difficulty moving, muscle loss, and sometimes paralysis. Frequently, workers must lose time from work to recover; some never regain full health. These disorders include carpal tunnel syndrome, tendinitis, sciatica, herniated discs, and low back pain. MSD does not include injuries resulting from slips, trips, falls, or similar accidents.

2.3 Musculoskeletal Disorders (MSDs)

Musculoskeletal Disorders (MSDs) are consideration of health and safety issues for which challenges and opportunities that are exist for better understand of causes and effects, economics impacts, and effective strategies to avoid and cure these complicated disorders. Musculoskeletal disorders (MSDs) are injuries of the soft tissues, muscles, tendons, ligaments, joints, supporting structure of the upper and lower limbs, neck and lower back [3]. All this injuries are caused by sudden exertion or prolonged exposure to physical factors such as awkward posture, force, vibration or repetition. These disorders have a variety of names from Occupational Safety and Health Administration (OSHA), including cumulative trauma disorders, repetitive stress injuries, occupational overexertion syndrome and repeated trauma. All this injuries generally develop gradually over a weeks, months and might take until years. Musculoskeletal Disorders (MSDs) commonly caused by excessive vibration which is from vibrating tools such as drill or jack hammer can decrease blood flow, contribute to muscle fatigue and also damage nerves. Driving truck or operating subways can cause a whole body vibration. It can affect the skeletal muscles and can cause low back pain and working in a cold condition can affect the performance of the workers during performing a task given. High gripping force can cause pain and discomfort. The risk factor that are thought to be associated with MSDs, are repetitive, heavy lifting, long driving time, seat discomfort, bending and twisting, uncomfortable working position, exerting too much force, working too long without break, adverse working environment such as hot or cold, and also psychosocial factor such as high job demands, lack of control and time pressures [4 - 11]. The table 2.1 shows the examples of Musculoskeletal Disorders.

Table 2.1: Examples of Musculoskeletal Disorders

Body Parts Affected	Symptoms	Possible Causes	Workers Affected	Disease Name
Thumbs	Pain at the base of the thumbs	Twisting and gripping	Butchers, housekeepers, packers, seamstresses, cutters	De Quervain's Disease
Fingers	Difficulty moving finger; snapping and jerking movements	Repeatedly using the index fingers	Meatpackers, poultry workers, carpenters, electronic assemblers	Trigger Finger
Shoulders	Pain, stiffness	Working with the hands above the head	Power stress operators, welders, painters, assembly line workers	Rotator Cuff Tendinitis
Hands, wrists	Pain, swelling	Repetitive or forceful hand and wrist motions	Core making poultry processing, meatpacking	Tenosynovitis
Fingers, hands	Numbness, tingling; ashen skin; loss of feeling and control	Exposure to vibration	Chain saw, pneumatic hammer, and gasoline-powered tool operators	Raynaud's Syndrome (white finger)
Fingers, wrist	Tingling, numbness, severe pain; loss of strength, sensation in the thumbs, index, or middle or half of the ring fingers	Repetitive and forceful manual tasks without time to recover	Meat and poultry and garment workers, upholsterers, assemblers, VDT operators, cashiers	Carpal Tunnel Syndrome
Back	Low back pain, shooting pain or numbness in the upper legs	Whole body vibration	Truck and bus drivers, tractor and subway operators; warehouse workers; nurses aides; grocery cashiers; baggage handlers	Back Disability

(Source: Ergonomics Study of Works, 2000)