UNIVERSITI TEKNIKAL MALAYSIA MELAKA

A STUDY ON RELATIONSHIP BETWEEN HAND PRESSURE GRIP FORCE WITH HAND TOOL VIBRATION AT AUTOMOTIVE INDUSTRY

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

by

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APPROVAL

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

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ABSTRAK

Kekuatan cengkaman adalah daya yang dikenakan oleh tangan untuk objek cengkaman dan sebahagian tertentu kekuatan tangan. Ia biasanya dianggap bahawa semua aspek tangan, perlu dijalankan untuk menghasilkan tangan yang sihat dan kuat. Penggunaan berulang-ulang tangan akan menyebabkan ketidakseimbangan antara menutup dan membuka otot, dan boleh membawa kepada masalah seperti sindrom jari putih. Tujuan kajian ini adalah untuk menganalisis daya cengkaman tekanan tangan dan keletihan otot pada aktiviti sebelah kiri dan kanan di kalangan pekerja dalam industri automotif sekiranya pekerja melaksanakan tugas mereka. Kaedah projek ini adalah seperti temu bual, pemerhatian, soal selidik mengenai pengalaman ketidakselesaan pekerja, percubaan menggunakan peralatan Tekscan dan perisian bentuk mengukur tangan kuasa cengkaman dan taburan tekanan kawasan dan mengukur getaran tangan. Semua keputusan di atas digunakan untuk menentukan perhubungan antara alat tangan dan getaran. Dapatan kajian akan menunjukkan faktor-faktor pada tempoh alat tangan getaran, daya genggaman dan daya taburan tekanan yang memberi kesan kepada prestasi pekerja.

ABSTRACT

Grip strength is the force applied by the hand to grip objects and is a specific part of hand strength. It is generally considered that all aspects of the hand must be exercised to produce healthy and strong hand. Repetitive usage of hand will cause an imbalance between closing and opening muscles, and can lead to problem such as white finger syndrome. The purpose of this study is to analyze the hand press grip force and muscle fatigue at the left and right activity on hand among the workers in automotive industry while workers perform their task. The method for this project has been through the interview, observation, questionnaire regarding the worker discomfort experience, experiment using Tekscan equipment and software form measure the hand grip force and pressure distribution area and measure on vibration at the hand using hand arm vibration. All the result above can be used to determine the significant factor for the effect between the hand tool vibration, handgrip force and pressure distribution area. The finding shows the factors on duration of hand tool vibration, handgrip force and pressure distribution force can give effect to worker performance.

DEDICATION

This thesis is dedicated to my beloved husband, Azril Eddyra Bin Moksan, my mom Hjh The Binti Saarani, my family, friends, FKP senior, FKP and FTK technicians and who given their support, encouragement and good advice to me. This thesis is also in debt to Dr. Seri Rahayu Kamat, a mentor who has been a constant source of knowledge and inspiration.

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CHAPTER 1

INTRODUCTION

This chapter contain the background of the study which related to the work area at the automotive industry. It also covers the problem statement, objectives and scope of the study.

1.1 Background

Rework is a correcting of defective, failed or non-conforming item, during or after the inspection. Rework includes all follow on efforts such as disassembly, repair, replacement and reassembly. Vibration is the one causing when do the rework activities such as grinding, drilling, hand use guided equipment and holding material being worked. The situation occurs if doing in repetition and will be effected to the human body.

The human body can amplify the vibration (in these lower frequencies) that exists from an outside source. For instance, that musculoskeletal system (muscle, tendons, and bones) can be a path for vibration and actually amplify the vibration as it moves through the body. An example of low frequency vibration includes the use of handled power tools that transmit the vibration from the hand, through the arm and the upper body. Several factors, including the frequency, amplitude, direction, point of application, time of exposure, clothing and equipment, body size, body posture, body tension and composition are related to human response.

Vibration requires the measurement of acceleration in well-defined directions, frequencies, and duration with a complete assessment of exposure (WISHA Hand-Arm Vibration Analysis, 2010).

In manufacturing workplaces, most of the processes jobs were recommended to be performed in awkward posture. For example, they need to raise their elbow above their shoulder, bend their neck forward greater than 30 degrees, bend their wrist downward with palm facing downward greater than 30 degrees, bend their back forward greater than 45 degrees, and squatting, etc (T-Krajewski et al.,2010).

The factors of musculoskeletal disorder such as awkward hand posture, static loading of the muscle during repetitive gripping of the handle, excessive force exertions, the weight of the tool being supported exposure to hand-arm vibration can be caused by repetitive usage of hand held tools (Govindu et al., 2012). To determine the optimal diameter for handle use for the general population an extensive research has been conducted. Tool handle diameter has been identified as the most significant factors that affect grip force production (Edgren et al., 2011). Grip production, local contact pressure of a handle configuration and the perceived acceptability can be affected handle orientation; texture, angle and shape as a factors (Sancho-Bru et al., 2011).

1.2 Problem statement

In Automotive industry, almost all the jobs are performed in standing and sitting position and this can lead to muscle fatigue. At PHN Sdn Bhd, the operators at the rework area are doing task manually. Most of the task involved performing the job tasks such as grinding and use hand guided equipment, the operators might feel discomfort and pain in their arms and wrist. The operators are tending to experience fatigue while performing job at Rework Area that may take to serious injuries known as Musculoskeletal Disorders (MSDs).

MSDs are often caused by awkward postures, excessive force and repetition because of the vibration hand tools, standing for prolonged periods and heavy equipment. The manager in PHN Industry Sdn Bhd is worried about the declined health quality of the operators can affect their productivity and hence decreases the efficiency of the manufacturing operation.

This study focus on analyzing related between hand pressure grip force with hand tool vibration that gives discomfort for workers in rework area by using tekscan system and lastly giving suggestion on proper technique to reduce hand discomfort and muscle fatigue by using an ergonomics approach to overcome all the problems. Based on the scenario of the working environment at PHN Industry Sdn Bhd, it is important to explain and give the best understanding about MSDs and Hand-Arm Vibration Syndrome in the automotive industry.

1.3 Objectives

The objectives of the study are :

i. To study the effect workers activity by using the hand tool vibration.
ii. To analyze the relationship between hand tool vibration and press grip force.
iii. To justify the relationship between hand tool vibration and press grip force that gives effect to worker performance.

1.4 Scope and Limitation of Study

This study focused on analysis of hand tool vibration activities at rework area. It is done by collecting data from PHN Industry Sdn Bhd. In this study, the aspects that will be look are ergonomic requirement, ergonomic principle and ergonomic problem faced by the workers. Besides, other aspects such as improving the muscle fatigue were also covered in this study.

1.5 Importance of the Study

This study is able to :

i. Provide and analyze of the best ergonomic approach that can be used to reduce all the pain or health experience that occur because of the effects of discomfort.

ii. Encourage the implementation of ergonomics approach in automotive industry.

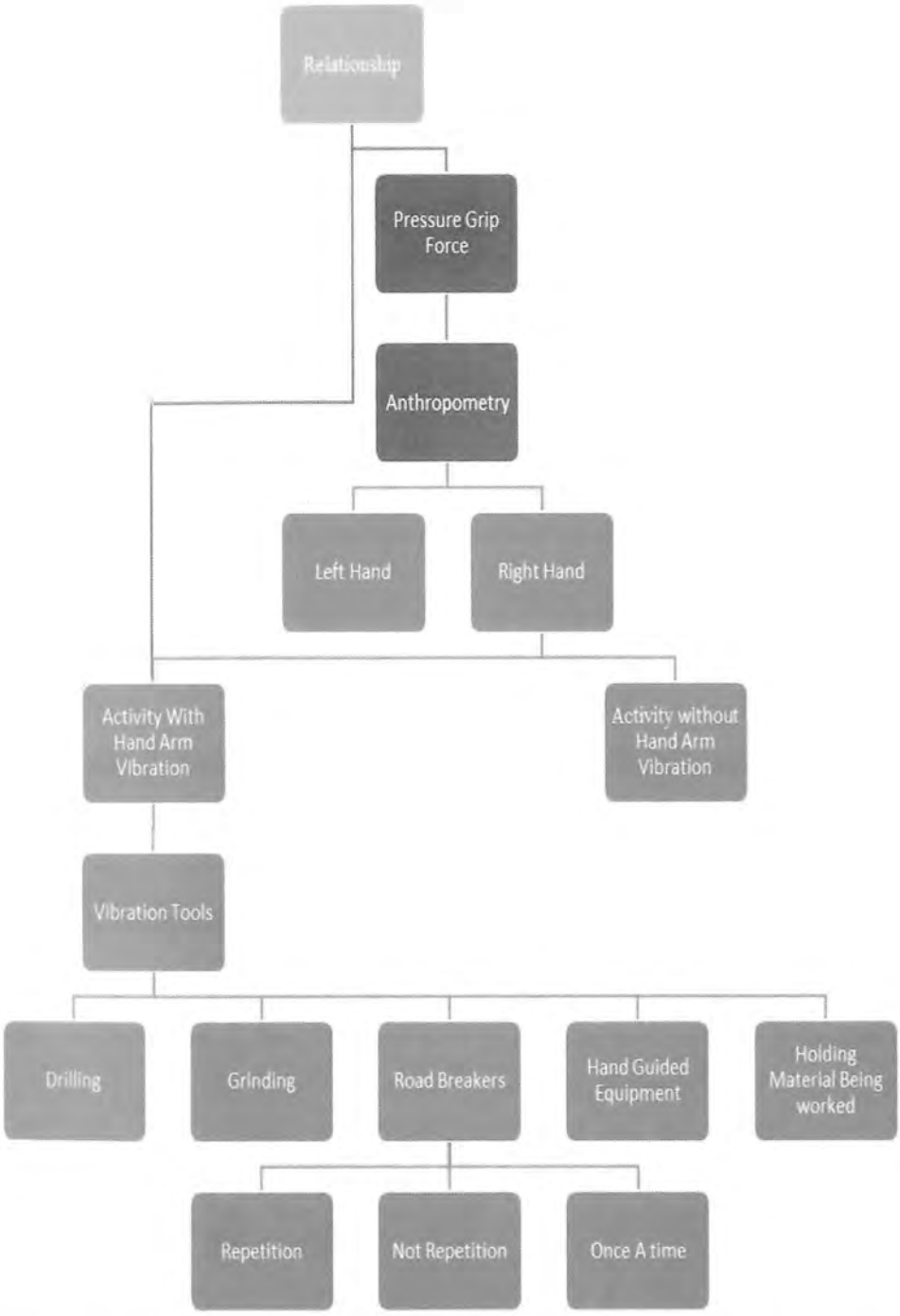

Figure 1.0 : The Flowchart Relationship Between Hand Pressure Grip Force With Hand Tool Vibration

CHAPTER 2

LITERATURE REVIEW

This chapter contain the literature review of the study which related to the objectives and scope of the study. It will look in to ergonomics, ergonomic risk factor and discuss the hand tool vibration, pressure grip force, muscle fatigue experience and activities with hand arm vibration. It also covers the hand –arm vibration syndrome (HAVS).

2.1 Ergonomics

Ergonomics is the science of fitting workplace condition and employments interests to the capabilities of the working population. In other meaning, ergonomic is the laws of work that define the limits to human capability. Effective and successful fits assure high productivity, increased satisfaction among the employee of the organization and avoidance of illness and injury risk.

Despite the fact that the scope of ergonomic is much wider, the term here refers to assessing those work related factors that may induce a risk of musculoskeletal disorder and recommendation to reduce them. Basic examples of ergonomic risk factor are found in the works involving the repetitive, forceful or prolonged exertions of the hands; prolong awkward posture; and frequent or heavy lifting, pushing, pulling or carrying of heavy objects.

Jobs or working conditions that shows multiple risk factors will have a higher probability of developing a work related musculoskeletal disorders. The level of risk relies on the frequent, intensity and duration of the exposure to these condition and individual's capacity to meet the force of job demands that might be included.

Ergonomic assessment are required with a specific end goal in order to know how efficiently the company is implementing ergonomics or precisely where to begin when first utilizing ergonomics. An ergonomic assessment of workplace can disclose any unsafe areas, identify ergonomics solutions and help to implement an ergonomic plan that will improve the overall ergonomics of the organization.

2.2 Ergonomik Risk Factor

Ergonomic risk factor cause difficulties in elimination, identification, reduction and control, thus give the challenge to the management team handle the problems. According to Mat Rebi (2003), Ergonomics Risk Factor (ERF) is a circumstances that exist or created purposefully or unintentionally that could or may help contribute to results contravene or against the standard or philosophy of ergonomics that could or may be unsafe to the wellbeing and health of clients or individuals at work or after work.

Before solutions for the issues could be found, awareness and understanding on the negative factors of Ergonomic Risk Factors are essential and critical for countermeasure to take. According to Jaffar et al.,(2011), the primary Ergonomics Risk Factors are include force, vibration, static loading, awkward posture, contact stress, repetition and extreme temperature.

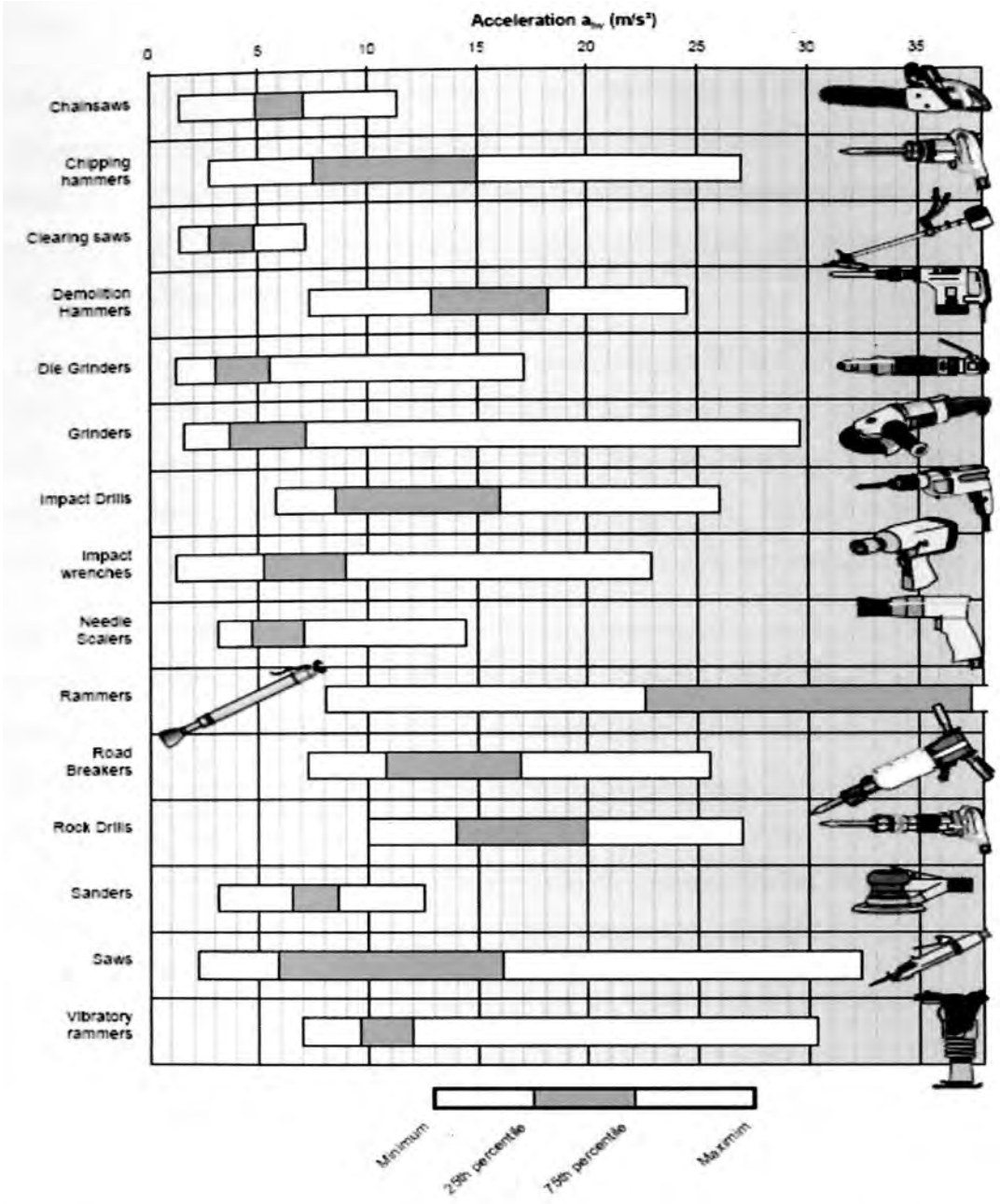

Figure 2.1: Frequency information about common power tools (Canadian Center for Occupational Safety and Health (CCOHS) (Oct 21, 2008).

2.3 Vibration and the human body

Vibration is a distinction has to be made between whole body vibration and hand arm vibration. In whole body vibration, it is brought into vibration via the feet (in standing work) or via the seat (in seated work). Usually the vibration is more vertical, such as in vehicles. Hand-arm vibration affects only the hand and arms and often arises when using motorized handled tools.

According to Jan Dul et al., (2008) there are three variables are important in assessing vibration : level (expressed in m/s), frequency (expressed in Hz) and exposure duration. Low-frequency body vibrations (<1 Hz) can produce a feeling of seasickness. Body vibrations between 1 and 100 Hz, especially between 4 and 8 Hz, can lead to chest pains, difficulties in breathing, low back pain and impaired vision.

The possible consequences of hand-arm vibration frequencies between 8 and 1000 Hz are reduced sensitivity and dexterity of the fingers, vibration "white finger" as well as muscle, joint and bone disorders. Vibration "white finger" (also called dead finger) is caused by hand-arm vibration. The main symptom of disorder is a reduction of blood flow in the fingers leading to discoloration of the skin. The fingers feel cold and become numb, which in time can actually lead to necrosis of the fingertips. The condition is aggravated by cold (Bernard Weerdmeester et al., 2008).

The most common frequency range for handled motorized tools is between 25 and 150 Hz. In practice, most vibration consists of several separate vibrations at different frequencies and in different directions. From the individual characteristics of these vibration, it is possible to calculate an average measure of the vibration level. This average level can then be used in practice to assess the impact of the vibration.

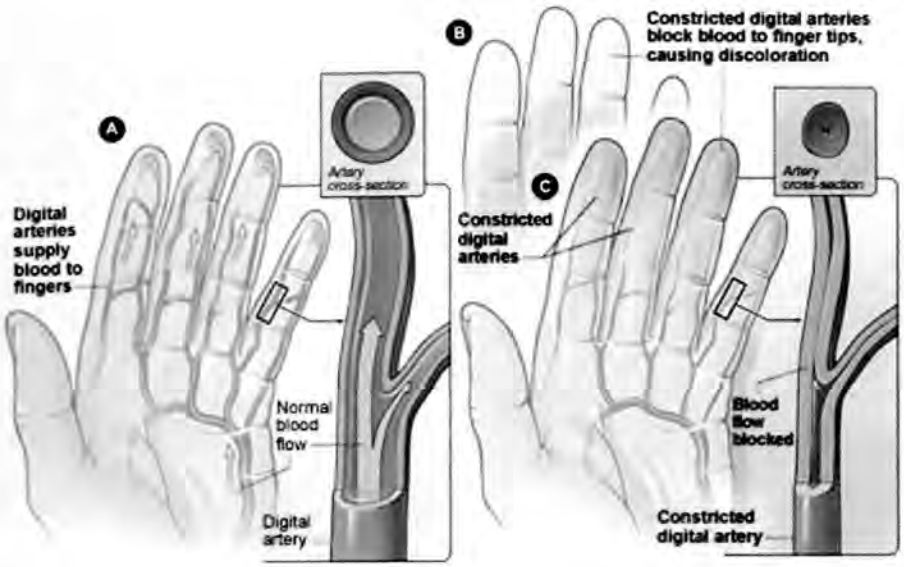

Figure 2.2 : (A) Image of arteries in the fingers (digital arteries) with normal blood flow.

(B) shows fingertips that have turned white due to blocked blood flow.

(C) shows narrowed digital arteries, causing blocked blood flow and blue fingertips. (Adapted from nhlbi.n h.gov)

The human body is a complicated and amazing collection of systems and sensory capabilities that permit an infinite number of movements, activities and functions. The senses of the body are inherent safety mechanism, which respond to external stimuli and are the gateway to the human. The senses interpret external signals and allow the internal systems to respond. Hazardous conditions may be immediately sensed and workers and management must pay attention to these signals to eliminate acute hazards. These types of hazards can cause long-term disability and health concerns (Pamela , 2010).

Figure 2.3 : Vibration white finger diseased hand (Adapted from whitefinger.co.uk, drmueller- healthpsychology.com and nailsmag.com)

2.4 Pressure Grip Force

The hand force is considered either as the grip force or the press force. The grip force (Fg) is a clamp like force exerted by the hand when enclosing a handle, which is compensated within the hand by a gripping motion acting in the opposite direction towards a dividing plane as shown in Figure 2.4. The press force (Fp) is the force exerted by the hand away from the operator's arm towards the work surface area, which is not compensated within the contacting surface of the hands.

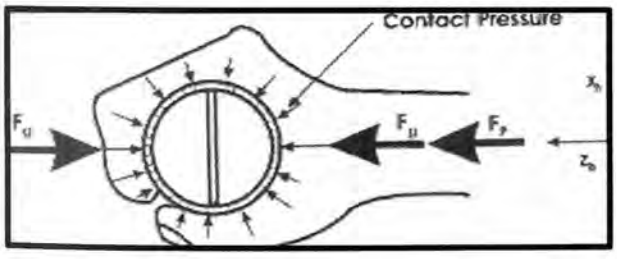

Figure 2.4 : Definitions of the grip push and contact forces (D. Welcome et al., 2004)