THE ASSOCIATION BETWEEN RISK FACTORS AND THE PREVALENCE OF MUSCULOSKELETAL DISORDERS (MSDS)AMONG VEHICLE TECHNICIANS IN PERODUA PUCHONG SERVICE CENTER

AMIRUL HAFIZ BIN SHUIB

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AMIRUL HAFIZ BIN SHUIB

A Final Year Project submitted in fulfilment of the
requirementsfor the degree of
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Malaysia2020

DECLARATION

Name: Amirul Hafiz Bin Shuib

Matric Number: 930408145109001

I hereby declare that this final year project is the result of my own work, except for quotations and summaries which have been duly acknowledged.

Signature: Date:

29/4/2021

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ABSTRACT

The primary objective of this study was to determine the association between risk factors and the prevalence of musculoskeletal disorder (MSD) among vehicle technician in Perodua Puchong service center. Overall, 35 technicians from Perodua Puchong service center were stratified sampling as participants of this study. For evaluations of perceived MSD in nine different sections of the body, a modified version of the general Standardized Nordic Questionnaire was used. This study made use of the Rapid Upper Limb Assessment (RULA), vibration measurement on a hand power tool, a job content questionnaire, and force exertion. To assess the impact of risk factors on MSD prevalence, direct logistic regression was used. Vehicle technicians at the Perodua Puchong service center are likely to be exposed to a variety of ergonomic hazards and risk factors. As a result, ergonomics awareness among employers and employees, as well as training and information sharing, must be increasedin order to reduce the prevalence of MSDs.

Keywords: Musculoskeletal disorder (MSD), Vehicle technician, Hand arm vibration

PERSATUAN ANTARA FAKTOR RISIKO DAN PENCEGAHAN PENYAKIT MUSKULOSKELETAL (MSDS) DI TEKNIK KENDERAANDI PUSAT PERKHIDMATAN PERODUA PUCHONG.

ABSTRAK

Objektif utama kajian ini adalah untuk mengetahui hubungan antara faktor risiko dan prevalensi gangguan muskuloskeletal (MSD) di kalangan juruteknik kenderaan di pusat servis Perodua Puchong. Secara keseluruhan, 35 juruteknik dari pusat servis Perodua Puchong menjadi sampel berstrata sebagai peserta kajian ini. Untuk penilaian MSD yang dirasakan di sembilan bahagian badan yang berbeza, versi yang diubah suai dari Soal Selidik Nordic Standardized umum telah digunakan. Kajian ini menggunakan Rapid Upper Limb Assessment (RULA), pengukuran getaran pada alat kuasa tangan, soal selidik kandungan pekerjaan, dan kekuatan tenaga. Untuk menilai kesan faktor risiko terhadap prevalensi MSD, digunakan regresi logistik langsung. Juruteknik kenderaan di pusat servis Perodua Puchong cenderung terdedah kepada pelbagai bahaya dan faktor risiko ergonomik. Akibatnya, kesedaran ergonomi di antara majikan dan pekerja, serta latihan dan perkongsian maklumat, harus ditingkatkan untuk mengurangi prevalensi MSD.

Kata Kunci: Gangguan muskuloskeletal (MSD), Juruteknik kenderaan, Getaranlengan tangan

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Amirul Hafiz

Bin Shuib29

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CHAPTER 1
INTRODUCTION

1.1 Background

Musculoskeletal disorders (MSDs) have accounted countless compensation days and disability in numerous countries. In United States, the direct cost of MSDs was $1.5 billion in the year 2007. The indirect costs were $1.1 billion for MSDs for the same year (Bhattacharya, 2014).

Musculoskeletal symptoms are prevailing and their influence is extensive. MSDs are the most frequent cause of serious lifelong illness and physicaldisability. MSDs influence hundreds of millions people globally too. MSD greatly impact psychosocial level of those who experience it, their family and caretaker (Woolf & Pfleger, 2003). Musculoskeletal syndromes are a various category that links to path of physiology but are connected to pain and weakened bodily system. The conditions of MSDsinclude a critical occurrence that could last for short duration or are permanent like rheumatoid arthritis, osteoporosis, osteoarthritis and lowerback pain.

Musculoskeletal pain is a common issue among those who working in vehicle servicing industries. Researchers have investigated the occurrence of musculoskeletal pain and possible risk factors for such pain among vehicle service technicians (Nasrull et al., 2010; Torp et al., 2001; Vyas et al. 2011). A vehicle body shape is not adjustable hence it requires employees to adapt physically during the servicing process that included working inside, underneath or around the vehicle. Vehicle services are mostly dominated by men and they are usually young in age (Åström et al., 2006). Vehicle service industries have developed from using traditional manual hand tools to using hand power pneumatic tools, vehicle lifts and electronic diagnosis to check for any engine default. Despite these improvements, the service process is still challenging for employees and this might be linked to MSDs.

Working in a comfortable environment at a workplace can reduce injuries, avoid risk factor and also reduce the working time. People have become aware that occupational psychosocial aspects could influence musculoskeletal disorders. These risk factors consist of repetition, forceful exertions, false postures, contact stress, and segmental vibration.In addition, ergonomic hazards are identified in the work of automotive service technicians. This is caused by several factors such as physical exposures which include forceful exertion at upper and lower extremities as well as segmented vibration. Even though ergonomics assessment is considered for the vehicle designs for those who work in automotive manufacturing, vehicle designs for automotive maintenance appear to be neglected. Therefore, this study is conducted with the objective: to determine the prevalence of MSDs and the association with risk factors among vehicle service technicians. Hence, improvements can be made tolimit or eliminate the risk factors of MSDs at the workp

1.2 Problem statement

Among all factors of disabilities, MSDs make the second place and this is as identified by the global years lived with disability. MSDs influence hundreds of millions people globally. Presently, the estimation of people experiencing MSDs are 632 million for back pain, 332 million for neck strain, 250 million for osteoarthritis (OA) knee and 560million for other musculoskeletal conditions (Bone and Joint Decade, 2012).

It had been reported by Social Security Organization (SOCSO) (2012, 2013 & 2014), there is an increasing on the number of occupational diseases and benefit paid according to causal of occupational musculoskeletal disorders as shown in Figure 1.1.

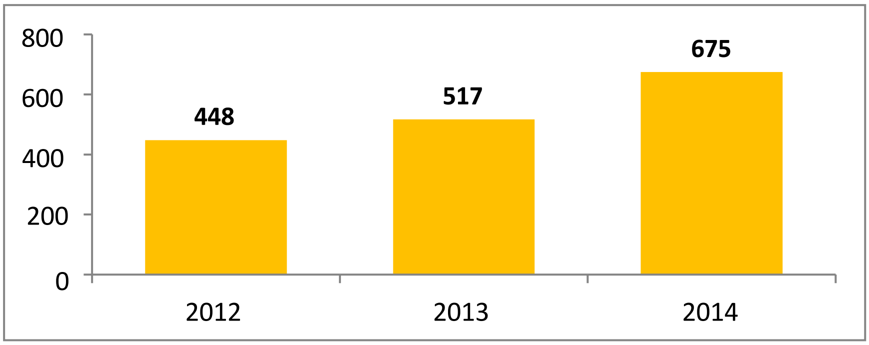


Figure 1.1: Number of occupational diseases and benefit paidaccording to causal of occupational musculoskeletal disorders (Source: Social Security Organization, 2012, 2013 & 2014)

In 2014, a total of 1169 number cases of invalidity caused by disease of the musculoskeletal system have been reported to the Social Security Organization, and reported as the highest numbers of invalidity comparedto other causal of disease as shown in Figure 1.2. The total benefit payment for invalidity pension and grant for 2014 is 496.82 million ringgit Social Security Organization

(SOCSO) (2014).

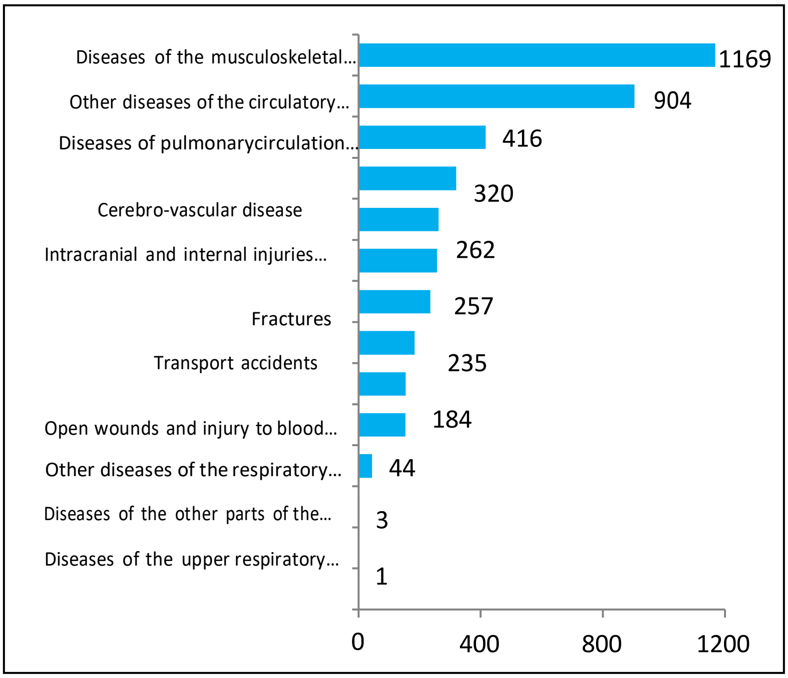


Figure 1.2: Number of invalidity cases reported

(Source: Social Security Organization, 2014)

According to Malaysian Development Investment Authority (MIDA), Malaysia is one of the countries in the South East Asia (ASEAN) with high volume of vehicles due to economic stability and high purchasing power. Based on statistic from Malaysian Investment Development Authority (2014), Malaysia showed the third highest total vehicle sales inthe ASEAN (Figure 1.3).

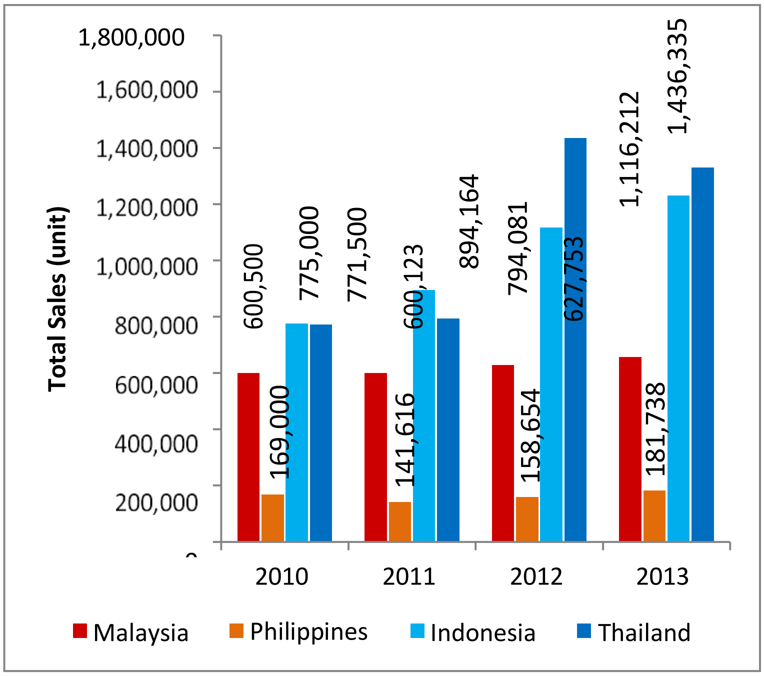


Figure 1.3: Vehicle sales in four major ASEAN countries from 2010to 2013

(Source: Malaysian Investment Development Authority, 2014)

Due to the increasing demands of vehicles, hence, the necessity for services and maintenance of vehicles which are equally on the rise. According to Department of Statistics Malaysia, (2008) there are approximately 18, 000 service outlets for vehicle services and maintenance in Malaysia with total of 209,835 employees.

According to the study conducted by Nasrull (2010) on the MSDs study in vehicle servicing industries, it was found that the prevalence of MSDs prevalence in vehicle servicing industries is 91.7%. According to Department of Statistics Malaysia, the total vehicle service employees in Malaysia are 209,835 employees. Therefore, the number of possible employees to get the MSDs is

192,419 employees.

In Malaysia, there is no study conducted to determine the prevalence of MSDs among those who working in vehicle servicing industries. Therefore, this study will be an inaugural study in Malaysia to determine the prevalence of MSDs among vehicle service technicians.

1.3 Study justification

This study will provide the data based on the current prevalence of MSDsamong those who working in vehicle servicing industries in Malaysia. It is acknowledged that although there are many vehicle services outlet in Malaysia, the effects of the workplace risk factors to MSDs among vehicleservice technician has not been highlighted. In Malaysia there is no research on the MSDs association with workplace risk factors among vehicle service technician.

Even though no cases specifically reported on the MSDs among vehicle service technician in Malaysia, it is suspected that several number of patient suffered MSDs cause by exposure to the workplace risk factors. Therefore, this study was conducted to determine relationship between MSDs and workplace risk factors among vehicle service technicians in Perodua Puchong Service Center.

Due to the lack of studies conducted in this area in Malaysia, the information and results from this study will be used as baseline data for further study. The data can also be used by enforcement bodies such as the Department of Occupational Safety and Health (DOSH) in facilitating them in focusing the enforcement to the correct target group. The study may improve the safety and health of the workers, as it will allow the problem to be detected at early stages.

1.4 Conceptual framework

This study is to determine the association between risk factors and the prevalence of MSD among vehicle technicians in Perodua Puchong Service Center.

The vehicle service technician exposed to the various type of MSDs risk factors during perform their daily task such as ergonomics occupational factors, psychosocial work factors, workplace environment factors, lifestyle factors, psychological factors and demography factors.

There are four common ergonomics risks present among vehicle service technician namely awkward posture, forceful exertion, vibration and repetition. Among all the risk factors, only three ergonomics risk factors is considered may give an effect to the MSDs namely awkward posture, forceful exertion and hand arm vibration. Repetition risk factor was neglected from this study since the operation of the technician is a various process which depended on the type of vehicle and type of service work process. The postures performed by vehicle service technicians were analyzed using Rapid Upper Limb Assessment (RULA) that will be discussed in Methodology section. The postures performed by vehicle service technicians when the height of the work area is inconvenient led to an awkward posture; especially in a bending position. It was apparent that the workers practiced a limited number of positions with the vehicle. Each of this position was associated with a specific set of awkward posture and contact stress risk factors but was not dependent on the task being executed. These risk factors were influenced by the size of the vehicle and to a lesser extent by the size of the service technician. A studydone by Vyas, (2011) among automobile repair technician found that

awkward postures, challenging occupational requirements and manual handling would cause strain, muscle fatigue, lethargy. Moreover, strenuous work postures practiced by technicians increase the symptoms of MSDs (OR 1.8, 95%CI 1.5– 22.2) (Vyas et al., 2011). Another ergonomic factor that may influence the occurrence of MSD is the force of exertion. Vehicle maintenance technicians must carry heavy pneumatic wrenches and heavy tires in addition to suffering stress from tire handling operations. This is called over-exertion and it can result in musculoskeletal damage (Denis et al., 2008). A study conducted in automotive plant identified that physical exertion was associated with the MSDs (neck: OR 5.6, 95%CI 1.8-21.2, shoulder: OR 4.9, 95%CI 1.4-20.4, lower back: OR 6.4, 95%CI 2.0-24.4) (Fredriksson et al., 2001). Technicians endure overexertion to achieve a shorter time of servicing process. In order to achieve that, they usually work while bending their neck and backs together with repetitious hand and finger gestures.

The last risk factor that will be focused on in this study is hand-arm vibration (HAV). HAV is transmitted from the hand power tool to technicians' necks which leads to muscle and joint strains (Åström et al., 2006). However, HAV might indirectly impact neck and shoulders when a static posture is regularly practiced hence muscular burden is raised. It is well-known that people will likely escalate their grip force when they handle HAV tools (Åström et al., 2006).

The second factor for MSD is psychosocial work factors such as unrewarding work, lack of control from management and job demand. The prevalence of work-related MSDs is said to be linked to excessive physical occupational requirement. For instance, it is analyzed that a minimum of one-third employees who face more physical occupational requirement are likely to be affected with MSDs than those who do not face it which is only 10%. Additionally, occupational MSDs are likely to affect those who face administrative and psychosocial job stresses (e.g. job strain, effort-reward inequality, emotionally challenging task, tense circumstances, and psychological and sexual harassment). The occurrence of occupational MSDs also increases up to 40% among employees who face all of the four physical occupational requirements and administrative job stress. This is also linked to psychological affliction and depressing symptoms among male and female employees (Vezina et al.,2010). The third factor for MSDs is workplace factors such as income, overtime and incentive rate that may lead to job dissatisfaction. A study by Da Costa and Vieira, 2010, showed that the increased level of job dissatisfaction affects the OR for musculoskeletal symptoms to be high as well. The fourth factor is psychosocial factors that were analyzed using general health questionnaire 12 (GHQ-12) that will be discussed in

Methodology section. The final factor is social demographic factor like age, body mass index and smoking habit had been reported as a cofounding risk factors influencing MSD. A study by Veira et al., (2008) reported that smoking and overweight associated with MSD with OR=2 and OR 1.38 respectively (Vieira et al., 2008).

Therefore, it is very important to determine the association between risk factors and the prevalence of MSD among vehicle technicians at the early stage. Figure 1.4 shows the summary of all the factors and the study variables.

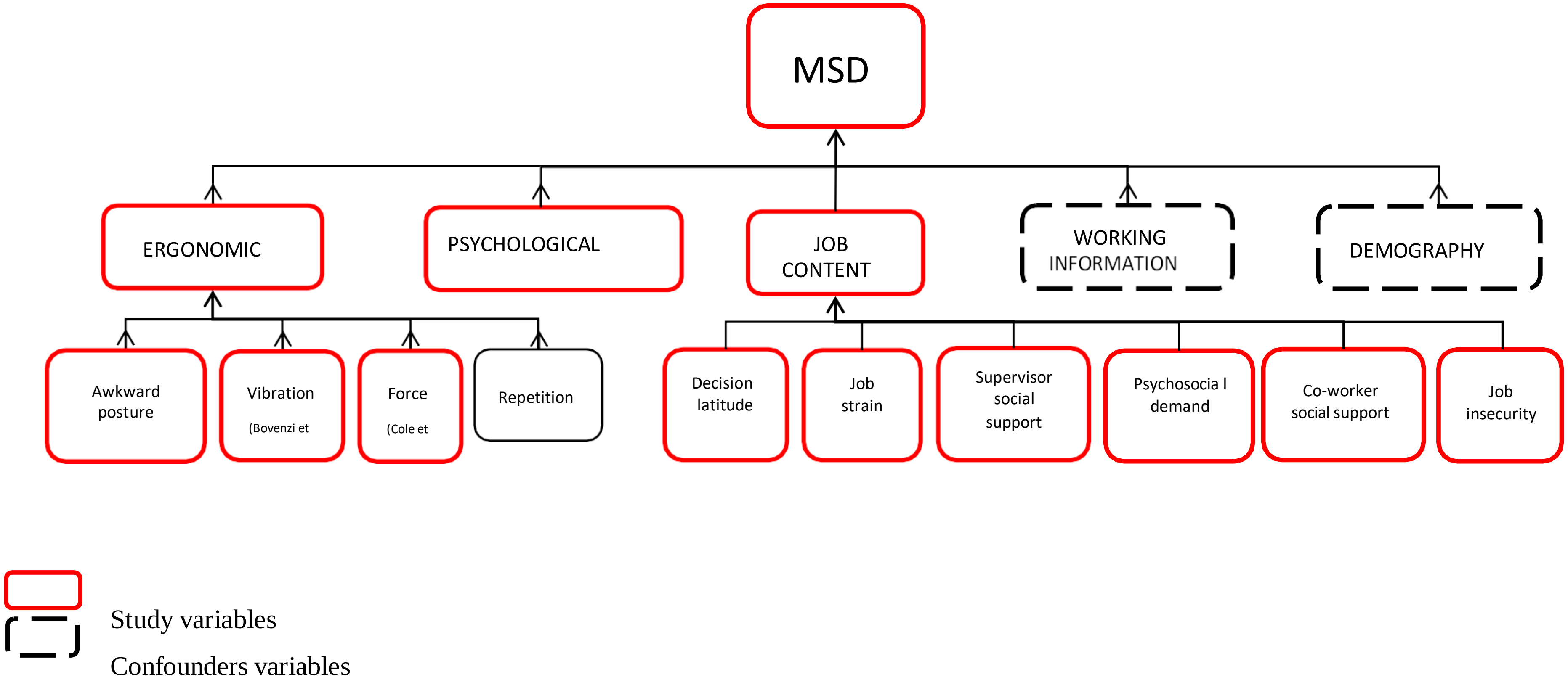


Figure 1.4: Conceptual frameworks of factors contributing to musculoskeletal disorder among vehicle technicians in Perodua Puchong Service Center.

1.5 Research objective

1.5.1 General objective

To identify the association between risk factors and the prevalence of MSD among vehicletechnicians in Perodua Puchong Service Center.

1.5.2 Specific objectives

1) To identify the prevalence of MSD among technicians.
2) To identify the working posture adapted and the association with MSD among vehicleservice technicians.
3) To determine the accurate magnitude of vibration and the association with MSD among vehicle service technicians.
4) To determine the work forceful exertion and the association with MSD among vehicleservice technicians.
5) To determine the work psychosocial factors and the association with MSD among vehicle service technicians.
6) To determine the psychological factors and the association with MSD among vehicleservice technicians.
7) To determine the association of multivariate factors from working posture adapted, magnitude vibration, forceful exertion, work psychosocial and psychological factors and MSD among vehicle service technicians.

1.6 Hypothesis

1) There is significant association between poor working posture and MSD among vehicle service technicians.

2) There is significant association between exposure of hand above permissible level ofvibration and MSD among vehicle service technicians.

3) There is significant association between high level of forceful exertion and MSD among vehicle service technicians.

4) There is significant association between high level of work psychosocial

and MSD among vehicle service technicians.

5) There is significant association between high level of psychological depression and MSD among vehicle service technicians.

6) Poor working posture, exposure of hand arm vibration above the permissible level, high level of forceful exertion, high level of work psychosocial and high level psychological depression are the most influences factors to the MSD among vehicle service technicians.

1.7 Definition of variables

Dependent variable: Prevalence of MSD

Independent variable: Poor working posture, exposure of hand on above permissible levelof vibration, great amount of forceful exertion, great amount of job psychosocial factors and high level of psychological depression.

Confounders variable: Age, body mass index, smoking habit, working overtime, and working incentives.

1.8 Terminology

1.8.1 Musculoskeletal disorders (MSDs)

Conceptual Definition

Musculoskeletal disorders (MSDs) are injuries and disorders that affect the human body's movement or musculoskeletal system (i.e. muscles, tendons, ligaments, nerves, discs, blood vessels, etc.).

Operational Definition

MSDs symptoms were identified using Standardized Nordic Questionnaire (Kourinka et al., 1987) by answering either ‘Yes’ or ‘No’. Prevalence of musculoskeletal symptoms were identified at 9 body parts area which area neck, shoulder, elbow, arms, upper back, lower back, thigh, knees and legs.

1.8.2 Awkward posture

Conceptual Definition

Awkward or false posture concerns with how a body is positioned during an occupational activity. Awkward posture is linked to a greater consequence of injury. It is believed that when a joint is stretched beyond the recommended limit, it will increase the risk of injury(Michael, 2002).

Operational Definition

Awkward posture is obtained from the posture assessment: Rapid Upper Limb Assessment (RULA) or Rapid Entire Body Assessment (REBA) that will be discussed in Methodology.

1.8.3 Hand arm vibration

Conceptual Definition

Hand-arm vibration (HAV) is an extensive threat in numerous organizations and professions which includes the handling of hand-held tools (like grinders or hammer drills), hand-control machines (like lawnmowers and plate compactors) or hand-fed machines (like pedestal grinders). Constant and customary contact vibration might influence employees' health which might result with pain or dysfunction the nerves, blood supply, joints, and hand as well as arm muscles (Health & Safety Executive (HSE) UK, 2005).

Operational Definition

Hand arm vibration (HAV) is measured to get a value in m/s^2 A (8) units. HSE UK introduced Vibration regulation 2005 on the Exposure Action Value and Exposure Limit Value for HAV (Health & Safety Executive (HSE) UK, 2005).

Exposure Action Value	: 2.5 m/s^2 A(8)
Exposure Limit Value	: 5 m/s^2 A(8)

1.8.4 Forceful exertion

Conceptual Definition

Forceful exertions occur when a lot of physical efforts are needed to do a task. For example, manual tasks that require human to pick up, push, pull, transport and operate a tool or machine.

Operational Definition

Borg rating perceives exertion category ratio (CR) scale is used to determine the rating of force exertion. CR scale positions verbal expressions on a ratio scale based on quantitativenature (Borg, 1990). Numbers from 0 to 10 are used to with regard of the regular form of the scale. Perceptual responses that are really strong are implied by the number 10. Examples of activities that fall under this category are running in a fast speed or lifting and carrying particularly heavy weights. Number 10 is the highest degree of strain that one may experience.

1.8.5 Job demands

Conceptual Definition

Job demand or occupational requirement is defined as pressure that arise from anxiety in completing certain assignments, doing unanticipated duties and facing occupational personal problem (Karasek, 1985).

Operational Definition

Job demands may be derived from the measurement of five questions in the core Job Content Questionnaire (JCQ) version. To eliminate neutral answer during JCQ measurement scale 4 points Likert-type scale, ranging from 1= strongly disagree to 4= strongly agree has been used in the study.

1.8.6 Job strain

Conceptual Definition

Job strain is known as increased psychological demand during lack of judgement circumstances (decision latitude). (Job Strain and the Prevalence and Outcome of CoronaryArtery Disease, 1995)

Operational Definition

Job strain may be obtained from the method of Karasek, (1985). Responses to job statements with 4-points scale: 4, strongly agree; 3, agree; 2, disagree; and 1, strongly disagree. Items are categorized into two scales (decision latitude and psychologicaldemands), with the formula below (Karasek, 1985).

$$Job\ strain\ index = \frac{(32 - Decision\ latitude)}{32 - 8}$$

1.8.7 Body Mass Index (BMI)

Conceptual Definition

The BMI is defined as the body mass divided by the square of the body height, and is universally expressed in units of kg/m^2, resulting from mass in kilograms and height in metres.

Operational Definition

Calculation of body weight and the height of a person is done using the formula below:

$$BMI = \frac{Weight(kg)}{[Height\ (m)]^2}$$

CHAPTER 2

LITERATURE REVIEW

2.1 Human musculoskeletal system

2.1.1 Anatomy of human musculoskeletal

Musculoskeletal tissues include bone, tendon, ligament, cartilage, and skeletal muscle. Thetypes of tissues mentioned here are tough and sturdy. Both cartilages and bones are solid and they have great compression capacity. In addition, soft tissues like tendons and ligaments are strong as well as stretchable (Abousleiman & Sikavitsas, 2006). The anatomy of human musculoskeletal system is featured in Figure 2.1.

2.1.2 Common reported musculoskeletal pain area

The most common reported injury sites of musculoskeletal pain among automotive industry workers are divided into nine areas namely: neck, shoulder, arm, upper back, lower back, hand, forearm/wrist, knee and feet.

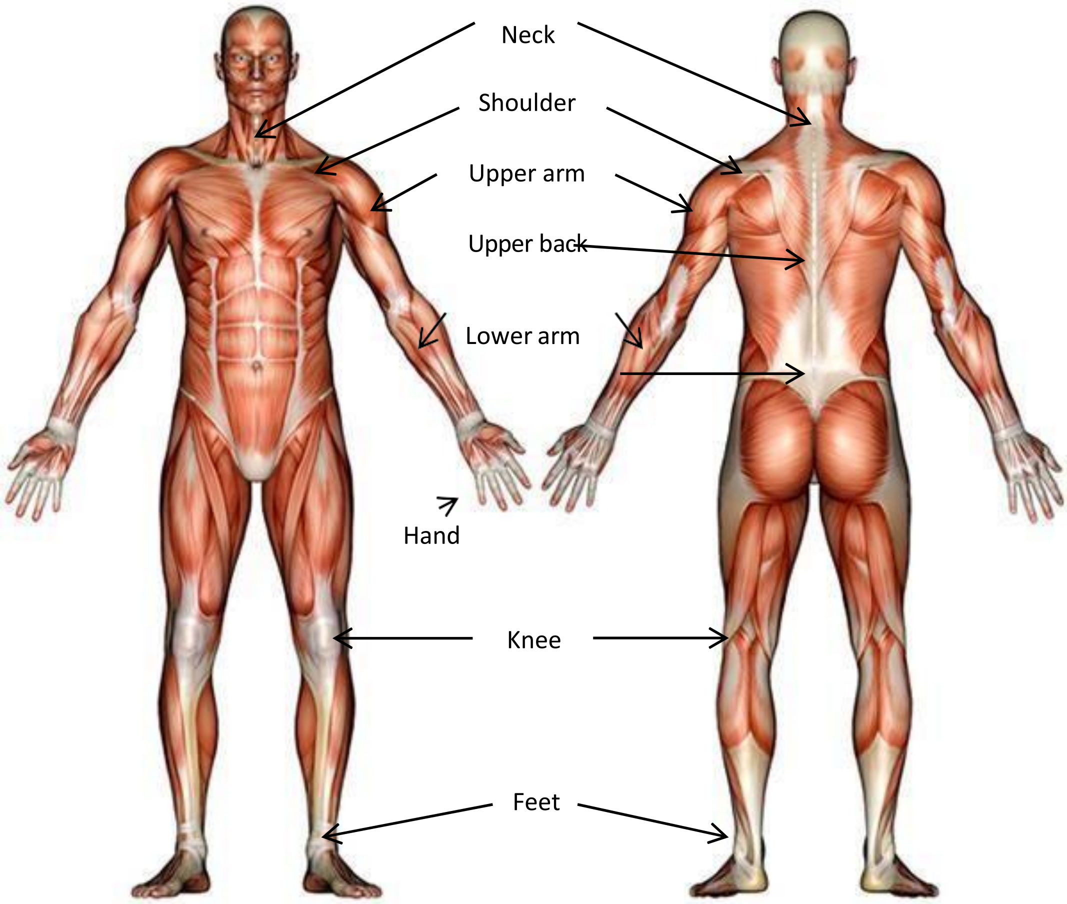


Figure 2.1: Basic Diagram of Human Musculoskeletal System

(Source: Dimon&Qualter, 2008)

2.2 Ergonomic

Ergonomics is derived from Greek words which are ‘‘ergon’’ that means work and ‘‘nomos’’ that means rule or law (Murrell et al., 1971). Ergonomics consists of three components which are physical, cognitive and organizational ergonomics. Physical ergonomics is the aspects of anatomy, anthropometry and physiology of work design (Karwowski, 2001). As for cognitive ergonomics, it assesses mental systems like information management, reaction, coordination, and apperception (Vicente, 1999). Another term for organizational ergonomics is “macro- ergonomics’’ and it focuses on approaches, organizations and processes of socio-technical structures (Karwowski, 2005).

2.3 Prevalence of musculoskeletal disorders (MSD) among automotive industryworkers

2.3.1 Perspective from studies done by developed countries

Musculoskeletal disorders (MSDs) are common in many countries and they create significant budgets and affect people's living quality. In many places, they contribute a majority of recorded and/or compensable occupational illnesses even though they may notparticularly caused by occupation. It is challenging to acquire exact facts on MSDs frequency and occurrence and it is demanding as well to compare authorized data betweencountries. However, MSDs are a prime group of occupational disease and it demonstratesa third or more of all recorded job-related illnesses in Japan, the Nordic countries and the United States (Bernard, 1997).

It has been reported in various studies among people at work that 20% to 30% or even higher made the frequency of symptoms at upper body. In 2010, MSDs in the United Statesmade up 29% of the injuries and sicknesses which made an average of 10 days absenteeism and this data has not changed much since 2005 (U.S. Department of Labor, 2011). The annual cost of MSDs as measured by reimbursement expenses, gone salaries, and low productivity is roughly from $40 to $55 billion (Dunning, 2010). Despite of the payment,the effect of MSDs is huge for individual well-being and corporate finances.

Researchers in Germany found that the most common MSDs in automotive industry workers was forearm illnesses especially at flexor tendons area. The maximum percentage of MSDs were mostly among trainees and blue-collar employees who have more experiences and have faced recent change in either work scopes or regular order of task performance (Spallek et al., 2010). On the other hand, Torp, (1996) found that the most common symptoms of MSD among vehicle mechanics in Norway were from neck, lower back, head and shoulders. MSDs that are caused by symptoms of pain at the shoulders (OR= 4.2), lower back (OR=2.3) and upper back (OR=2.1) were related with the rate of absenteeism (Torp et al., 1996). A study in Sweden revealed that MSDs increased significantly among automobile assembly workers that showed symptoms at the upper body part but not at the lower back and lower body part (Fredriksson et al., 2001).

MSDs incidence in 2010 recorded about 1967 cases per 10,000 in primary care only and 2143 cases per 10,000 in primary and secondary care combined. Among the conditions examined, back pain was the most common condition of all (Figure 2.2). The prevalence MSDs combined increased with age and it was higher among women (rate ratio 1.16; 95%CI 1.07, 1.26)(Jordan et al., 2014).

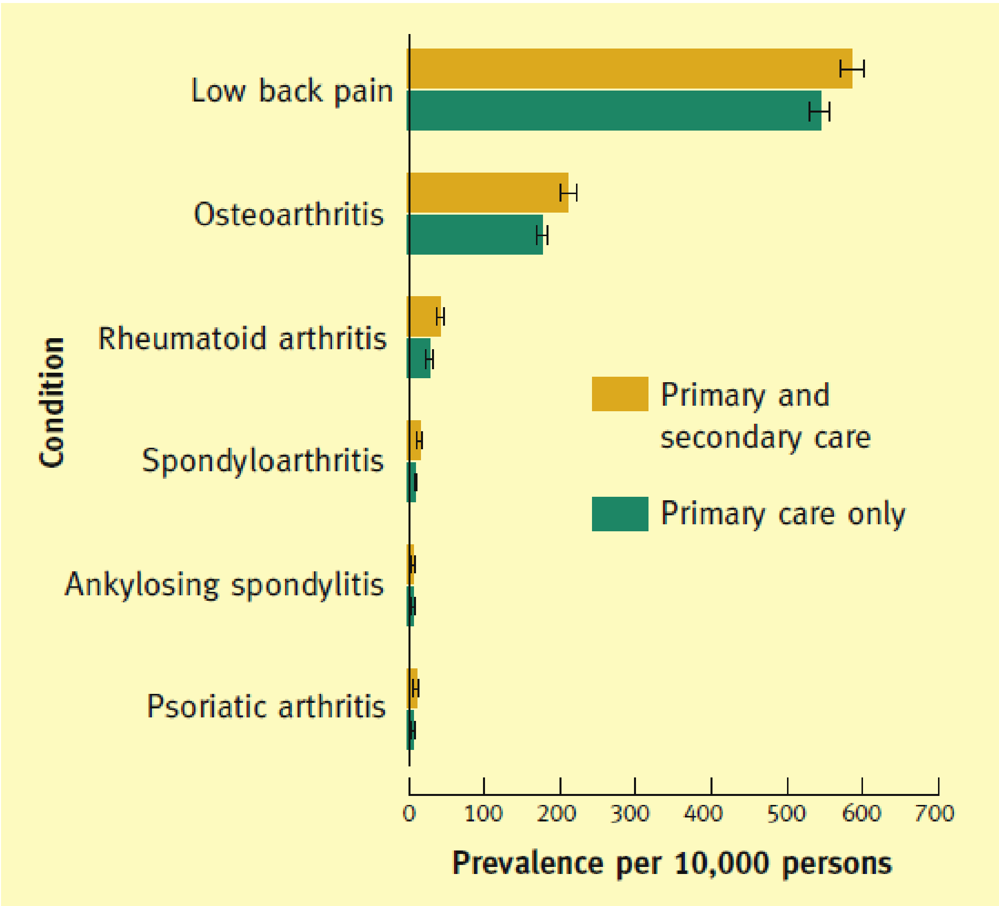


Figure 2.2: Annual consultation prevalence of MSD, North Staffordshire, England2010

(Source: Jordan, 2014)

2.3.2 Perspective from Studies Done by Developing Countries

A study in China showed 861 automobile companies employees recorded a number of about 2,750 MSDs symptoms at their body area (Chan et al., 2014). The amount of incidences per employee has increased gradually according to age. Upon 35 years old, there is about 10% employees who reported that they have not experienced MSDs-relatedpain. This means that the other 90% were all afflicted by MSDs-related symptoms. Some of the workers have quit their jobs because they the pain was unbearable for them and affected their work performance. Some of them might have remained if the management permitted them to recover by giving them medical leaves. However, they quit anyway since the management did not agree to do so (Chan et al., 2014).

Another research was done in Henan state (n=5,338), a province with the highest population in China (population = +/-100 million) found that many employees showed MSDs symptoms at neck (48.6%), shoulders (38.8%), wrists (33.5%), and lower back (59.7%). Female employees showed more musculoskeletal symptoms than male employees at the neck, shoulders, and wrists (Yu, 2012).

In Malaysia, it was reported a significant percentage of MSDs symptoms among automotive manufacturing worker (n=500) which was lower back pain (24%). Followed by pain at feet/ankle (20%) and followed by pain at upper back (20%) areas. Nearly 33% of the respondents complained of experiencing pain at their upper back and lower back areas (Daros et al., 2010).

A survey by World Health Organization/International League of Associations for Rheumatology Community-Oriented Programme for Control of Rheumatic Diseases (WHO-ILAR COPCORD) showed the prevalence rates of typical symptoms and rheumatic disorders in cities and countries in developing countries which can be seen in Tables 2.1–2.2. The incidence of rheumatic MSDs was different in cities which was 12% in Vietnam and 47% in Peru. As for the countries, the prevalence was 12% in Shantou, China and 55% among native Australians. In addition, it was reported that the most frequent pain areas were at knee, lower back, neck and shoulder (Veerapen et al., 2007).

Table 2.1 Prevalence of pain area in rural population (%)

	IN	ID	TH	BD	MY	PH	AU	EG
Sample size	4092	4683	2463	2635	1267	846	847	5120
Pain at any area	17.9	24	36.2	26.9	23	14.5	33	16.2
Neck	6.5	5	5	10.8	3.6	7.3	3	2.1
Lower back	11.9	15.1	4	20.1	7	11.3	NA	4.9
Shoulder	7.4	11	NA	11.5	4	NA	9	<1
Elbow	5.9	10	NA	6.7	2.7	NA	4	1.1
Hand	6.1	NA	NA	5.8	NA	NA	5	1.8
Wrist	6.4	NA	NA	6	NA	NA	6	NA
Knee	12.7	12.2	12.5	14	11	7	11.2	9.1
Ankle/feet	8	NA	NA	2.1	NA	NA	7	<1
Hip	1	NA	6.5	13	NA	NA	2	NA
Heel	2.7	NA	NA	7.7	NA	NA	NA	NA

IN=India, ID=Indonesia, TH=Thailand, BD= Bangladesh, MY= Malaysia, PH=Philippines, AU=Australia, EG=Egypt (Source: Veerapen et al., 2007)

Table 2.2 Prevalence of pain area in urban population (%)

	IN	ID	CN (Shanghai)	CN (Shantou)	VN	BD	PE	IR
Sample size	8145	1071	6584	2040	2119	1259	1965	2502
Pain at any area	14.1	32	21.2	18.1	11.9	27.9	47	48
Neck	2.8	12	3.5	4.6	6.6	10.2	NA	14
Lower back	7.6	23.3	8	11.5	18.4	6.3	22	
Shoulder	3	NA	7	5	NA	9.3	NA	18
Elbow	2.3	NA	1.9	2.6	NA	6.2	NA	NA
Hand	2.8	NA	2.6	2.1	NA	6.4	35	15
Wrist	NA	NA	1.4	1.5	na	6.9	NA	13
Knee	9.2	14.8	10.2	7.5	17.4	15.8	41	18
Ankle	4.3	NA	1.2	2.3	NA	3.3	NA	13
Feet	NA	NA	NA	1.1	NA	NA	NA	NA
Hip	NA	NA	1.3	1.8	NA	7	NA	10.2

IN=India, ID=Indonesia, CN=China, VN= Vietnam, BD= Bangladesh, PE=Peru, IR=Iran(Source: Veerapen et al., 2007)

2.4 Risk factors of musculoskeletal pain among automotive worker

National Institute for Occupational Safety and Health (NIOSH) stated that there are several aspects influencing MSDs like repeated motion, extreme force, awkward and/or sustained postures as well as persistent sitting and standing (Bernard, 1995).

2.4.1 Postures

Awkward posture is one of the common risk factors that may affect MSDs. Studies showed that Malaysia reported prevalence of musculoskeletal pain among vehicle service technicians (92%), in Sweden (76%) and in India (68%). In addition, all of the researchers concluded that the musculoskeletal pain were strongly associated with awkward postures practiced by the workers (Nasrull et al., 2010; Torp et al., 1996; Vyas et al., 2011).

The tasks of vehicle technicians are bodily awkward and difficult. Technicians' tasks often result in stress and harm to wrists, elbows, upper and lower back and the spine. Technicians need to stand for extended time period, to kneel, squat or crawl while servicing cars. Kneeling and squatting for >1hr/day have a significant relationship with MSDs (Baker et al., 2003). Besides, technicians regularly stoop or twist their body while repairing, especially whilst stretching over the vehicle hood. They usually practice the same motionsas well. A research was held among employees in Denmark and a relationship was present between MSDs and twisting or bending for quarter or half (1/4-1/2) of working hours (Feveile et al.,2002). Often times, they practice the same restricted postures like static standing for quite a long time which are usually the case among vehicle technicians (d'Errico et al., 2007). Another study by Andersen, (2007) found that when worker standing more than 30 min/hr, the worker is 1.9 times affected with MSDs at lower back area compare to worker who is standing below than 30min/hr (Andersen et al.,2007). Some of the awkward working positions and postures in vehicle service industries are shown inFigure 2.3.

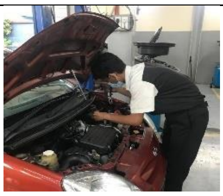
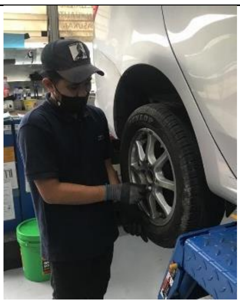
Image	Positio n	Associated postures
	Under vehicle	Shoulder elevation, back extension, neck extension, static holding.
	Side of vehicle	Possible awkward arm and wrist postures
	Under hood	Back flexion with static holding, awkward arm and wrist postures, shoulder elevation contact stress for legs and chest
	Changi ng tyre	Shoulder elevation, back, neck extension, static holding and kneeling

Figure 2.3 Awkward working positions and postures

(Source: Perodua, 2020)

During the phase of vehicle design, most of the vehicle designers normally consider the ergonomic and human factors for the drivers and passengers only. There are only a few designs that consider the ergonomics and human factors for technicians during maintenance job. Therefore, the technicians are required to work with awkward posture to fit to the vehicle design. Besides, automobile designers also design automobiles to be compact so that the engine can be fit in a small area (Vivek, 2011). In a way, this affects vehicle technicians to adapt to different challenging work settings, endeavouring to “fit thehuman to the task”.

2.4.2 Forceful exertion

Forceful exertion is defined as a load of effort produced by muscles and a load of pressure put to one's physical which are resulted from different occupational strains. Every job scope needs employees to use their muscles to some extent and exerting it with force. Nevertheless, when the force needed to be exerted for the activity is too great, working muscles, joints, tendons and soft tissues might be damaged. Normally, the damages are caused by muscles generating repeated levels of force that are moderate to high. This occurs more if the force is exerted in an extended duration paired with awkward bodily postures. Some job tasks require high force loads on different parts of the body. For instance, carrying a heavy load farther from one's body can increase the compressive force on vertebral discs and at the lower back. This may possibly harm the discs and vertebrae (Callaghan & McGill, 2001).

A study conducted by Cole et al., (2005) in Canada found that high forceful exertion was significantly associated with MSDs with OR 2.00 (1.29-3.12) (Cole et al., 2005). Similarly,another study done by IJzelenbergand & Burdorf (2005) which focused on industrial plant workers also showed that high forceful exertion was significantly associated with MSDs with OR 1.67 (1.05-2.68).

2.4.2.1 Rating of Perceived Exertion (RPE) Borg Scale

Physiological measurements need ratings of perceived exertion (or "effort and exertion") as their complementary. Perceived exertion is the most crucial in giving information of the degrees of physical strain. This is done with the symptoms shown by peripheral joints andmuscles, respiratory and cardiovascular functions as well as the central nervous system (Borg, 1990). Figure 2.4 illustrates how perceptual response is related with physical and mental load that are also connected to the physiological measurements. Researchers often pair physical load with physiological responses and mental load with perceptual responses in their study. Usually, physiological indicators are used to determine the degree of strain.Nonetheless, perceptual indicators are still as important to be used as indicators of degreeof strain.

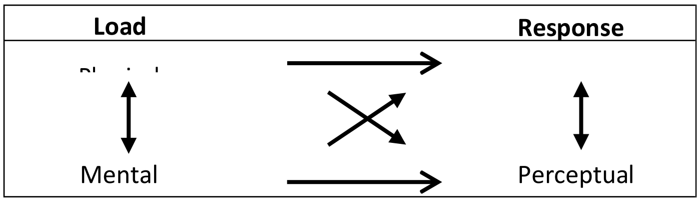


Figure 2.4 Illustration physiological and perceptual responses used as indicators ofboth physical and mental work load.

(Source: Borg, 1990)

Category Ratio (CR) scale is used to determine the rating of perceived exertion. CR scale positions verbal expressions on a ratio scale based on quantitative nature (Borg, 1990). Numbers from 0 to 10 are used to with regard of the regular form of the scale. Perceptual responses that are really strong are implied by the number 10. Examples of activities that fall under this category are running in a fast speed or lifting and carrying particularly heavy weights. Number 10 is the highest degree of strain that one may experience. However, some respondents may experience stronger degree of strain; the “absolute” limit can be placed higher than 10. Thus, it is permissible for the respondents to put numbers that are higher than 10 like 12, 13 and etc. This is normal for respondents who perceive exertion that is higher than the maximum level. Another reason why CR scale is used is for its quantitative rating that provides reference point. This value can be used as a “semi-public”component to compare modes like between vibration, pain, noise, taste, and exertion with different individuals and groups (Borg, 1990)

Many researchers have implemented Rating Perceived Exertion (RPE) scale in their studies. A study was conducted by McGorry et al. using Borg CR10 scale ratings in the measurement of grip forces linked with works that require hand tools (McGorry et al., 2010).

In comparison, another study done by Kee, (2010), also used Borg CR10 scale rating to investigate the relationship between subjective and objective methods in testing postural strains (Kee, 2010). It was found that there was a linear relationship between the discomfort that was measured with the estimation of magnitude and with the discomfort that was measured with Borg CR10 (Kee & Lee, 2012). Borg CR10 scale has also been incorporated in a research done by Vuille-Lessardet.al., (2012) to measure the effort perception of patients who have undergone any orthopaedic injury. Hincapie-Ramos & Guo., 2014, used Borg CR10 scale in a study to demonstrate the relationship between exerted endurance andarm fatigue (Hincapié-Ramos & Guo, 2014).

Borg's CR-10 scale		
0	Nothing at all	
0.5	Extremely weak	(just noticeable)
1	Very weak	
2	Weak	(light)
3	Moderate	
4		
5	Strong	(heavy)
6		
7	Very strong	
8		
9		
10	Extremely strong	(almost max)

Figure 2.5 The CR-10 scale, the category (C) scale with ratio (R) properties
(Source: Hincapié-Ramos & Guo, 2014)

2.4.2.2 Manual Material Handling

Manual Material Handling (MMH) covers a wide range of activities including lifting, lowering, carrying, pushing and pulling (Snook, 1978). It has long been a focus for a diverse range of disciplines as a result of the vast economic and human cost of injuries expended by workers during auto repair job situation. The physical movements involved in such activities are so diverse that only certain basic aspects can be touched on. The factors are different on every individual, physical condition, sex, age and more. A study in an automotive manufacturing company showed that the highest prevalence among workers who do MMH activities was lower back pain (LBP) with (39% , n=59)(Deros et al., 2010). Another study in Japan also showed that there was an increase of LBP risk of 16.7 among nurses who frequently handle patients manually compared to nurses who do not do so (n=329) (Smith et al., 2003). Workers generally uses a variety of push/pull techniques; namely forward pushing, forward pulling (one handed) and backward pulling (two handed) which necessitate a combination of forward and backward walking (Jung, 2005).

Pushing and pulling capabilities have been studied within a very limited scope as compared with lifting. The use of trolleys, handling heavy tools and other wheeled devices allow movement of a large quantity of goods at a lower risk of injury than lifting and lowering (Jung, 2005). These MMH tasks result in more back injuries than other types of MMH tasks. For the purpose of this study, five variables that influence the level of stress placed on body during lifting will be focused on. The five variables that influence the amount of strain put on body during carrying activity are;

a) Horizontal position of the load
b) Height and range of carrying
c) Technique of carrying from the floor
d) Frequency of carrying
e) Object characteristics

2.4.2.3 Pushing and Pulling

Pushing and pulling can be defined as the force that is exerted by anyone or anything with the condition that the direction of the ultimate component is parallel to the resultant force. For pushing, the person or the object applies the force away from the body while for pulling; they apply the force towards the body. Nevertheless, there is little cause-effect evidence that proves that musculoskeletal complications are resulted from pushing and pulling (Hoozemans, 1998).

Fifty percent of the main reasons for musculoskeletal injuries are caused by physical exertion and postures that are practiced at the time of the incident. These made up approximately 50% of all incidents related to pushing and pulling activities in a vehicle service outlet. Frequently, there is a need for teams to push or pull a load and this task mayincrease the level of musculoskeletal risk. A study pertaining to this issue was conducted by Abou-ElWafa et.al., (2012) among respondents who were municipal solid waste collectors in Mansoura, Egypt. These collectors were regularly involved in pulling/pushing of loads that are more than 20kg. It was found that they had significant association with the LBP risk (OR=5.5, 95% CI=1.8 to 17.0)(Abou-ElWafa, El-Bestar, El-Gilany, & Awad,2012).Another study has been conducted in Malaysia in a food processing and manufacturing company. The result showed that pushing and pulling of loads was significantly related to upper and lower back pain (x2=15.37, p= 0.04) (Deros et al., 2010). Meanwhile, in Shiraz, Iran, Choobineh and Movahed, (2010), conducted a study among operation room nurses who were regularly involved in pulling/pushing heavy objects. It was proven that there was a relationship between MMH and MSDs with OR 6.16 (1.31– 29.02, p=0.021) (Choobineh & Movahed, 2010)

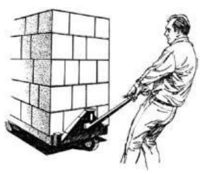
	 
Lifting, lowering or carrying	Pushing or pulling

Figure 2.6 Type of manual material handling

(Source: Jung,2005)

2.4.2.4 Grip Force

Automotive vehicle service works involve frequent gripping action of various intensities. There is proof that strong muscle lessens injuries of musculoskeletal and risks of accident (Peate, 2007). It was also proven that overall muscle strength can be predicted by handgripforce among adolescents (Wind, 2010).

Extra grip force is necessary in circumstances below:

- The employee is gripping a small instrument.
- The employee is holding slick or weirdly-shaped tools that are hard to be held.
- Tools are too big for a neat grasp.
- Tools are gripped with a pinch grip instead of a power grip.
- Vibrating tool or equipment is used.
- The employee is wearing thick or large gloves that cause gripping to be harder.
- Handles or grip widths are too large or too small.
- The handles of the tools are awkwardly shaped.

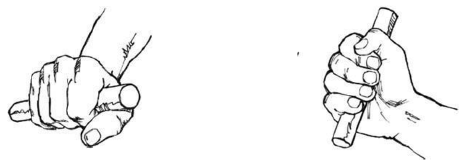
	
Pinch Grip	Power Grip

Figure 2.7 Type of grip force

(Source: Jung,2005)

A study by Waters et al., (2007), in New Zealand was performed among veterinarians. It was found that those who practiced awkward grasp or hand gestures had 12.91 (95% CI 3.46–84.21) times the probability of MSD when compared to those whose work did not practice such movements. The movements were also associated with arm and back pain (Waters et al., 2007). This is affected by the wrist muscles being exerted extremely (Burt & Fine, 1997).

Gangopadhyay et.al., (2007), investigated the relationship between brass metal workers who frequently engage hand intensive jobs and handgrip strength. The result revealed thatthese people were more likely to suffer MSD with a decrease of handgrip strength with t value 8.8 ($p<0.001$)(Gangopadhyay et al., 2007).

2.4.3 Hand arm vibration

Hand–arm vibration syndrome (HAVS) is a syndrome that consists of circulatory disorders (i.e. vibration white finger), motor and sensory disorders, and MSDs. These might happenamong employees who regularly handle handheld vibrating tools, particularly pneumatic drills, jackhammers, electric drills and saws, as well as grinders (Weir, 2005).

Around 20% of European employees reported that they had been exposed to vibration for no less than half-time at work from handheld tools or machines (European Commission, 2002). It was also stated it the said study that 13% of the employees believed that their working habit influenced the prevalence of MSD near the upper body. Vibration is a causethat is acknowledged to give risk of peripheral circulation injury at one's fingers (also known as 'vibration white finger'). In addition, it is not easy for employees to identify the link between occupational strains and cardiovascular diseases than occupational strain and MSDs (European Commission, 2002). In Congo, a study was conducted among vibration- exposed African handling cassava and corn millers (Lukuke et al., 2014). It was indicatedthat the risk of experiencing musculoskeletal symptoms were seven times (OR=7.10, (CI) 4.03-12.50, $p < 0.0001$) higher compared to those who were not exposed to vibration exposure. Another study done in Italy showed an increased risk for MSDs of the upper limb amongst female employees who are prone to hand-transferred vibration with the prevalence ratio 1.06, CI=0.78–1.46 (Bovenzi et al., 2005).

From the year 1996 to 1997, 12% of Swedish female trade unionists faced the exposure ofhand- transferred vibration while working and 2% of them handled the vibrating tools beyond 25% of their time at work (Bylund et al., 2002). Meanwhile, on a weekly basis,it was found that nearly 4.2 million male (20.5%) and 667,000 (2.9%) female employees were susceptible to hand- transferred vibration in Great Britain (Palmer, 2000). It was stated as well that 1.2 million male and 44,000 female employees were exposed to an amount of vibration of A (8) which is greater than 2.8 ms^2r.m.s., as recommended for daily amount in UK (Palmer, 2000). According to case definition, the survey also reported that

Raynaud's incidence was attributed to hand-transferred vibration measured between 31.5% and 37.6% among male while3.1% to 5.3% among female employees (Palmer, 2000).

2.4.3.1 Hand power tools

In automotive industries, hand powered tools are commonly used. Though they greatly ease workers' workload, they also contribute to an increased risk of injury. This is because, they are weightier, they have higher vibration and work ratio compared to instruments that are handled. Figure 2.8 show some of pneumatic tools commonly used in automotive industry.

		
Pneumatic Impact Wrench Tool	Pneumatic Impact Screwdriver	Pneumatic Impact Grinder

Figure 2.8 Type of pneumatic tools commonly used in automotive industry

(Source: Chicago Pneumatic Tools, 2015)

2.4.4 Psychological demands at work - Job Content Questionnaire Karasek (JCQ)

The Job Content Questionnaire (JCQ) is an independent analysis created to assess social and psychological characteristics of people's careers. The leading-known scales:(a) decision latitude,

(b) psychological demands, and (c) social support--are used to assess one's job strain development whether it is high-demand/low-control/low-support. Firstly, stress-related risk is predicted and followed by active-passive behavior that correlates to jobs. Other criteria are assessed too: (d) physical demands and (e) job insecurity. It is recommended that the instrument has 49 questions in length (Karasek, 1979; Theorell, 1990).

2.4.4.1 Scale 1: Decision latitude and Scale 2: Psychological demands

Demand/control model is the most applied hypothesis and it is observed that the opposing reactions of psychological strain mostly happen when there is job strain. Job strain occurs when the psychological strains had increased combined with the worker's low decision latitude (Karasek, 1979; Theorell, 1990). This is also influenced by short of social support at workplace which influences the prevalence. In the meantime, there is a second set of hypotheses named active behavior hypotheses and they are related to good stress. Good stress includes dynamic behavioral improvement under two conditions which are high demands and high decision latitude. These conditions promote enthusiasm, discovery, and adapting to transformation (but the demands must not be too high). In comparison, there will be opposite reactions for low demands and low decision latitude. The reactions consist of a demotivating working environment which leads to negative job learning and/or diminishing skill performance that were acquired previously (Karasek, 1979; Theorell, 1990).

2.4.4.2 Scales 1a and 1b: Components of decision latitude—Skill discretion anddecision authority

Decision latitude contains two sub-dimensions that are significantly related which are skill discretion and decision authority. In order to measure the employees' supervision over their occupational performance, these sub-dimensions are analyzed (Karasek & Theorell, 1990). Skill discretion (Subscale la) concerns with the skill and creativity level that are essential for the job and it is tested by a section of questions. As for the following sub-dimension which is decision authority (Subscale lb), it acts as an assessment of the workers' potentials to perform decisions in the organization. Questions regarding with skills are also asked to assess under-utilized skill (Subscale lc). The third macro-level set of questions consist of questions regarding with decision latitude that tests probability of participating effect on organizational matters and union together with work-group involvement (Subscales ld, le, If).

2.4.4.3 Scale 3: Social support

It has been discussed that there are different effects between being supported by co- workers and supervisor and this separates the instrumental and socio-emotional impacts (Subscales 3a, 3b, 3c, 3d) (Karaseket al., 1990). Social support is to test social relations at the workplace and interpersonal hostility is measured as well since it is an impact of the loss of social security (Subscales 3e, 3f).

2.4.4.4 Scale 4: Physical demands

"Demanding costs" are divided into two which are mental and physical demand. In terms of a more traditional workloads concept, they mostly involve physical demand. It can be seen in previous literatures that stress affects physiologically on cardiovascular system, the mental processing efficiency and overall lethargy. All of these rely upon mental and physical stress. Therefore, these are also evaluated in JCQ. Even though there is only one item on physical strain in the primary questionnaire survey (Subscale 4a), a suitable form of JCQ that contains items on static (Subscale 4b) and dynamic physical loads (Subscale 4c) is suggested since the two factors are considered crucial in the prevalence of MSDs.

2.4.4.5 Scale 5: Job insecurity

The work of carrying out tasks and the human costs to adapt to the dynamics of labor market makes up work psychological burden. There were some challenges in determining the statistics as there are low frequency of unemployment events even though the fear of job insecurity were experienced by majority of people. (Subscale 5a). The effects of job insecurity are dependent on the labor market criteria of particular skills which limit the possibilities of occupational development in the future (Subscale 5b).

2.4.5 Psychological distress – General Health Questionnaire 12 (GHQ 12)

General Health Questionnaire (GHQ) is a self-operational questionnaire that is designed to investigate one that may be having a psychiatric disorder in consulting settings (Goldberg & Hillier, 1979). Originally, there were 60 items in the questionnaire (GHQ- 60) but the items were deducted to 30 (GHQ-30), 28 (GHQ-28; in Spanish population (Gili et al., 2000) then followed by 12 items (GHQ-12) (Goldberg et al., 1997). General Health Questionnaire (GHQ- 12) has been widely used in detecting non-psychotic psychiatric disorders especially in multi-centers and international clinical trials (Goldberg et al., 1997). This instrument assesses circumstances of depression and psychiatric disorder. The aim of using (GHQ- 12) is to identify psychiatric disorders by focusing on psychological compounds which may be present in a patient who came to medical clinics. The questionsasked in GHQ 12 are as shown in Table 2.5.

Table 2.5 GHQ 12 questionnaire

No	Question
1	Feeling unhappy
2	Thinking of self as worthless
3	Losing confidence
4	Feeling unhappy and depressed
5	Could not overcome difficulties
6	Capable of making decision
7	Face up problems
8	Able to concentrate
9	Enjoy normal activities
10	Play useful part in things
11	Under strain
12	Lost much sleep

A study conducted by Maria et al., (2009), measured that there is association between mental distress and MSD with (OR = 3.94, 95% CI, 1.80-8.65, p =

0.001). In the meantime, a study among bankers in Ghana showed a result of multiple logistic regressions betweenMSD and mental distress (OR 1.40, 95% CI, 1.22-1.60) (Abledu, 2012).

2.5 Perodua Puchong Service Center work process

There are several type of work at Perodua Puchong Service Centre which are start from customer send the vehicle to the service center until invoicing and payment. Each type of work exposed to a different type of hazards. However, workers exposed to ergonomic hazards mainly during general service or car repair.

Servicing job includes replacing or servicing engine oil, oil filter, gasket, brake fluid, spark plug, air filter, fuel filter, cabin filter, coolant, power steering oil, gear steering oil, gear oil/ATF oil, differential gear oil, battery water, air conditioner service, wheel alignment & wheel balancing, replace brake pad and replace belting.

Workers will expose to the several type of ergonomic hazards during car servicing or repair. However, workers commonly exposed to awkward posture and high force risk factors.

2.6 Summary of related study

2.6.1 Study on musculoskeletal disorders prevalence in automotive industry

Researchers	Title	Study Design	Sample Size	Study Outcome
Torp, 1996	Work-related musculoskeletal symptoms among car mechanics: a descriptive study.	Cross-sectional study	103 respondents	MSDs prevalence: Lower back pain – 76% Neck pain – 62% Head pain – 55%
Vyas et al., 2011	Occupational Injuries in Automobile Repair Workers Car Mechanic	Cross-sectional study	153 respondents	MSDs prevalence: Lower back pain – 68% Upper back pain – 58% Shoulder pain – 28%
Nasrull et al., 2010	Investigation of ergonomic risk factors in a car tire service center	Case-control study	12 respondents	MSDs prevalence: Hand/wrist pain – 92% Shoulder pain – 83% Lower back pain – 75%
Hussain, 2004	Musculoskeletal symptoms among truck assembly workers	Cross-sectional study	461 respondents	MSDs prevalence: Lower back pain – 65% Neck pain – 60% Shoulder pain – 57%

Deros et al., 2010	Work-Related Musculoskeletal Disorders among Workers' Performing Manual Material Handling Work in an Automotive Manufacturing Company	Cross-sectional study	525 respondents	MSDs prevalence: Lower back pain – 24% Feet/ankle pain – 20% Upper back pain – 19%
Chan et al., 2014	Disposable Bodies and Labor Rights: Workers in China's	Cross-sectional study	1091 respondents	MSDs prevalence: Back pain – 14% Feet pain – 12% Hands pain – 11%

2.6.2 Study on the relationship between musculoskeletal disorders and workplace ergonomic risk factors

Researchers	**Title**	**Study Design**	**Sample Size**	**Study Outcome**
Svendsen et al., 2004	Work related shoulder disorders: quantitative exposure response relations with reference to arm posture.	Cross-sectional study	1886 respondents	The worker who exposed to awkward posture (elevated shoulder) was associated with MSDs. OR=1.08 (95% CI 1.04 to 1.13)

Vyas et al., 2011	Occupational Injuries in Automobile Repair Workers Car Mechanic	Cross-sectional study	153 respondents	Task associated with work activities such as high manual material handling (OR 2.7, 95%CI 1.1–6.9), physically demanding task situations (OR 2, 95%CI 1.4–5.2) and postural stress (OR 2, 95%CI 1.1–5.9) were associated with occurrence of MSDs.
Andersen et al., 2007	Risk factors for more severe regional musculoskeletal symptoms: a two-year prospective study of a general working population.	Cohort study	5,604 respondents	Highly repetitive work predicted arm pain, heavy lifting and prolonged standing predicted low back pain, and heavy pushing or pulling predicted lower limb pain.
Su et al., 2011	Hand-arm vibration syndrome among a group of construction workers in Malaysia.	Comparative Cross-sectional study	243 respondents	Hand grip weakness: E =20.9%, C =11.1% Upper limbs musculoskeletal problems: E=22.3%, C=11.1% Neck musculoskeletal problems: E=17.3%, C=5.6%

Audrey et al., 2014	Personal, Biomechanical, Organizational and Psychosocial Risk Factors for Neck Disorders in a Working Population	Cross-sectional study	3,710 respondents	The work-related risk factors of neck disorders were sustained or repeated arm abduction (OR 2.08 [1.35−3.21] in men and 2.22 [1.27−3.86] in women) and neck flexion (OR 1.64 [1.26−2.12] in women).
Leap et al., 2016	Prevalence of musculoskeletal symptoms among garment workers in Kandal province, Cambodia	Cross-sectional study	714 respondents	Subjects with work requiring forceful exertion had a higher risk of lower back pain (OR=2.45, 95% CI: 1.68−3.59) than subjects without work requiring forceful exertion.

2.6.3 Study on the relationship between musculoskeletal disorders and psychosocial and psychological risk factors

Researchers	Title	Study Design	Sample Size	Study Outcome
Leap et al., 2016	Prevalence of musculoskeletal symptoms among garment workers in Kandal province, Cambodia	Cross-sectional study	714 respondents	Feeling stressed with work was significantly associated with musculoskeletal symptoms in the shoulder (OR=1.64, 95% CI: 1.20−2.25) and upper back (OR=2.07, 95% CI: 1.52−2.82),
Julie et al., 2012	Effects of Individual and Work-related Factors on Incidence of Shoulder Pain in a Large Working Population	Cross-sectional study	3,710 respondents	Shoulder pain was associated with low decision latitude (OR=1.6; 95% CI: 1.0–2.3).
Yun et al., 2007	Workers Perception of the Changes of Work Environment and its Relation to the Occurrence of Work-Related Musculoskeletal Disorders	Cross-sectional study	15,750 respondents	Work-related musculoskeletal disorders associated with over mental load (OR=1.25; 95% CI: 1.10-1.42).
Su et al., 2011	Studying the association between musculoskeletal disorders, quality of life and mental health. A primary care pilot study in rural Crete, Greece	Cross-sectional study	176respondents	According to multiple regression analysis, subjects with mental distress were likely to suffer neck pain (Beta = 1.92, 95% C.I.1.21- 38.40, p = 0.03) or

				shoulder pain (Beta = 1.18, 95% C.I. 1.40-7.47, p = 0.006).
Yu et al., 2012	Musculoskeletal Symptoms and Associated Risk Factors Among Office Workers With High Workload Computer Use	Cross-sectional study	254 respondents	High psychologic distress was significantly associated with shoulder and upper back complaints (OR=3.46; OR=2.24), whereas a high workload was significantly associated with lower back complaints (OR=1.89).
Jonathan et al., 2012	Physical and psychosocial ergonomic risk factors for low back pain in automobile manufacturing workers	Longitudinal cohort study	505 respondents	Participants reporting high physical exposures and low job control, psychological demands were associated with an increased LBP risk (RR 1.30, 95% CI 1.02 to 1.66).

2.7 Research gap

In recent years there has been an increased focus on the relationship between MSDs and occupational or non-occupational risk factors (Jonathan et al., 2012). Prior studies have generally found a positive relationship between MSDs and occupational or non-occupational risk factors (Nasrull et al., 2010, Vyes et al., 2011, Chan et al., 2014, Audreyet al., 2014).

CHAPTER 3

METHODOLOGY

3.1 Study background

This study was conducted from 1st of October 2020 to 31st of March 2021. The study was done among all vehicle service technicians in Perodua Puchong service center. The study involved a few types of data collection method which include interviewing the respondents using questionnaires (Appendix 1); RULA and hand arm vibration testing.

3.2 Study location

Perodua Puchong Service Center, No 4 Jalan BP 4/4, Bandar Bukit Puchong, 47100 Puchong, Selangor

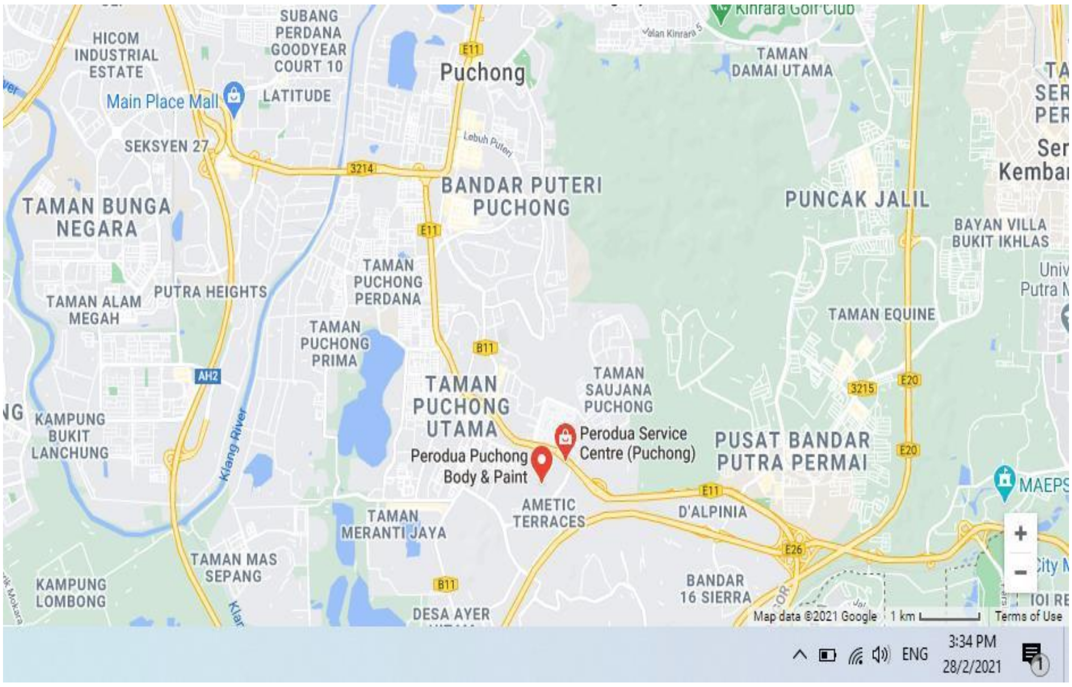


Figure 3.1 Services Outlet Locations

(Source: Google Map, 2020)

Figure 3.2 General Service Outlets Front View

(Source: Perodua, 2020)

3.3 Study process flow

Details of work process as follow:

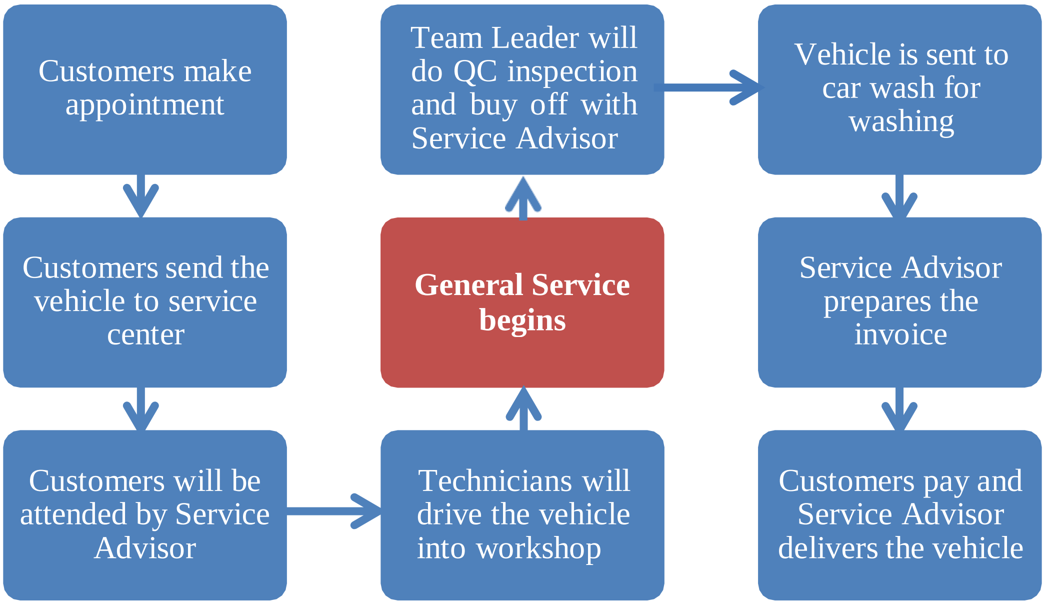
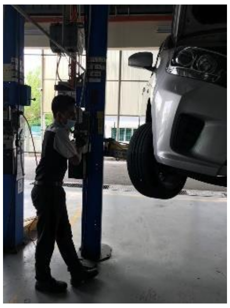
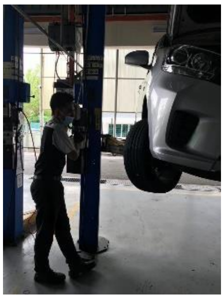


Figure 3.3 General Services Process Flow

(Source: Perodua, 2020)

When technicians are conducting the vehicle services, there are several tasks that use or apply physical activity such as engine oil replacement, coolant services, fuel filter services and others. However, for this study, only 3 tasks selected to be focused on which are Task (1) Working under vehicle for engine oil replacement, Task (2) Loosening/tightening wheel nut and Task (3) Lifting up/down tyre. The process flow for each tasks are as shownin figure 3.3 to 3.5.

	
Open bonnet and do visual check.	Visual check under vehicle.
	
Hoist vehicle up.	Hoist down vehicle.
	
Loosen engine plug.	Fill new engine oil or other fluid and lubricant.
	

Drain used engine oil or other lubricant.	Visual check and close bonnet.

Figure 3.4 Task 1 - Working under vehicle for engine oil replacement process flow

(Source: Perodua, 2020)

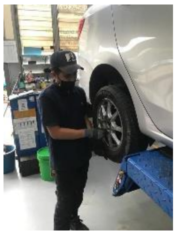
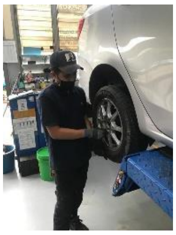
	
Hoist vehicle up.	Tighten nut tyre
	
Locate tire trolley	Hoist vehicle down.
	
Loosen nut tyre	

Figure 3.5 Task 2 – Loosening/tightening nut tyre using pneumatic tools processflow

(Source: Perodua, 2020)

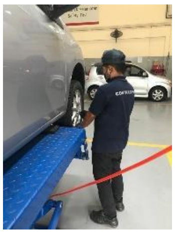
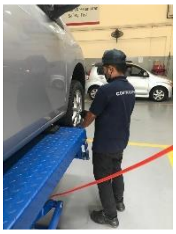
	
Hoist vehicle up.	Put tyre on the trolley
	
Locate tire trolley	Perform wheel service
	
Loosen nut tyre	Lift tyre up
	
Lift tyre down	Tighten nut tyre

Figure 3.6 Task 3 – Lifting up/down tyre process flow

(Source: Perodua, 2020)

3.4 Study design

3.4.1 Case control study

This is a case control study to determine the association between prevalence of MSD and the risk factors among vehicle technicians in Perodua Puchong service center.

3.5 Sampling method

3.5.1 Sampling framework

The sampling implemented are taken from all 35 vehicle service technician due to low population.

3.5.2 Sampling unit

The sampling unit is the vehicle service technician that meets the inclusion criteria as statedbelow:

3.5.2.1 Inclusion criteria

The inclusion criteria are:

i. Workers working as technician.
ii. Workers with at least one year (12 months) working experience with the company.
iii. Age between 20-55 years old.

3.5.2.2 Exclusion criteria

The exclusion criteria are:

i. Workers who have previous accident with musculoskeletal injury (such as bonefractured or operation at musculoskeletal area)
ii. Having symptoms of neurological or vascular dysfunction.

3.6 Instrumentations

Instruments that were used for this study were as follows: -

i. Questionnaires
ii. Job Content Questionnaire (JCQ) Karasek
iii. General Health Questionnaire (GHQ-12)
iv. Rating Perceived Exertion Borg Scale (CR-10)
v. Rapid Upper Limb Assessment for postural assessment
vi. Hand arm vibration measurement

3.6.1 Questionnaires

The questionnaires integrated were Nordic Questionnaires for MSD (Kuorinka 1987), Job Content Questionnaire for work tasks content (Karasek, 1985), General Health Question 12 for psychological content (Goldberg et al., 1997). and Rating Perceive Exertion Borg Scale for perceived exertion force (Borg G., 1990). The questionnaires were distributed to respondents during their rest. Each of the technicians was briefed regarding the content of questionnaire and was asked to fill in consent form to participate in the study before answering all the given questions. Each of the questions was checked after each session toensure that they had filled in correctly. An average of 30 minutes was taken to fill up the questionnaire. Appendix 1 shows the example of questionnaire used.

3.6.1.1 Questionnaires on socio demography and working condition

The items include socio-demographic and background information such as age, sex, monthly income, education level, ethnics, marriage status, smoking habit, ethnics, outsideactivity, length of employment and working information like monthly overtime duration, amount of monthly overtime allowance, frequency of incentive reward per year and part- time work as a vehicle service technician.

3.6.1.2 Questionnaires on musculoskeletal disorders

To obtain information on musculoskeletal disorder, Nordic questions were translated intoMalay language from the original Nordic questionnaire (SNQ) (Kuorinka I., 1987). The questionnaire also consist a body mapping of neck, shoulder, elbow, arm, hand, upper back, lower back, thigh, knee and leg so to assist the technician in identifying the correct body parts in answering the questions.

The questions were in simple phrases such as “Do you have any feel of pain within the past 12 months (discomfort, pain and aching) at the areas?: (1) neck, (2) shoulder, (3) elbow, (4) arm, (5) upper back, (6) lower back, (7) hip and thigh, (8) knee and leg.”.

3.6.2 Questionnaires on job content

Information on psychological demands at work (five questions from the Job Content Questionnaire, JCQ), job control (eight questions from the JCQ) and social support at work(supervisor and co-worker support, four questions from the JCQ), as well as job insecurity(five questions) were translated into Malay language from the original Job Content Questionnaire (JCQ) (Karasek R., 1985). Technicians rated 11 statements about their jobs on a 4-point scale: 4, strongly agree; 3, agree; 2, disagree; and 1, strongly disagree. Responses to these items were used to form two scales (decision latitude and psychologicaldemands).

The two scales mentioned earlier are related to a term called ‘job strain’. Job strain is classified as high psychological demand. In this study, job strain is analysed as a valued job strain index. High job strain is defined as present if the patient’s decision latitude is greater than mean score measured in the study. The same goes to psychological demands. The list of questions was constructed based on the recommended Job Content Questionnaire Instrument – 49 questions. Refer to appendix 1.

$$Job\ Strain\ Index = \frac{(32 - Decision\ Latitude)}{(32 - 8)}$$

Decision latitude score is obtained by sum of skill discretion and decision authority. Theformula of JCQ calculations areas follow;

i. Skill Discretion = [Q3 + Q5 + Q7 + Q9 + Q11 + (5-Q4)] □2

ii. Decision Authority = [Q6 + Q10 + (5-Q8)] □4

iii. Psychological Job Demands = [(Q19 + Q20) □ 3 + (15-(Q22+Q23+Q26)) □ 2]

iv. Job Insecurity = [Q33 + Q36 + (5-Q34)]

v. Supervisor Support = [Q48 + Q49 + Q51 + Q52]

vi. Co-worker Support = [Q53 + Q54 + Q56 + Q 58]

The mean score for each scale was used to indicate the level of job content psychosocial.

3.6.3 Questionnaires on psychological content

Malay version of GHQ-12 was used in this study. The aim of using (GHQ- 12) is to identifypsychiatric disorders by focusing on psychological compounds which may be present in apatient who came to medical clinics (Goldberg et al., 1997). It is to assess the severity of psychological complications in the past few weeks. The instrument has been validated in the local population of Malaysia using Malay versions (Yusoff, 2010).The items of Malayversion GHQ-12 were rated under 4 categories of responses; *sangat lebih dari biasa* (much more than usual), *lebih dari biasa* (more than usual), *tidak lebih dari biasa* (not more than usual),*tidak langsung* (not at all). The GHQ scoring method (0-0-1-1) was chosen in this study. The simple Likert scale of (0-1-2-3) was not chose, as this particular method able to

create biases that that might result from respondents who tend to choose responses 1 and 4 or 2 and 3, respectively. Adding all the questions on the scale ranging from 0 to 12 summed up the scores. Refer appendix 1. The mean of GHQ score for a population of respondents was suggested as a rough indicator for the best cut-off point (Goldberg et al., 1997). Therefore, based on the GHQ mean score for this sample, the cut-off point 5/6 was used to determine the respondents' level of psychological well-being. Some examples of the questions in the GHQ-12 are: *1) Been able to concentrate on whatever you are doing;*
2) Lost much sleep over worry; 3) Felt constantly under strain; and 4) Been losing self- confidence in yourself

3.6.4 Questionnaires on rating perceived exertion

The Borg CR 10 scale was used as the instrument to identify the rating of perceived exertion by the technicians. In the Category Ratio (CR) scale, numbers from 0 to 10 are used to measure their effort and exertion. The number 0 implies 'no effort and exertion' and number 10 also implies an extremely strong perceptual intensity. An example of number 10 is for perceived intensity of extremely heavy physical exercises or lifting and carrying extremely heavy weights. Ten is defined as the strongest effort of exertion that not many people haveever experienced. The moderate score 3 was suggested as indicator for effort between weak or strong exertion required for a certain task. Some examples of the tasks in the Borg CR 10 are: *1) Angkat tayar (lifting tyre); 2) Buka/tutupnat (Opening/tightening nut); 3) Buka/pasang penutup enjin minyak (Opening/tightening oil cap)*

3.6.5 Rapid Upper Limb Assessment

Rapid Upper Limb Assessment (RULA) was developed by Drs.McAtamney and Corlett of the University of Nottingham's Institute of Occupational Ergonomics. This ergonomic technique evaluates people's exposures to postures, forces and muscle activities that have been shown to contribute to Repetitive Strain Injuries (RSIs). It was developed to detect risk factors that deserve further attention.

Many studies had included RULA to determine loads sustained by the musculoskeletal system due to work posture, muscle use and force exerted. It has also been used to calculateexposure to risk factors associated with work-related upper limb disorders such as in officedesign and others (McAtamney and Corlett, 1993). A study done in automotive assembly plant reported that there is a significant association between MSD and RULA score (OR = 69.38, 95%CI 14.51- 331.73) Malaysian Journal of Medicine and Health Sciences (Anita, Yazdani, Hayati, & Adon, 2014). An almost similar study was conducted in vehicle services that also included RULA to improve their posture quality (Gironimo et al., 2010). RULA was also utilised by researchers in posture analysis for the solution of efficiency ofincreasing problems in technological process of the automotive industry (Ülgen& Upendram, 1997).

Continuing on the Likert scale, score 1 indicates the ‘‘best’’ or most neutral posture, e.g. arms by the sides, elbows in approximately 90° flexion, wrists in neutral position, forearms are mid-way between pronation and supination, neck is in 10° flexion, sitting trunk and legs are well supported. A score of 4 indicates the worst position: e.g. shoulder flexion above 90° or flexion between 45° and 90° and abduction.

The combined individual scores for shoulder, elbow and wrist makes the total for score A and the scores for neck, trunk and legs total up as score B. Muscle use and force exerted in each working position were attributed a score of 1 and 0, respectively since they are static postures without loading movement. These scores were added to score A and B to obtain score C and D, respectively (McAtamney and Corlett, 1993) (Figure 3.8). Based on the design of the RULA method, each combination of score C and D (a number of 1–7) iscalled grand score and it reflects the musculoskeletal loading associated with the worker’s posture. Whereas, lower grand scores (of 1 or 2) indicate that the work posture is acceptable. Meanwhile, an action that is suggested for the higher scores need further investigation and changes if required. For grand score 3 or 4; prompt investigation may bedone and changes may be made for grand scores of 5 or 6. For grand score 7, immediate investigations and changes shall be made if required.

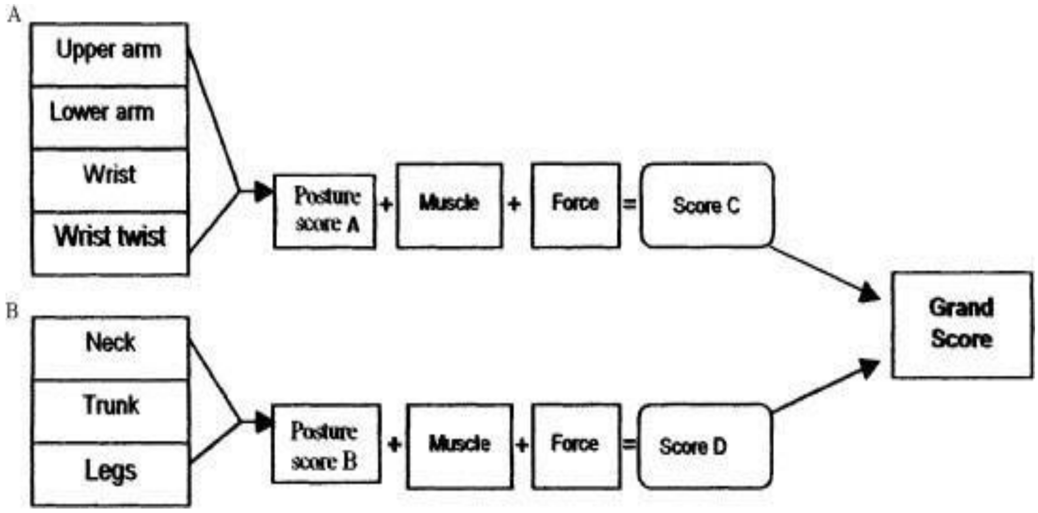


Figure 3.7: RULA method scoring sheet (McAtamney and Corlett, 1993)

The task of lifting tyre up/down is one of the 3 tasks observed in this study and the greatestamount of the work posture had been selected as per shown in Figure3.9.

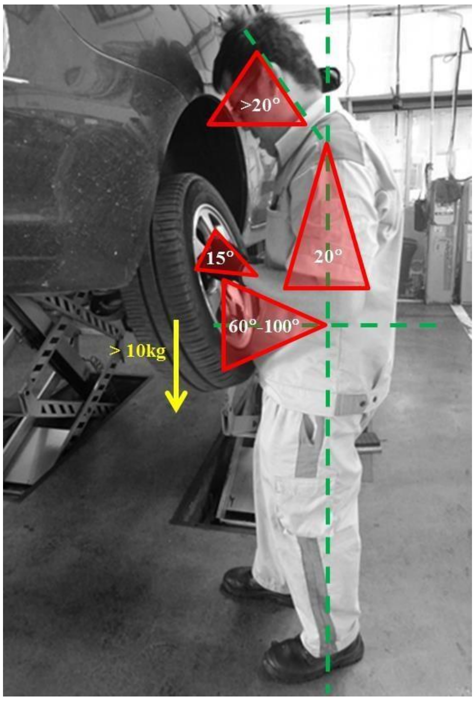


Figure 3.8: Technician posture assessment (RULA)

Figure 3.10 shows the diagram for scoring the posture of the body parts in Group A and B which are the upper arm, lower arm, wrist, neck, trunk and leg. The ranges of movement were assessed and scored. The scores are:

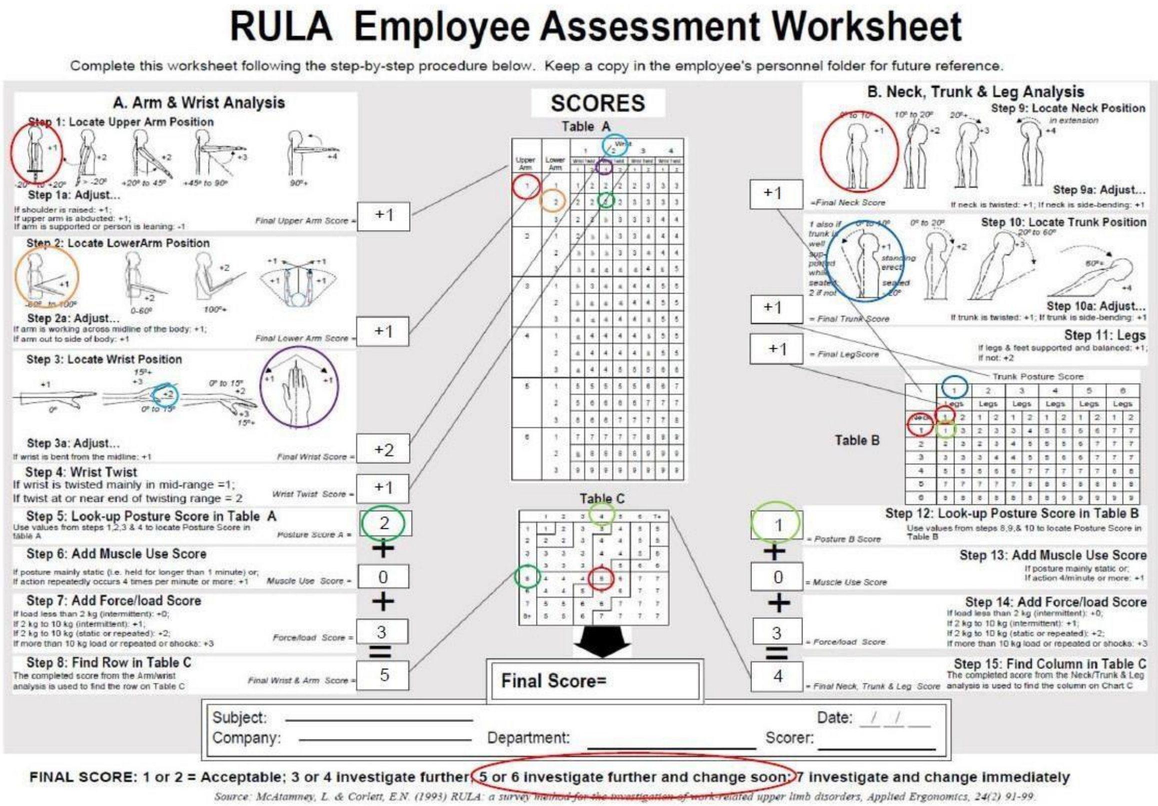


Figure 3.9: RULA Assessment Worksheet

Table 3.2: RULA score (Assessment worksheet)

No	Body Part	Observation	Posture Score
1	Upper arm	20 extension to 20 flexion, shoulder was not elevated, upper arm was not abducted, arm was not supported	1
2	Lower arm	60 -100 flexion, lower arm was not working across the midline of the body	1
3	Wrist	0-15 in either flexion or extension, wrist was not in either radial or ulnar deviation	2
4	Wrist twist	Mainly in mid-range	1
5	Neck	10 -20 flexion, no side bending	1
6	Trunks	Well supported with a hip-trunk angle of 90 or more	1
7	Leg	Legs and feet were well supported with weight evenly balanced	1

The combined individual scores for shoulder, elbow and wrist were scored 2 for group A and the combined scores for neck, trunk and legs was1 for group B. Score for muscle usewas 0 as there was no static posture (moving around) and it was not repetitive as action was not repeated more than four times in a minute. However, holding loads were scored 3 as the load was more than 10kg. Based on the design of the RULA method, combination of score C and D which were 5 and 4 respectively showed a grand score of 5 and the action level was 3 which indicated that investigation and changes are required soon.

3.6.6 Hand arm vibration measurement

Hand arm vibration is defined as mechanical vibration that is transferred to human arm that may risk the health and safety of workers especially at vascular, bone or joint, neurological or muscular disorders.

The method that is used as per defined in European Standard EN ISO ISO 8662-7:1988 measurement of vibrations at the handle. Examples of the vibration measurement are wrenches, screwdrivers and nut runners with impact, impulse or ratchet action. General and detailed practical guidance in using at the workplace is set out in EN ISO ISO 8662- 7:1988 method for measurement of vibration.

In simple terms, vibration is defined by its magnitude (traditionally described using acceleration, and it is expressed in m/s^2) and frequency (the number of times the vibrating body moves back and forth expressed in cycles or hertz (Hz) per second,). The risk of damage is not equal to frequency at all. Therefore, when calculating exposure, a weighting frequency is used. Furthermore, vibration must be evaluated in three axes. From each vibration axis a frequency- weighted root-mean-square average acceleration is measured. This is referred to as a_{hw}. HAV risk is based on the frequency-weighted acceleration totalvalue a_{hv} given by the root sum of squares of the frequency-weighted acceleration from the three orthogonal axes, x, y and z:

$$a_{hv} = \sqrt{a_{hwx}^2 + a_{hwy}^2 + a_{hwz}^2}$$

The vibration directive defines the daily exposure, a (8), as:

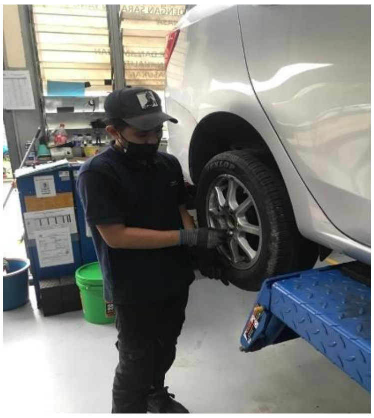
HAV: the equivalent continuous acceleration, normalised to an eight-hour day; the A (8) value is based on root-mean-square averaging of the acceleration signal and has units of m/s^2; where T is the daily duration of exposure to the vibration magnitude a_{hv} and T0 is the reference duration of eight hours. In the EU Directive 2002/44/EC Exposure,limit values and action values for hand-arm vibration are defined as follows:

$$A(8) = a_{hv}\sqrt{\frac{T}{T_0}}$$

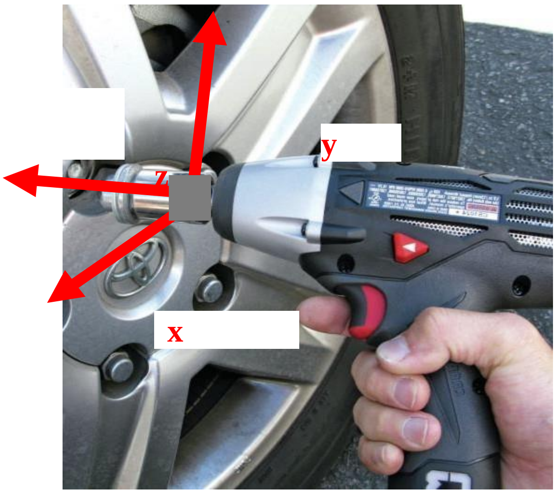
i. Daily exposure limit value standardized to an eight-hour reference period shallbe 5 m/s2; *(DELV)*

ii. Daily exposure action value standardized to an eight-hour reference period shallbe 2.5 m/s2. *(DEAV)*

To obtain hand arm vibration that technicians were exposed to, information on the numberof operations that occur during the working day had been accessed (the number of car wheel services completed per day). Average duration for an operation is estimated by observing the work rate over a sample work period. Then, the total daily duration can be calculated. The number of vehicle wheel service per day and the number of wheel-nuts perwheel (by using impact wrench and knowing how long it typically takes to loosen or tighten one wheel-nut) had been accessed by observation at the workplace. For the number of wheels per day, it was estimated that each technician handles an average of 15 vehiclesper day while the average number of wheel-nuts per wheel is 4 per vehicle. Hence, total ofwheel nut tightened or loosened is 60 per day. Duration took to loosen or tighten is 1 minute per wheel-nut. Figure 3.11 shows the postures of technician when the measurement was taken.



Posture of technician when the measurement was taken



Position of magnitude vibration at technician's hand

Figure 3.10 Posture of technician during measurement and the position of magnitude vibration at technician's hand while holding the impact wrench.

This monitoring was done using Human Vibration Meter Model HVM100, Larson Davisas shown in figure 3.12.

3.7 Quality control

3.7.1 Questionnaire

Quality control was done to ensure the result of the data that was obtained throughout the study. The questionnaire had to undergo constructive testing and reliability testing. For the constructive test, pre-test was conducted about 10% from the sample size. Twenty subjects who were homogeneous with the respondent's criteria were selected to do this pre-test. The function of this test was to know either the subjects understand or not the question in the questionnaire. Then, the questionnaire was edited again based on the complaint from the subjects and were given again to answer. A week after that, the same questionnaire wasgiven again to ensure that the answer is same. The result of the α-Cronbach test for both sessions was as shown in following table 3.3. Result from the table shows good reliabilityof more than 70% Cronbach Alpha Value.

Table 3.3: Questionnaire reliability testing

Questionnaire	Chronbach's Alpha
Part A: Socio Demographic	0.993
Part B: Employment history	0.808
Part C: Smoking	0.912
Part D: PPE	0.901
Part E: Other activities outside work	0.890

3.7.2 Rapid Upper Limb Assessment (RULA)

The instrumentation factor was maintained by having the same instructor and demonstrator for the whole research. The posture of the technicians in this study was assessed by the researcher and good inter reliability results were obtained as shown in following table 3.4

Table 3.4: RULA reliability testing

RULA score	Chronbach's Alpha
Score A : Arm & wrist	0.831
Score B: Neck, trunk & leg	0.794

3.7.2.1 Hand arm vibration measurement

Calibration was done to ensure the accuracy and precision of the Human Vibration Meterin measuring vibration level. The equipment was calibrated using the sensitivity value of the equipment given by the certificate of calibration from the supplier. The equipment was calibrated at the field before and after the measurement to ensure the reliability of the measured data. The calibration results show that the difference between before and after measurement calibration was within 5-6%. It was concluded that the data was reliable since the differences less than 10%. The Standard Operating Procedure (SOP) was followed during the measurement process according to HVM100 user manual.

Most of the process involved a very short duration of tool usage; less than 20 seconds percycle. In order to get reliable measurement data, at least four measurement were necessaryto ensure a total averaging time of more than 60 seconds (ISO 5349-2:2001).

3.8 Study bias control

To minimize the selection bias, data collections begin after receiving permission from the Perodua Headquarters to get the technician and office workers name list. They were givena consent letter and before participating in the study, a written and signed consensus was obtained as shown in Appendix 1.

Next, a set of preliminary questionnaire as shown in Appendix 1 was given to technician and office workers. This first form consist questions is to eliminate person who did not meet the inclusion criteria of this study. Thus, those who fulfilled the inclusion criteria were included as a respondent. After the selections, interview and orientation was conducted to the respondents regarding the study, procedure and their rights. In addition, to minimize the information bias, the technicians were reassured that the data would be used for research purposes only and that the questionnaires would not be released to the company. No managers were present during the survey. Questionnaire reliability testing also had been carried out and shows good reliability of more than 70% Cronbach Alpha Value. The inter-observer variability had been minimized by having the same person on gathering and entering data.

3.9 Data analysis

All of the data were computed and analyzed using SPSS (Statistical Package for Social Science) version 21.0. In this study data were analyzed based on the questionnaire, RULA score and hand arm vibration measurement (vibration acceleration magnitude).

3.9.1 Univariate analysis

3.9.1.1 Socio Demography

After completing data entry into SPSS, descriptive analysis was used to obtain frequency, standard deviation, mean and percentage in order to summarize and explain the general background of the respondents, socio demographic of the respondent, employment history, smoking habit, use of PPE, others activities outside work and the prevalence of MSD.

3.9.2 Bivariate analysis

Bivariate analysis is derived from analysis of two variables, such as the Pearson's chi- square test, analysis of association between categorical independent variables with the present of MSDs. In order to determine the association between posture assessment score, forceful exertion level, vibration acceleration magnitude level, job decision latitude level, psychological stress level, confounding factors and the prevalence of MSD, Pearson's chisquare test was used.

3.9.3 Multivariate analysis

The significant data in the chi-square test was further analyzed by using multiple logistic regression. Since the dependent variable was dichotomous outcome, the binary logistic regression was used in this test.

3.10 Ethics

Written approval was obtained from the Medical Research Ethics Committee of the University Putra Malaysia as shown in Appendix 4 (UPM/TNCPI/RMC/IACUC/1.4.18.1/F1). The company management was informed about the objective of the study, method of data collection and who could assess the data and formal approval was obtained from the company management.

The respondents were also briefed about the objectives, method, benefit of the study, confidentiality of data and the need for written consent from each respondent before conducting the study to ensure the participation was on a voluntary basis. In order to ensure the truthfulness in answering the questionnaires, the respondents were assured that the analysis of data would be used for research purposes only and that the questionnaires would not be released to the company.

CHAPTER 4

RESULT

4.1 Socio-demographic and occupational information of the vehicle servicetechnicians

The thirty-five respondents were participated in this study. Thus, the response rate for thisstudy was 100%.

Overall, the mean age of the 35 respondents was 29.41+6.72. Majority of the respondentswere Malay (91.4%) and single (20%). Their BMI lies at an average of 24.10+5.03. The majority of the respondents received education up to STPM/vocational certificate level (85.7%). Twenty one of thirty five respondents are smokers.

Thirty one of the respondents receives salary more than RM 1,500 per month and majority of the respondents do overtime work in every month (77.1%).More than half of the respondents who do the overtime work received overtime allowance greater than RM 2,000 per month (48.6%). All respondents are received incentives. Only 6 respondents out of 35 do part time job as a vehicle service technician (17.1%).The details data was illustrated inTable 4.1.

Table 4.1 Socio-demographic and occupational information of the vehicle servicetechnicians

Variable		**Frequency (n)**	**%**	**Mean± SD**
Age (years)				29.41± 6.72
	≤30 years old	28	80	
	>30 years old	7	20	
BMI (kg/m^2)				24.10± 5.03
	Normal	35	100	
	Overweight	0	0	
Ethnicity	Malay	32	91.4	
	Chinese	1	2.85	
	Indian	1	2.85	
	Others	1	2.85	
Educational Level	PMR	0	0	
	SPM	5	14.3	
	STPM/Cert	25	71.4	
	Diploma	5	14.3	

N=35

Table 4.1 Socio-demographic and occupational information of the vehicle servicetechnicians (continue)

Variable	Frequency (n)		%	Mean ±SD
Marital Status	Single	7	20	
	Married	28	80	
Smoking	Yes	21	60	
	No	14	40	
Monthly Income	≤RM 1,500	4	11.4	
	>RM1,500	31	88.6	
Overtime	Yes	27	77.1	
	No	8	22.9	
Overtime allowance per month (RM)	≤RM 2,000	18	51.4	
	>RM2,000	17	48.6	
Received incentives	Yes	35	100	
	No	0	0	
Do part time job as a technician	Yes	6	17.1	
	No	29	82.9	

N=35

4.2 Prevalence of MSD among vehicle service technician at PeroduaPuchong service center.

The first objective of this study is to determine the prevalence of MSD among vehicle service technician at Perodua Puchong service center.

As shown in Table 4.2, the lifetime prevalence of MSD among the vehicle service technician studied was 87.4%. According to body parts, shoulder recorded as the highest prevalence of MSD (68.5%) followed by legs (65.7%), neck and lower back (62.9%), upper back (60%), knee (60%), arms (57.1%), elbow (54.3%) and thigh (45.7%). While the twelve months prevalence of MSD studied was 82.7%. The body parts MSD prevalence recorded shoulder and legs as the highest prevalence of MSD (62.9%), followed by neck (57.1%), lower back (54.3%), upper back (54.3%), knee (51.4%), arms (51.4%), elbow (45.7%) and thigh (40%). The seven days prevalence of MSD was lower the twelve months prevalence of MSD, at 62.8%. Neck, shoulder & lower back recorded as the highest complaint of body part 8.6%, followed by upper back and elbow (5.7%), arms and thigh (2.9%), knee and legs (0%). Overall the prevalence of MSD reporting on the body part by lifetime and 12 months show no difference. This was illustrated in Figure 4.1.

Table 4.2 Prevalence of MSDs among the vehicle service technician at PeroduaPuchong service center

Lifetime Prevalence			Twelve Months Prevalence		Seven Days Prevalence	
Body Parts	Freq. (n)	%	Freq. (n)	%	Freq. (n)	%
Neck	22	62.9	20	57.1	3	8.6
Shoulder	24	68.5	22	62.9	3	8.6
Elbow	19	54.3	16	45.7	2	5.7
Arms	20	57.1	18	51.4	1	2.9
Upper back	21	60.0	19	54.3	2	5.7
Lower back	22	62.9	19	54.3	3	8.6
Thigh	16	45.7	14	40.0	1	2.9
Knee	21	60.0	18	51.4	0	0
Legs	23	65.7	22	62.9	0	0
At any body parts	11	31.4	6	17.1	1	2.9

N=35

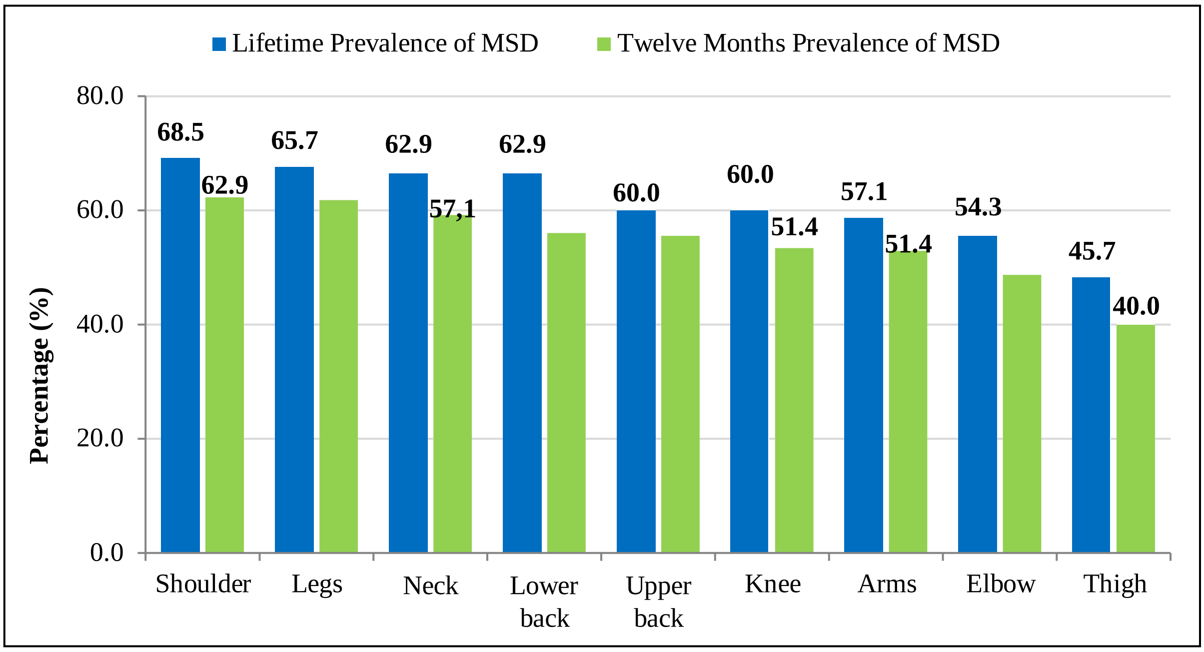


Figure 4.1 Life time and Twelve Months prevalence of MSDs among therespondents, divided by body part

4.3 Rapid Upper Limb Assessment (RULA) analysis score

4.3.1 Arm & wrist analysis

Table 4.3 refers to the RULA arm & wrist analysis score of vehicle service technicians for each task that been studied. In section A of RULA score; Task 1 recorded 91.4% working at 45 to 90 degree for upper arm with 82.9% with shoulder abducted and 57.1% working at greater than 100 degree for lower arm with 34.3% working across the midline of the body. While for wrist, 65.7% working at -15 to 15 degree with wrist is bent away from midline. 54.2% of technicians working with wrist twist near 0 degree. 88.6% working withno resistance / less than 2kg intermittent load or force. While for Task 2, 88.6% working at -20 to 20 degree for upper arm with 28.6% shoulder is raised and 31.4% upper arm is abducted. At lower arm posture, 77.1% working at 60-100 degree with 100% working across the midline of the body. For wrist, 71.4 % working at near 0 degree with 100% wrist is bent away from midline. 65.7% working with wrist twist. 91.4% recorded with 2-10kg intermittent load or force. Lastly for Task 3, 94.3% of technicians working at 20 to 45 degree for upper arm with 37.1% shoulder are raised and 62.9% upper arm is abducted. Lower arm analysis recorded 82.9% working at greater than 100 degree with 31.4% working out to the side. For wrist, 77.1% working at more than 15 degree with 94.3% wrist is bent away from midline. 62.9% working with wrist twist. 100% of technicians workingat 10kg static load with rapid build-up force.

Table 4.3 RULA arm & wrist analysis score

Posture		**Task 1[a]**		**Task 2[b]**		**Task 3[c]**	
	Score	**Freq. (n)**	**%**	**Freq. (n)**	**%**	**Freq. (n)**	**%**
Upper Arm Position							
-20° to +20°	+1	0	0.0	31	88.6	2	5.7
> -20°	+2	0	0.0	0	0.0	0	0.0
+20° to +45°	+2	0	0.0	4	11.4	33	94.3
+45° to 90°	+3	32	91.4	0	0.0	0	0.0
> 90°	+4	15	8.6	0	0.0	0	0.0
Score adjust							
Shoulder is raised	+1	6	17.1	10	28.6	13	37.1
Upper arm is abducted	+1	29	82.9	11	31.4	22	62.9
Arm weight supported	-1	0	0.0	0	0.0	0	0.0
Lower Arm Position							
-60° to 100°	+1	10	28.6	27	77.1	6	17.1
0 to -60°	+2	23	14.3	0	0.0	0	0.0
100° +	+2	20	57.1	8	22.9	29	82.9
Score adjust							
If arm is working across midline / outside of the body	+1	12	34.3	35	100	11	31.4
Wrist Position							
0	+1	4	11.4	25	71.4	0	0.0
0 to 15°	+2	23	65.7	10	28.6	8	22.9
> 15°	+3	8	22.9	0	0.0	27	77.1

Table 4.3 RULA arm & wrist analysis score (continue)

Posture		Task 1[a]		Task 2[b]		Task 3[c]	
	Score	Freq. (n)	%	Freq. (n)	%	Freq. (n)	%
Score adjust							
Wrist is bent away from midline	+1	16	45.7	35	100	33	94.3
Wrist Twist							
Mainly in mid-range	+1	18	51.4	12	34.3	13	37.1
At or near end of twisting range	+2	17	48.6	23	65.7	22	62.9
Muscle Use							
Posture is mainly static or repeated more than 4 times per minute	+1	0	0	0	0	0	0
Force / Load							
No resistance / less than 2kg intermittent load or force	0	31	88.6	0	0	0	0
2–10kg intermittent load or force	+1	4	11.4	32	91.4	0	0
10kg or more intermittent load or force	+2	0	0	3	8.6	0	0
10kg repeated loads or forces / Shock or forces with rapid build-up	+3	0	0	0	0	35	100

N=35

a: Working under vehicle for engine oil replacement process
b: Loosening/tighteningnut tyre using pneumatic tools process
c: Lifting up/down tyre process

4.3.2 Neck, trunk & leg analysis

Table 4.4 refers to the RULA neck, trunk & leg analysis score of vehicle service technicians for each task that been studied. In section B of RULA score; Task1 recorded 80% working at 0 to 10 degree for neck with 22.9% with neck is side-bending. While for trunk, 60% working at 0 with 20% trunk is side-bending. 100% standing with stable on both legs. 93.2% working at no resistance / less than 2kg intermittent load or force. For Task 2, 88% and 83.2% of technicians working with neck and trunk near 0 .100% technicians work with stable both legs and 94.3% recorded working at no resistance / less than 2kg intermittent load or force. While for Task3, 80% of technicians recorded working with neck at 0 . For trunk, 91.4% working at 0 to 20 . 100% working with both leg standing stable. 74.3% working 10kg or more intermittent force.

Table 4.4: RULA neck, trunk & leg analysis score

Posture	Score	Task 1[a] Freq. (n)	%	Task 2[b] Freq.(n)	%	Task 3[c] Freq.(n)	%
Neck Position							
0 to 10°	+1	28	80.0	31	88.6	28	80.0
10 to 20°	+2	7	20.0	4	11.4	5	14.3
> 20°	+3	0	0	0	0	2	5.7
< 0°	+4	0	0	0	0	0	0
Score adjust							
Neck is twisted	+1	0	0	0	0	0	0
Neck is side bending	+1	8	22.9	0	0	0	0
Trunk position							
0 to -10°	+1	21	60.0	29	82.9	3	8.6
0 to 20°	+2	14	40.0	6	17.1	32	91.4
20 to 60°	+3	0	0	0	0	0	0
> 60°	+4	0	0	0	0	0	0
Score adjust							
Trunk is twisted	+1	0	0	0	0	0	0
Trunk is side bending	+1	7	20.0	0	0	0	0
Legs							
Supported and balanced	+1	35	100	35	100	35	100
Not supported and balanced	+2	0	0	0	0	0	0
Muscle Use					0		0
Posture is mainly static or repeated more than 4	+1	0	0	0	0	0	0
Force / Load							
No resistance / less than 2kg intermittent load or force	0	33	94.3	32	91.4	0	0
2–10kg intermittent load or force	+1	2	5.7	13	8.6	7	20.0
10kg or more	+2	0	0.0	0	0.0	26	74.3
force							
10kg repeated loads or forces / Shock or forces with	+3	0	0.0	0	0.0	2	5.7

N=35

a: Working under vehicle for engine oil replacement process
b: Loosening/tighteningnut tyre using pneumatic tools process
c: Lifting up/down tyre process

4.3.3 RULA Analysis Grand Score

Table 4.5 showed the grand score for Rapid Upper Limb Assessment analysis. Task 1 and 2resulted 37.1% of technician adapted acceptable posture score (1 or 2). While other 60% recorded 3 or 4 score that require investigate further and the rest 2.9% with 5 or 6 score which need investigate further and change soon. While RULA score for Task 3 analysis, recorded 5.7% of score 3 or 4 (investigate further), 68.6% with 5 or 6 score (investigate further and change soon) and 25.7% of score >7 (investigate and change immediately).

Table 4.5 Rapid Upper Limb Assessment Grand Score Analysis

Task	RULA Grand Score	Frequency (n)	%
Task 1	1 to 2	13	37.1
(Working under vehicle for engine oil replacement)	3 to 4	21	60.0
	5 to 6	1	2.9
	> 7	0	0.0
Task 2	1 to 2	13	37.1
(Loosening/tightening nut tyre using pneumatic tools)	3 to 4	21	60.0
	5 to 6	1	2.6
	> 7	0	0.0
Task 3	1 to 2	0	0.0
(Lifting up/down tyre)	3 to 4	2	5.7
	5 to 6	24	68.6
	> 7	9	25.7

N=35

4.4 Hand arm vibration measurement

Table 4.6 summarised the information about hand arm vibration measurement showed that the daily exposure A(8) is 88.6% of technician expose to magnitude of vibration above daily exposure action level (2.5m/s^2) and 22.9% of technician exposed to magnitude of vibration above daily exposure limit level (5m/s^2). This study found the maximum magnitude vibration recorded at 5.82m/s^2.

Table 4.6 Hand arm vibration measurement

Variables		No of respondent (%)
Hand Arm Vibration	Within daily action level limit ($2.5m/s^2$)	4 (11.4)
	Above daily action level limit ($2.5m/s^2$)	31 (88.6)
	Within daily exposure level limit ($5m/s^2$)	27 (77.1)
	Above daily exposure level limit ($5m/s^2$)	8 (22.9)

N=35

4.5 Forceful exertion

Force exertion was measured by Borg CR 10 questionnaire and table 4.7 showed that force exertion applied for Task 1 was weak with 71.4%, and force exertion applied for Task 2 and 3 were high with 77.1% and 82.9% respectively.

Table 4.7 Forceful exertion

Variables		No of respondent (%)
Forceful exertion		
Task 1[a]	Weak	25 (71.4)
	Strong	10 (28.6)
Task 2[b]	Weak	8 (22.9)
	Strong	27 (77.1)
Task 3[c]	Weak	6 (17.1)
	Strong	29 (82.9)

N=35

a:Working under vehicle for engine oil replacement process
b:Loosening/tighteningnut tyre using pneumatic tools process c:Lifting up/down tyre process

4.6 Psychosocial Job Content Factor

Table 4.8 show result of psychosocial Job Content Factor using Karasek questionnaire recommended version. The study reported that 51.4% of technicians were at high job demand level. For co-worker support, most of the technicians show low of co-worker support with 60% however high supervisor support with 62.9%. High job insecurity showed 54.3%.

Table 4.8 Psychosocial Job Content Factor

Variables		No of respondent (%)
Job demand level	Low	17 (48.6)
	High	18 (51.4)
Co-worker support level	Low	21 (60.0)
	High	14 (40.0)
Supervisor support level	Low	13 (37.1)
	High	22 (62.9)
Job insecurity level	Low	16 (45.7)
	High	19 (54.3)

N=191

4.7 Psychological GHQ 12 risk factor

Table 4.9 show 85.7% of technicians are in normal psychological level with only 14.3% recordedin distress level.

Table 4.9 Psychological risk factor

Variables		No of respondent (%)
Psychological level (GHQ12)	Normal	30 (85.7)
	Distress	5 (14.3)

N=35

4.8 Association between non-occupational and occupational factors with MSDsamong vehicle service technicians

Chi-square test was done to determine whether the non-occupational (socio-demographic and lifestyle) and occupational profile are significantly associated with the WMSDs symptoms reported for the past 12 months by the vehicle service technicians. The risk factors involved including age, BMI, ethnicity, educational level, marital status and. smoking, of injury and physical activity (Table 4.10). Risk factors originated from the occupation itself were also tested, including monthly income, overtime work, amount of overtime allowance per month, received incentives and do part time job as a technician (Table 4.11). The chi-square test results revealed that only age ($\chi2$ = 4.887, p = 0.027), BMI ($\chi2$ = 4.351, p = 0.037) and monthly income ($\chi2$ = 4.406, p = 0.036) are significantly associated with MSDs symptoms reported.

Table 4.10 Association between non-occupational profiles with MSDs amongvehicle service technicians

Variables	**MSDs Reporting (twelve month prevalence)**				**X^2**	**p-value**
	Yes		**No**			
	n	**(%)**	**n**	**(%)**		
Age (years)						
≤30 years old	22	84.6	6	66.7	4.887	0.027*
>30 years old	4	15.4	3	33.3		
BMI (kg/m^2)						
Normal	31	100	4	100	4.351	0.037 *
Overweight	0	0	0	0		

N=35
*p-value is significant at p<0.05

Table 4.10 Association between non-occupational profiles with MSDs among vehicle service technicians (continue)

Variables	MSDs Reporting (twelve month prevalence)				X^2	p-value
	Yes		No			
	n	(%)	n	(%)		
Ethnicity						
Malay	22	88	10	76.9	6.371	0.95
Chinese	1	4.0	1	7.7		
Indian	1	4.0	1	7.7		
Others	1	4.0	1	7.7		
Educational Level						
PMR	0	0	0	0	5.115	0.164
SPM	3	12.5	2	18.2		
STPM/Cert	18	75.0	7	63.6		
Diploma	3	12.5	2	18.2		
Marital Status						
Single	4	17.4	3	25.0	0.077	0.782
Married	19	82.6	9	75.0		
Smoking						
Yes	16	61.5	5	55.6	0.794	0.373
No	10	38.5	4	44.4		

N=35

Table 4.11 Association between occupational profiles with MSDs among vehicle service technicians

Variable	MSDs Reporting (twelve month prevalence)				X^2	p-value
	Yes		No			
	n	(%)	n	(%)		
Monthly Income						
≤RM 1,500	2	8.79	2	16.7	4.406	0.036*
>RM1,500	21	91.3	10	83.3		
Overtime						
Yes	21	77.8	6	75.0	-	0.573b
No	6	22.2	2	25.0		

N=35 *p-value is significant at p<0.05 b: Fisher Exact Test

Table 4.11 Association between occupational profiles with MSDs among vehicle service technicians (continue)

Variable		MSDs Reporting (twelve month prevalence)				X^2 value	p-
		Yes		No			
		n	(%)	n	(%)		
Overtime allowance per month (RM)							
≤RM 2,000		12	54.5	6	46.2	0.309	0.578
>RM2,000		10	45.5	7	53.8		
Received incentives							
Yes		28	100.0	7	100.0	-	1.000[b]
No		0	0	0	0		
Do part time job as a technician							
Yes		4	18.2	2	15.4	-	0.471[b]
No		18	81.8	11	84.6		
RULA Risk Level							
Task 1[x]	Acceptable	10	45.5	3	23.1	2.641	0.104
	Not acceptable	12	54.5	10	76.9		
Task 2[y]	Acceptable	10	45.5	3	23.1	2.641	0.104
	Not acceptable	12	54.5	10	76.9		
Task 3[z]	Acceptable	0	0	0	0	-	-
	Not acceptable	10	100	25	100		
Hand Arm Vibration Exposure level							
Below daily permissible exposure limit		22	88.0	5	50.0	1.848	0.174
Above daily permissible exposure limit		3	12.0	5	50.0		
Forceful exertion force level							
Task 1[x]	Low	14	70.0	11	73.3	2.192	0.139
	High	6	30.0	4	26.7		
Task 2[y]	Low	5	25.0	3	20.0	3.29	0.07
	High	15	75.0	12	80.0		
Task 3[z]	Low	4	20.0	2	13.3	1.604	0.205
	High	16	80.0	13	86.7		

N=35, [b]: Fisher Exact Test

x:Working under vehicle for engine oil replacement process y: Loosening/tightening nut tyre using pneumatic tools process z: Lifting up/down tyre process

Table 4.11 Association between occupational profiles with MSDs among vehicle service technicians (continue)

Variable	MSDs Reporting (twelve month prevalence)				X^2	p-value
	Yes		No			
	n	(%)	n	(%)		
Job demand level						
Low	7	41.2	10	55.6	2.267	0.132
High	10	58.8	8	44.4		
Co-worker support level						
Low	11	47.8	10	45.5	0.095	0.758
High	12	52.2	12	54.5		
Supervisor support level						
Low	8	33.3	5	45.5	3.075	0.08
High	16	66.7	6	54.5		
Job insecurity level						
Low	10	47.6	6	42.9	0.883	0.347
High	11	52.4	8	57.1		
Psychological level						
Normal	19	86.4	11	84.6	-	.071[b]
Distress	3	13.6	2	15.4		

N=35 [b]: Fisher Exact Test

4.9 Risk factors associated with MSDs among vehicle service technicians

Binary logistic regression was conducted in this study to assess whether the risk factors significantly predicted the present of MSDs among respondents or not. Table 4.12 shows the results for binary logistic regression. The MSDs is used as the dependent variable and RULA score, HAV in A(8), forceful exertion level, job demand level, co-worker support, supervisor support, psychological level, age, BMI, and monthly income as independent variables were included in this test after the assumptions were met.

The logistic regression shows the odds in reporting MSDs among technicians was increase 3.713 for technicians who expose to high job demand. It was also found that MSDs was strongly associated with other factors which overweight and earn more than RM 1,500 permonth increase the risk level of getting MSDs by 4.661 and 4.771 respectively.

The prediction model of MSDs among vehicle service technicians is:

Logit (P) = In [P/1-P] = -3.005 + [1.1312*job demand] + [1.539*BMI] + [1.563*monthlyincome]

Table 4.12 Factors associated with MSDs among vehicle service technicians from logistic regression analysis

Variables		Coefficient B	Adjusted OR	95% C.I. Lower	95% C.I. Upper	Wald Statistics	p-value
Age (years)	>30 years old	0.326	1.385	0.331	5.799	0.199	0.654
	<30 years old		1.00				
BMI (kg/m2)	Overweight	1.539	4.661	1.204	18.030	4.970	0.025*
	Normal		1.00				
RULA Risk Level	Not acceptable	0.864	2.373	0.834	6.752	2.625	0.105
	Acceptable		1.00				
Forceful exertion level	High	0.283	1.327	0.294	5.992	0.136	0.712
	Low		1.00				
HAV in A(8)	Above daily PEL**	-0.480	0.614	0.160	2.356	0.503	0.478
	Below daily PEL		1.00				
Job demand level	High	1.311	3.713	1.121	12.290	4.610	0.031*
	Low		1.00				
Co-worker support level	High	-0.490	0.611	0.195	1.913	0.713	0.398
	Low		1.00				
Supervisor support level	High	-0.760	0.464	0.139	1.550	1.553	0.212
	Low		1.00				
Job insecurity level	High	0.680	1.974	0.695	5.605	1.634	0.201
	Low		1.00				

Psychological level	Distress	-0.810	0.444	0.107	1.843	1.247	0.264
	Normal		1.00				
Monthly Income	>RM1,500	1.562	4.77	1.393	16.330	6.189	0.012*
	<RM 1,500		1.00				

N=35

*p-value is significant at p<0.05

**PEL: Permissible Exposure Limit

CHAPTER 5

DISCUSSION, CONCUSION AND RECOMMENDATION

5.1 Background information

A research was conducted to determine the prevalence of MSD and the associated risk factors among vehicle service technicians at Perodua Puchong service center. A total of 35 vehicle service technicians had participated in this study, which started from 1stof October 2020 until 31st of March 2021 in Perodua Puchong service center.

5.2 Prevalence of MSD among vehicle service technicians in PeroduaPuchong service center

The first objective is to identify the prevalence of MSD among vehicle service technicianin Perodua Puchong service center. The study shows a high prevalence of MSD among vehicle service technician which has the highest complaints that occur at nine areas of thebody. The result is the same with the finding of Nasrull, (2010) which stated that the highest prevalence of MSD vehicle service industries in Malaysia. However, if comparedwith the present study, the finding of Nasrull, (2010) was much lower which was 75%. Indeveloped countries, Svendsen et al., (2004), reported a prevalence of 16.8% MSD rate among car mechanics whereas in developing countries such as India, Vyas, (2011), reported the prevalence of MSD at 85%. Meanwhile, in Bangladesh, Rahman, (2014) found that the MSD prevalence is 81%. Although MSD prevalence is common amongst Malaysian vehicle service technicians, it is lesser than the MSD prevalence found in studies done by other developing countries (Vyas et al., 2011, Nasrull et al., 2010).

This study found that from the 9 body parts, shoulder is the highest complaint among Malaysian vehicle service technicians followed by legs, neck, lower back, upper back, knee, arms and elbow pains. The finding of this study is relevant with similar study that showed shoulder as the main complaint with regards to MSD (Silverstein et al., 2008).

The high prevalence among Malaysian vehicle service technicians in Perodua Puchong service center might be due to overexertion of body parts as stated by Nasrull, (2010) vehicle service technicians were typically subjected to postural stress. Nasrull, (2010) alsoadded that in the process of servicing vehicle like force exertion of shoulder, neck, upper and lower back as well as wrist are important since there are required force and awkward posture depending on the exterior and interior shape of vehicle. Furthermore, by lifting heavy parts (tyre) or working under vehicle, this leads to excessive use of body which increases the energy consumption and circulatory demands.

5.3 The Association between Risk Factor of MSD among vehicle servicetechnicians in Perodua Puchong service center

The next objective of this study is to analyze the risk factors and its link to MSD among vehicle service technicians in Perodua Puchong service center. All the contributing factorsto MSD were collected from the respondents during interview session using questionnaire, posture assessment and hand arm vibration measurement.

5.3.1 Awkward Posture (RULA score)

Although most of studies showed that postures such as arm being raised overhead, neck side bending and bending forward have been reported in development of MSD among vehicle service technicians (Nasrull et al., 2010, Vyas et al., 2011).

However, this study revealed that there was no significance relationship between MSDs and awkward posture. It is because, all the respondents working in acceptable postures.

5.3.2 Hand arm vibration (HAV)

The third objective of this study is to determine the relationship of MSD and exposure to hand arm vibration. However, this study revealed that there was no significance relationship between MSDs and hand arm vibration. This was supported by the result of the study, 80.4% of technicians who reported MSDs in past twelve months showed that exposed to hand arm vibration below the daily permissible exposure limit.

5.3.3 Forceful exertion

This study found that there was no significance relationship between MSDs and forceful exertion. It is because, even though there is lifting process of tyre by the technicians duringworking, the distance of lifting is less than 500 millimeters due to use of tyre trolley and vehicle hoist lift.

5.3.4 Job Demand

This study found that there was significance relationship between MSDs and job demand. It was also observed that monthly income was significance association with MSDs. It canbe explained that higher amount of monthly income the bigger job roles and responsible among the technicians. A past study by Svendsen et al., (2004) reported that job demand had significant association with MSD among vehicle service technicians in Denmark with (OR=3.19, 95% CI 1.62-6.31)(Svendsen et al., 2004). Another comparable study also reported that a significant association between occupational requirement and occupational injury among manufacturing factory workers in Japan with OR=1.30 (Murata et al., 2000). This present study shows that supervisor support reduces the risk of MSD (OR=0.837). According to Koukoulaki (2014), teamwork ($p < 0.001$) and task support ($p < 0.005$) had negative relationship to stress (as job support increase, job stress decrease). Meanwhile, short of suitable tools had positive relationship to stress ($p < 0.010$) (as lack of adequate tools increase, job stress increase). Team works showed a negative correlation to stress. Positive support from colleagues strengthen their weaknesses. Task support from colleagues and supervisors also reduces occupational difficulties and stress (Koukoulaki, 2014).

5.3.5 Psychological stress factor

This study found that there was no significance relationship between MSDs and psychological stress. It is because, only 9.5% from technicians who reported MSDs symptoms in past 12 months have psychological distress. In addition, 62.3% reported that the technicians received high support from the supervisor.

This was supported by a similar study, Kuroda, 2016 reported that good support from superior to their employee significantly improve employees' mental health.

5.4 Conclusion

Findings from this study showed that:

1. The prevalence of MSDs for past 12 months among vehicle service technicians at Perodua Puchong service center shows shoulder pain as the highest symptom of complaints (62.3%) among the nine body areas studied. Followed by legs (61.8%), neck (59.2%) and lower back pain (56%).

2. This study found that there was no significant relationship between MSDs and posture among vehicle service technician at Perodua Puchong service center. Most of thetechnicians work in acceptable score posture.

3. This study found that there was no significant relationship between MSDs and exposure of hand arm vibration among vehicle service technician at Perodua Puchong service center. The hand arm vibration measurement reported that most of the technicians exposed to hand vibration below than permissible exposure limit.

4. This study found that there was no significant relationship between MSDs and forceful exertion among vehicle service technician at Perodua Puchong service center.

5. This study found that there was significant relationship between MSDs and job demand among vehicle service technician at Perodua Puchong service center

6. This study found that there was no significant relationship between MSDs and psychological condition among vehicle service technician at Perodua Puchong service center.

7. This study shows that the overall prediction model of MSDs among vehicle service technicians is: Logit (P) = In [P/1-P] = -3.005 + [1.1312*job

demand] + [1.539*BMI] + [1.563*monthly income]. Hopefully, this study provides database and guidance to vehicle services industry in developing a safe and healthy working environment.

5.5 Study Limitation

There are some limitations in this study that cannot be avoided by the researcher such as information about the musculoskeletal symptoms is obtained only from the respondents' confession in the questionnaire. There is no clinical examination and diagnosis to confirm their complaints. The recall process may be bias like remembering the complaint of muscle pain within a year period or within one week cannot be confirmed since no records were collected from the hospital or private clinics. These are only based on what were claimed by the respondents. In addition, information given by the respondents was considered accurate and it is beyond the researcher's control to verify each of the information. Moreover, factors from the type of vehicles were not studied such as model of each vehicle serviced and the weight of the vehicle's tyre since the vehicles that enter the service centreis variant based on customers' appointment.

5.5.1 Substitution

Substitution is the next most efficient method in controlling hazard after elimination. It comprises of the process of replacing the cause of hazards (similar to elimination) with other elements that are not hazardous. In this case, the use of hand tool can be substituted to amore ergonomic tool. For example, air impact wrench can be substituted to a lower vibration magnitude so that the vibration can be within action level value 2.5m/s^2.

5.5.2 Engineering control

Another way of limiting hazards is engineered controls. Instead of eliminating hazard, thepeople involved are being isolated from the hazard itself. The overall costs of engineered controls are more expensive other methods in the hierarchy. Nevertheless, they could greatly lessen upcoming costs (Department of Occupational Safety and Health (DOSH), 2008). For instance, the use of mechanical trolley to minimize the force of lifting or lowering tire (Figure 5.1).

Figure 5.1 Mechanical Scissor Trolley

(Source: SecureFix Direct, 2016)

5.5.3 Administrative control

Administrative controls are when employees change their working habits and practices. Some of the examples are procedure change, workshop for employees, and displaying signs as well as caution labels. With this control, hazards are not eliminated completely but they restrict or inhibit hazard exposure from employees likebody strengthening exercise. In this study, plank exercises can be introduced to the affected employees to strengthen their body so that they are fit to do the task. The plank exercise is as per figure(5.2).

Figure 5.2 Plank 5 minutes exercise

(Source: Menfitness, 2016)

5.5.4 Personal Protective Equipment

Personal protective equipment (PPE) are equipment consist of protective gloves, respirators, safety hats, safety glasses, reflective uniform, and safety boots. PPE is the least efficient method in hazard control since there is still high potential of injury. Anti-vibration gloves can be provided to minimize exposure of vibration when the employees are using hand power tools.

(Source: DOSH,2008)

5.5.5 Elimination

Physically removing the risk factors is the most efficient in controlling the hazards. The use of manual handling among technicians can be eliminated by the use of machines. It was observed that the there were certain technicians that worked using a special equipmentcalled as pneumatic trolley service (Figure 5.3). However this equipment is very limited and can only be used at certain outlets. It is used for a specific bay call as “express bay”. The ratio of express bay compared to normal bay is 1: 30. In addition, the cost of the pneumatic trolley is very expensive and it is imported from Japan. To extend this machine to all technicians will be costly to the operation.

Front view Side view Trolley in use

Figure 5.3 Pneumatic Trolley Service

(Source: Perodua, 2020)

5.6 Recommendation

From this study, recommendation can be given prior to the risk factors discussed earlier inthis study. Hierarchy hazard control concept (Figure 5.4) is suggested in this study to reduce prevalence of MSD among vehicle service technician at Perodua Puchong service center (Department of Occupational Safety and Health (DOSH), 2008). The control concepts are:

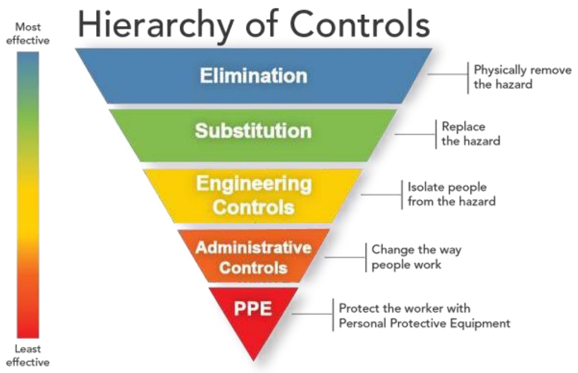


Figure 5.4 Hierarchy hazard control concept

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APPENDICES PREMILINARY QUESTIONNAIRE

PRELIMINARY QUESTIONNAIRE

OPEN UNIVERSITY MALAYSIA,

CLUSTER APPLIED SCIENCES.

BORANG KAJIAN BAGI MELIHAT HUBUNGAN DI ANTARA FAKTOR RISIKO DAN GANGGUAN OTOT YANG BERKAITAN DENGAN PEKERJAAN DI KALANGAN MEKANIK DI PUSAT SERVIS PERODUA PUCHONG

SEMUA MAKLUMAT DIJAMIN SULIT

Sila isikan maklumat dan tandakan √ pada ruang yang berkenaan Nama : ________________

Jabatan: ____

Staff No: ____

1. Pernahkah anda mengalami kemalangan yang teruk pada otot rangka (patahtulang/pembedahan)?

☐ 0.Tidak ☐ 1.Ya

2. Adakah anda mempunyai sejarah kesakitan fizikal dan mental?

☐ 0.Tidak ☐ 1.Ya

3. Adakah anda mempunyai sejarah penyakit yang berkaitan dengan saraf? (contohpenyakit saraf seperti sawan, lumpuh dan lain-lain.

Sakit urat/lenguh-lenguh bukan peyakit saraf)

☐ 0.Tidak ☐ 1.Ya

APPENDICES QUESTIONNAIRE

OPEN UNIVERSITY

MALAYSIA,CLUSTER

APPLIED SCIENCES.

BORANG KAJIAN BAGI MELIHAT HUBUNGAN DI ANTARA FAKTOR RISIKO DAN GANGGUAN OTOT YANG BERKAITAN DENGAN PEKERJAAN DI KALANGAN MEKANIK DI PUSAT SERVIS PERODUA PUCHONG

SEMUA MAKLUMAT DIJAMIN SULIT

Sila isikan maklumat dan tandakan √ pada ruang yang berkenaan Staff No :______________

BAHAGIAN A: MAKLUMAT AM RESPONDEN

1. Umur :______________tahun
2. Berat :______________kg
3. Tinggi :_____________cm
4. BMI :______________(Diisi oleh penyelidik)
5. Bangsa : _____________
6. Lain-lain : ___________________
7. Tahap Pendidikan : ___________
8. Status perkahwinan : __________
9. Pendapatan (Gaji pokok sebulan) : ___________
10. Adakah anda melakukan kerja lebih masa?

☐ 0.Tidak ☐ 1.Ya

Jika Ya, nyatakan anggaran jumlah pendapatan dalam sebulan

11. Adakah anda menerima insentif

☐ 0.Tidak ☐ 1.Ya

Jika Ya, nyatakan berapa kali anda menerima insentif dalam setahun

12. Adakah anda merokok?

☐ 0.Tidak ☐ 1.Ya

Jika **Ya**, nyatakan berapa purata batang rokok dalam sehari:______batang Sudah berapalama anda merokok______________tahun

BAHAGIAN B: MAKLUMAT PEKERJAAN

13. Jabatan: ______________
14. Jawatan: ______________
15. Lokasi: ______________
16. Penahkah anda bekerja sebelum ini :

☐ 0.Tidak ☐ 1.Ya

17. Berapa lamakah anda bekerja di bengkel ini?

__________Tahun_______Bulan

18. Tempoh masa bekerja?

________Jam

19. Adakah anda pernah mengambil OT

☐ 0.Tidak ☐ 1.Ya

Jika ya, berapa purata jam OT pada minggu lepas

_____________jam

20. Adakah anda melakukan kerja sampingan

☐ 0.Tidak ☐ 1.Ya

Jika Ya, nyatakan jenis pekerjaan sampingan tersebut _________

BAHAGIAN C: MAKLUMAT AM PERUBATAN

21. Penyakit pernafasan

☐ 0.Tidak ☐ 1.Ya

22. Penyakit Jantung

☐ 0.Tidak ☐ 1.Ya

23. Darah Tinggi

☐ 0.Tidak ☐ 1.Ya

24. Kencing Manis

☐ 0.Tidak ☐ 1.Ya

BAHAGIAN D : MAKLUMAT KANDUNGAN KERJA (KARASEK JCQ)

Sila bulatkan jawapan yang paling sesuai menggambarkan diri anda.

A. Sangat tidak setuju

B. Tidak setuju

C. Setuju

D. Sangat setuju

No	Soalan	Jawapan			
25	Adakah kerja anda memerlukan anda belajar benda baru.	A	B	C	D
26	Adakah kerja anda kerja yang berulang-ulang.	A	B	C	D

27	Adakah kerja anda memerlukan kreativiti	A	B	C	D
28	Adakah kerja anda memerlukan skil kerja yang tinggi.	A	B	C	D
2	Adakah kerja anda memerlukan pelbagai skil	A	B	C	D
9					
30	Adakah kerja anda membina kebolehan anda	A	B	C	D
31	Adakah anda mampu membuat keputusan sendiri dalam kerja anda.	A	B	C	D
32	Adakah anda diberikan kebebasan dalam membuat keputusan ketika bekerja	A	B	C	D
33	Adakah anda bercerita banyak pasal kerja anda	A	B	C	D
34	Adakah kerja anda memerlukan pendidikan dan latihan.	A	B	C	D
35	Adakah anda perlu selesaikan kerja dengan cepat	A	B	C	D
36	Adakah anda perlu bekerja dengan keras	A	B	C	D
37	Adakah anda perlu bekerja dengan lebih	A	B	C	D
38	Adakah anda mencukupi masa untuk menyelesaikan kerja anda	A	B	C	D
39	Adakah anda bekerja dalam keadaan terpaksa (bukan dengan kehendak anda)	A	B	C	D
40	Kerja anda memerlukan fokus yang tinggi	A	B	C	D
41	Kerja anda sering diganggu (kerja tambahan, rakan sekerja, penyelia dan sbg.)	A	B	C	D
42	Kerja anda sangat memenatkan	A	B	C	D

43	Kerja anda perlu tunggu pada hasil kerja orang lain	A	B	C	D
44	Penyelia saya ambil berat terhadap saya	A	B	C	D
45	Penyelia saya ambil perhatian terhadap saya	A	B	C	D
46	Penyelia bermusuh dengan saya	A	B	C	D
47	Penyelia saya sangat membantu dalam kerja saya	A	B	C	D
48	Penyelia saya bagus dalam mengatur kerja saya	A	B	C	D
49	Rakan sekerja saya orang yang berkemahiran	A	B	C	D
50	Rakan sekerja gembira dengan saya	A	B	C	D
51	Rakan sekerja bermusuh dengan saya	A	B	C	D
52	Rakan sekerja sangat ramah-mesra *(friendly)*	A	B	C	D
53	Rakan sekerja beri kerjasama dengan baik	A	B	C	D
54	Rakan sekerja sangat membantu dalam kerja	A	B	C	D
55	Kerja saya memerlukan kekuatan fizikal	A	B	C	D
56	Kerja saya banyak terlibat dengan mengangkat muatan berat	A	B	C	D
57	Kerja saya memerlukan pergerakan fizikal yang laju	A	B	C	D
58	Kerja saya terlibat dengan posisi badan yang tidak sesuai	A	B	C	D

59	Kerja saya terlibat dengan posisi lengan yang tidak sesuai	A	B	C	D
60	Kerja saya stabil	A	B	C	D
61	Kerja saya mempunyai jaminan yang baik	A	B	C	D
62	Dalam tahun ini, saya pernah ditukar bahagian atau kawasan berkerja *(branch)*.	A	B	C	D
63	Pekerjaan saya mempunyai masa hadapan yang cerah. *(Career possibilities)*	A	B	C	D
64	Pekerjaan saya memberikan saya kemahiran yang berharga. *(Skills valuable)*	A	B	C	D

BAHAGIAN E : MAKLUMAT UMUM KESIHATAN MENTAL (GHQ-12).

Kami ingin mengetahui kesihatan anda secara umum, dalam beberapa minggu sebelum ini.Sila bulatkan jawapan yang paling sesuai menggambarkan diri anda.

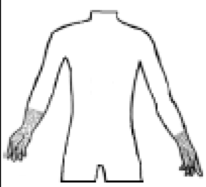
A. Kurang dari biasa
B. Sama seperti biasa
C. Lebih dari biasa
D. Berlebihan dari biasa

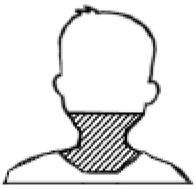
No	**Soalan**	**Jawapan**			
65	Kebolehan untuk memberi tumpuan / memfokus.	A	B	C	D
66	Kesukaran untuk tidur.	A	B	C	D
67	Memainkan peranan dalam sesuatu perkara.	A	B	C	D
68	Kebolehan membuat keputusan.	A	B	C	D

69	Mengalami tekanan.	A	B	C	D
70	Kesukaran menghadapi masalah.	A	B	C	D
71	Seronok melakukan aktiviti harian.	A	B	C	D
72	Berani menghadapi masalah.	A	B	C	D
73	Tidak gembira dan tertekan	A	B	C	D
74	Tiada keyakinan diri	A	B	C	D
7	Merasa diri tidak berguna	A	B	C	D
5					
76	Gembira apabila hanya ada sebab.	A	B	C	D

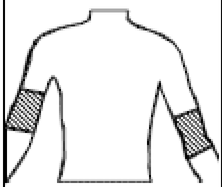
BAHAGIAN F: MASALAH OTOT RANGKA (MSD)

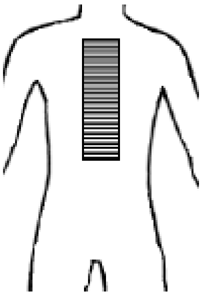
Arahan: Sila jawab kesemua soalan di bawah berpandukan jadual yang disediakan.
Sila tandakan [√] pada jawapan yang anda rasakan sesuai dan sila jawab kesemua sebaik mungkin.

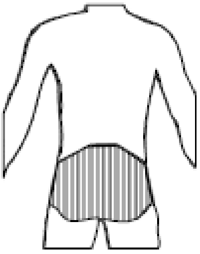
82. 	Adakah anda mengalami ***perit, sakit, tidak selesa*** pada ***satu/kedua belah tangan*** pada masa di bawah			Adakah anda merasakan ***masalah*** itu berpunca daripada ***pekerjaan*** anda.
	Bila-bila masa di dalam ***hidup*** anda	Di dalam tempoh ***12 bulan kebelakangan***	Di dalam tempoh ***7 hari kebelakangan***	
	0. Tidak ☐	0. Tidak ☐	0. Tidak ☐	0. Tidak ☐
	1. Ya ☐	1. Ya ☐	1. Ya ☐	1. Ya ☐

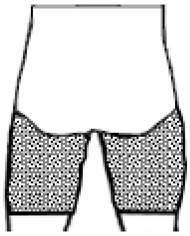
79. 	Adakah anda mengalami ***perit, sakit, tidak selesa*** pada ***tengkuk/leher*** pada masa di bawah			Adakah anda merasakan ***masalah*** itu berpunca daripada ***pekerjaan*** anda.
	Bila-bila masa di dalam ***hidup*** anda	Di dalam tempoh ***12 bulan kebelakangan***	Di dalam tempoh ***7 hari kebelakangan***	
	0. Tidak ☐	0. Tidak ☐	0. Tidak ☐	0. Tidak ☐
	1. Ya ☐	1. Ya ☐	1. Ya ☐	1. Ya ☐

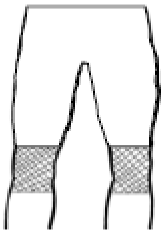
80. 	Adakah anda mengalami ***perit, sakit, tidak selesa*** pada ***bahu*** pada masa di bawah			Adakah anda merasakan ***masalah*** itu berpunca daripada ***pekerjaan*** anda.
	Bila-bila masa di dalam ***hidup*** anda	Di dalam tempoh ***12 bulan kebelakangan***	Di dalam tempoh ***7 hari kebelakangan***	
	0. Tidak ☐	0. Tidak ☐	0. Tidak ☐	0. Tidak ☐
	1. Ya ☐	1. Ya ☐	1. Ya ☐	1. Ya ☐

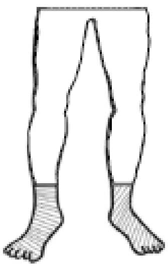
81. 	Adakah anda mengalami ***perit, sakit, tidak selesa*** pada ***satu/kedua belah siku*** pada masa di bawah			Adakah anda merasakan ***masalah*** itu berpunca daripada ***pekerjaan*** anda.
	Bila-bila masa di dalam ***hidup*** anda	Di dalam tempoh ***12 bulan kebelakangan***	Di dalam tempoh ***7 hari kebelakangan***	
	0. Tidak ☐	0. Tidak ☐	0. Tidak ☐	0. Tidak ☐
	1. Ya ☐	1. Ya ☐	1. Ya ☐	1. Ya ☐

83. 	Adakah anda mengalami *perit, sakit, tidak selesa* pada *belakang atas* pada masa di bawah			Adakah anda merasakan *masalah* itu berpunca daripada *pekerjaan* anda.
	Bila-bila masa di dalam *hidup* anda	Di dalam tempoh *12 bulan kebelakangan*	Di dalam tempoh *7 hari kebelakangan*	
	0. Tidak ☐	0. Tidak ☐	0. Tidak ☐	0. Tidak ☐
	1. Ya ☐	1. Ya ☐	1. Ya ☐	1. Ya ☐

84. 	Adakah anda mengalami *perit, sakit, tidak selesa* pada *pinggang/belakang bawah* pada masa di bawah			Adakah anda merasakan *masalah* itu berpunca daripada *pekerjaan* anda.
	Bila-bila masa di dalam *hidup* anda	Di dalam tempoh *12 bulan kebelakangan*	Di dalam tempoh *7 hari kebelakangan*	
	0. Tidak ☐	0. Tidak ☐	0. Tidak ☐	0. Tidak ☐
	1. Ya ☐	1. Ya ☐	1. Ya ☐	1. Ya ☐

85. 	Adakah anda mengalami *perit, sakit, tidak selesa* pada *satu/kedua belah peha* pada masa di bawah			Adakah anda merasakan *masalah* itu berpunca daripada *pekerjaan* anda.
	Bila-bila masa di dalam *hidup* anda	Di dalam tempoh *12 bulan kebelakangan*	Di dalam tempoh *7 hari kebelakangan*	
	0. Tidak ☐	0. Tidak ☐	0. Tidak ☐	0. Tidak ☐
	1. Ya ☐	1. Ya ☐	1. Ya ☐	1. Ya ☐

86. 	Adakah anda mengalami *perit, sakit, tidak selesa* pada *satu/kedua belah lutut* pada masa di bawah			Adakah anda merasakan *masalah* itu berpunca daripada *pekerjaan* anda.
	Bila-bila masa di dalam *hidup* anda	Di dalam tempoh *12 bulan kebelakangan*	Di dalam tempoh *7 hari kebelakangan*	
	0. Tidak ☐	0. Tidak ☐	0. Tidak ☐	0. Tidak ☐
	1. Ya ☐	1. Ya ☐	1. Ya ☐	1. Ya ☐

87. 	Adakah anda mengalami *perit, sakit, tidak selesa* pada *satu/kedua belah kaki* pada masa di bawah			Adakah anda merasakan *masalah* itu berpunca daripada *pekerjaan* anda.
	Bila-bila masa di dalam *hidup* anda	Di dalam tempoh *12 bulan kebelakangan*	Di dalam tempoh *7 hari kebelakangan*	
	0. Tidak ☐	0. Tidak ☐	0. Tidak ☐	0. Tidak ☐
	1. Ya ☐	1. Ya ☐	1. Ya ☐	1. Ya ☐

BAHAGIAN G : MAKLUMAT KADAR PENGERAHAN TENAGA (THE BORGCR-10 SCALE)

Sila jawab kesemua soalan di bawah berpandukan jadual yang disediakan.

Sila tandakan [O] pada jawapan yang anda rasakan sesuai dan sila jawab kesemua soalandengan sebaik mungkin**.**

Tahap	**Tenaga yang diperlukan**
0	Tidak memerlukan tenaga langsung
0.5	Tersangatlah sedikit.
1	Sangat sedikit.
2	Sedikit.
3	Biasa
4	Lebih sedikit daripada tahap biasa.
5	Lebih daripada biasa.
6	Kuat daripada biasa.
7	Sangat kuat.
8	Lebih sedikit daripada tahap Sangat Kuat.
9	Lebih banyak daripada tahap Sangat Kuat.
10	Melampau kuat.

88	Buka/tutup *bonet*	0	0.5	1	2	3	4	5	6	7	8	9	10
89	Periksa bahagian enjin	0	0.5	1	2	3	4	5	6	7	8	9	10

90	Buka/pasang *engine oil cap*	0	0.5	1	2	3	4	5	6	7	8	9	10
91	Buka/pasang *engine drain plug*	0	0.5	1	2	3	4	5	6	7	8	9	10
92	Buka/pasang *engine filter*	0	0.5	1	2	3	4	5	6	7	8	9	10
93	Buka/pasang tayar	0	0.5	1	2	3	4	5	6	7	8	9	10
94	Angkat/turun tayar	0	0.5	1	2	3	4	5	6	7	8	9	10
95	Periksa *brake pad*	0	0.5	1	2	3	4	5	6	7	8	9	10
96	Ganti *brake pad*	0	0.5	1	2	3	4	5	6	7	8	9	10
97	Mengisi *engine oil*	0	0.5	1	2	3	4	5	6	7	8	9	10
98	Buka/pasang *spark plug*	0	0.5	1	2	3	4	5	6	7	8	9	10
99	Buka/pasang *air filter*	0	0.5	1	2	3	4	5	6	7	8	9	10
100	Buka/pasang *gasket*	0	0.5	1	2	3	4	5	6	7	8	9	10

1	Buka/pasang *fuel*	0	0	1	2	3	4	5	6	7	8	9	1
01	*filter*		.5										0
102	Mengisi *gear oil/ATF oil*	0	0.5	1	2	3	4	5	6	7	8	9	10
103	Mengisi *power steering oil*	0	0.5	1	2	3	4	5	6	7	8	9	10
104	Mengisi *differential gear oil*	0	0.5	1	2	3	4	5	6	7	8	9	10
105	Mengisi *coolant*	0	0.5	1	2	3	4	5	6	7	8	9	10
106	Menyelanggara *aircond*	0	0.5	1	2	3	4	5	6	7	8	9	10
107	Melakukan *wheel alignment*	0	0.5	1	2	3	4	5	6	7	8	9	10
108	Melakukan *wheel balancing*	0	0.5	1	2	3	4	5	6	7	8	9	10

TAMAT

APPENDICES CONSENT LETTER & SUBJECT INFORMATION SHEET
CONSENT FORM (RESPONDENT)

RESEARCH TITLE :

THE PREVALENCE OF WORK RELATED MSD AND THE ASSOCIATION WITH RISK FACTORS AMONG VEHICLE SERVICE TECHNICIANS IN KLANG VALLEY, MALAYSIA

RESEARCHER : Ahmad Faisal 019 359 4649

I …………………………………… Identity Card No. ……………………………

address…………………………………………………………………………… ………

………………….

.. …………………………………………………..hereby voluntarily agree to take partin the clinical research *(clinical study, questionnaire study/ drug trial) specified above.

I have been informed about the nature of the clinical research in terms of methodology, possible adverse effects and complications (as written in the Respondent Information Sheet). I understand that I have the right to withdraw from this clinical research at any time without assigning any reason whatsoever. I also understand that this study is confidential and all information provided with regards to my identity will remain private and confidential.

I* wish / do not wish to know the results of the tests performed on any samples taken fromme.

* delete where necessary

Signature ……..………………………… Signature ……..…………………………….

(*Respondent*) (*Witness*)

Date :……………………………………..….. Name :……………………………………..…..

I/C No. :……………………………………..…..

I confirm that I have explained to the respondent the nature and purpose of the above – mentioned clinical research.

Date ……..………………………… Signature ……..…………………………….

(Researcher)

HELAIAN PENERANGAN RESPONDEN

Sila baca maklumat berikut dengan teliti. Sekiranya anda mempunyai sebarang pertanyaan,sila kemukakan kepada penyelidik.

TAJUK KAJIAN

KAJIAN BAGI MELIHAT HUBUNGAN DI ANTARA FAKTOR RISIKO DAN GANGGUAN MUSKULOSKELETAL (GANGGUAN OTOT) YANG BERKAITAN DENGAN PEKERJAAN DI KALANGAN MEKANIK KENDERAAN DI PUSAT SERVIS PERODUA PUCHONG.

PENGENALAN

Terdapat pelbagai jenis hazad di sektor automotif yang membuat pekerja terdedah secara langsung atatu tidak langsung seperti bahan kimia, ergonomik dan fizikal. Namun begitu, setakat ini kajian mengenai hazad dan kesan kepada kesihatan pekerja masih kurang mendapat perhatian dikalangan penyelidik dan juga majikan. Objektif kajian ini dilakukan adalah untuk mengkaji kesan pendedahan pekerjaan terhadap risiko gangguan otot.

APAKAH YANG PERLU ANDA LAKUKAN?

Semua responden akan diberi borang soal selidik untuk mengetahui latar belakang mereka. Responden juga akan diberikan ujian dan pemantauan seperti penilaian postur kerja *(Rapid Upper Limb Assessment, RULA)* dan Ujian gegaran *(Vibration Testing)*. Anda dikehendaki menandatangani borang penyertaan responden yang menyatakan minat anda untuk menyertai kajian ini. Ianya boleh dilakukan setelah anda membaca dan memahami isi kandungan penerangan ini. Borang penyertaan responden harus dikembalikan kepada pengkaji sebelum sesi kajian dijalankan. Sekiranya anda mempunyai sebarang kemusykilan, pengkaji akan membantu untuk memberi maklumat yang selanjutnya.

SIAPA YANG TIDAK BOLEH MENYERTAI KAJIAN INI?

1. Mereka yang pernah mengalami kemalangan yang teruk pada otot rangka (patah tulang/pembedahan)

2. Mereka yang mempunyai sejarah kesakitan fizikal dan mental

APAKAH FAEDAH MENYERTAI KAJIAN INI?

a) KEPADA ANDA SEBAGAI PESERTA?

Peserta dapat mengetahui kesan pendedahan pekerjaan terhadap risiko kesihatan gangguanotot.

b) KEPADA PENYELIDIK?

Maklumat dan data diperolehi boleh digunakan dalam menilai kesan pendedahanpekerjaan terhadap risiko kesihatan.

ADAKAH IA BERISIKO?

Ia tidak berisiko.

ADAKAH MAKLUMAT DAN IDENTITI SAYA KEKAL RAHSIA?

Makmlumat dan identiti peserta akan kekal sebagai rahsia.

SIAPA YANG SAYA PERLU HUBUNGI SEKIRANYA SAYA MEMPUNYAISOALAN TAMBAHAN SEMASA MENGIKUTI PENYELIDIKAN INI?

Anda boleh menghubungi penyelidik Amirul Hafiz 0102965903 / emailmyrulapiz_93@yahoo.com