



UNIVERSITI PUTRA MALAYSIA

***PREVALENCE OF MUSCULOSKELETAL DISORDER AND ITS
ASSOCIATION WITH RISK FACTORS AMONG VEHICLE SERVICE
TECHNICIANS IN KLANG VALLEY, MALAYSIA***

AHMAD FAISAL BIN AHMAD NASARUDDIN

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By

AHMAD FAISAL BIN AHMAD NASARUDDIN

**Thesis Submitted to the School of Graduate Studies, Universiti
Putra Malaysia, in Fulfilment of the Requirements for the Degree of
Master of Science**

November 2016

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in
fulfilment of the requirement for the degree of Master of Science

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November 2016

Chair: Assoc. Prof. Shamsul Bahri bin Hj. Mohd Tamrin, PhD
Faculty: Medicine and Health Science

Introduction: The primary objective of this study is to determine the association between risk factors and the prevalence of Musculoskeletal Disorder (MSD) among vehicle technicians in Klang Valley, Malaysia.

Methodology: This cross-sectional study was conducted at eight vehicle service centers in Klang Valley, Malaysia. One hundred and ninety one technicians were recruited. A modified version of the general Standardised Nordic Questionnaire was used for analyses of perceived MSD in nine different parts of the body (neck, shoulder, elbow, arms, upper back, lower back, thigh, knee and legs). Rapid Upper Limb Assessment (RULA) test had been done to determine the work posture of the respondent and hand vibration had been measured. Independent Chi-square test was used to determine the significant association between MSD prevalence and the risk factors. Binary logistic regression was performed to assess the association between risk factors on the MSD prevalence. The probability limits for evaluating statistical significance was $p < 0.05$. **Results:** The prevalence of MSD among vehicle service technicians is 82.7% and suffered from MSD especially on body parts which are shoulder 62.3%, legs 61.8%, neck 59.2% and lower back 56 %. The logistic regression shows significant association between MSDs and job demand $OR=3.713$ (95% C.I.=1.121-12.290, $p=0.012$). BMI and monthly income also show significant association with $OR=4.661$ (95% C.I.=1.204-18.030, $p=0.025$) and $OR=4.770$ (95% C.I.=1.393-16.330, $p=0.012$) respectively. **Conclusion:** Service technicians at vehicle service centers in Klang Valley are likely to be exposed to a variety of ergonomic hazards and risk factors. Therefore, ergonomics awareness among employer and employee with training and information sharing shall be increase to reduce the prevalence of MSDs.

Keywords: Musculoskeletal disorder, automotive, job demand

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains.

KELAZIMAN GANGGUAN MSD DAN KAITANNYA DENGAN FAKTOR-FAKTOR RISIKO DI KALANGAN JURUTEKNIK MENYELENGGARA KENDERAAN DI LEMBAH KLANG MALAYSIA

Oleh

AHMAD FAISAL BIN AHMAD NASARUDDIN

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Pengerusi: Assoc. Prof. Shamsul Bahri bin Hj. Mohd Tamrin, PhD
Faculty: Fakulti Perubatan dan Sains Kesihatan

Pengenalan: Objektif utama penyelidikan ini adalah untuk mengenal pasti hubungan antara factor-faktor risiko dan kelaziman gangguan MSD di kalangan juruteknik menyelenggara kenderaaan di Lembah Klang, Malaysia. **Metodologi:** Kajian keratan rentas ini telah dijalankan di lapan cawangan pusat servis di Lembah Klang, Malaysia. Satu ratus dan sembilan puluh satu telah mengambil bahagian. Soalan kajian Standardised Nordic Questionnaire telah diterjemahkan kepada Bahasa Melayu bagi menganalisa masalah gangguan MSD pada 9 bahagian badan (leher, bahu, siku, lengan, atas belakang, bawah belakang, paha, lutut dan kaki). Penilaian postur dengan menggunakan Rapid Upper Limb Assessment (RULA) bagi mengenalpasti postur kerja dan ujian tangan getaran telah diambil daripada juruteknik. Ujian Chi-square telah digunakan bagi mengenal pasti hubungan antara kelaziman gangguan MSD dan faktor-faktor risiko. Binari regresi logistik telah dijalankan bagi menilai hubungkait antara faktor-faktor risiko dan kelaziman sakit otot rangka. Had kebarangkalian untuk menilai kepentingan statistik adalah $p < 0.05$. **Keputusan:** Kelaziman gangguan MSD di kalangan juruteknik adalah sebanyak 82.7% dan peratusan pada anggota badan tertentu iaitu pada bahu 62.3%, kaki 61.8%, leher 59.2% dan bawah belakang 56 %. Keputusan binari regresi logistik menunjukkan hubungan yang ketara antara gangguan MSD dan permintaan pekerjaan dengan (OR=3.713 95% C.I.=1.121-12.290, $p=0.012$). BMI dan jumlah pendapatan bulanan juga menunjukkan hubungan yang ketara dengan (OR=4.661 95% C.I.=1.204-18.030, $p=0.025$) and (OR=4.770 95% C.I.=1.393-16.330, $p=0.012$). **Kesimpulan:** Juruteknik di pusat servis di Lembah Klang mungkin akan terdedah kepada pelbagai bahaya dan faktor-faktor risiko ergonomik. Oleh itu, kesedaran ergonomik di kalangan majikan dan pekerja perlu dipertingkatkan dengan latihan dan perkongsian maklumat tentang gangguan MSD.

Katakunci: Gangguan MSD , otomotif, permintaan pekerjaan

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I certify that a Thesis Examination Committee has met on 3 November 2016 to conduct the final examination of Ahmad Faisal Bin Ahmad Nasaruddin on his thesis entitled "Prevalence of musculoskeletal disorder and its association with risk factors among vehicle service technicians in Klang valley, Malaysia" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the degree of Master of Science.

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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 physical disability. 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 MSDs include a critical occurrence that could last for short duration or are permanent like rheumatoid arthritis, osteoporosis, osteoarthritis and lower back 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 to limit or eliminate the risk factors of MSDs at the workplace.

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 (SOC SO) (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.

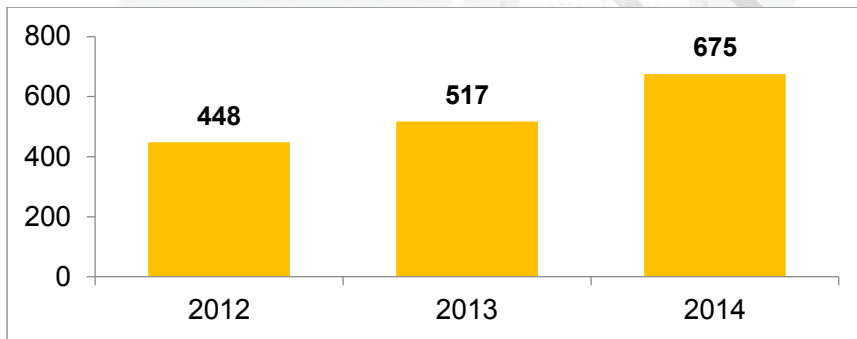


Figure 1.1: Number of occupational diseases and benefit paid according to causal of occupational musculoskeletal disorders
(Source: Social Security Organization, 2012, 2013 & 2014)

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 compared to 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 (SOC SO) (2014).

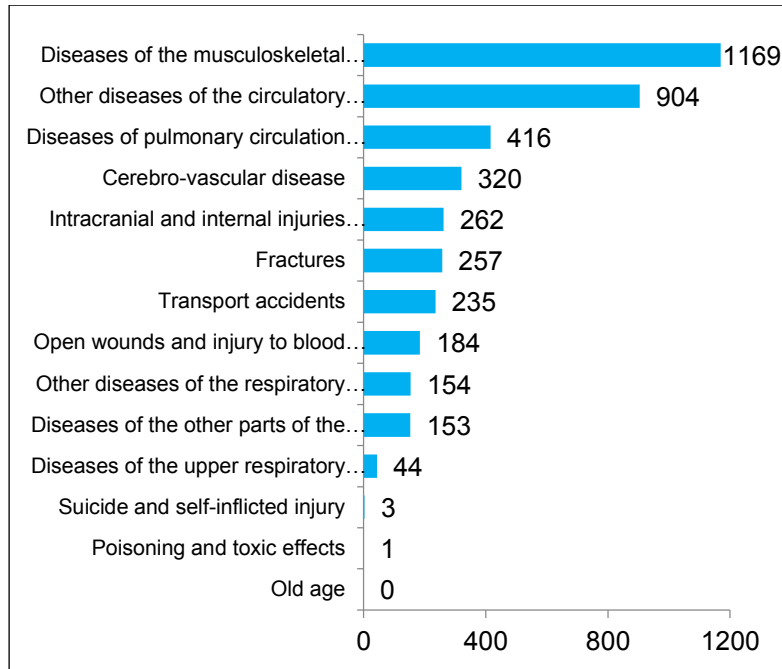


Figure 1.2: Number of invalidity cases reported
 (Source: Social Security Organization, 2014)

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 in the ASEAN (Figure 1.3).

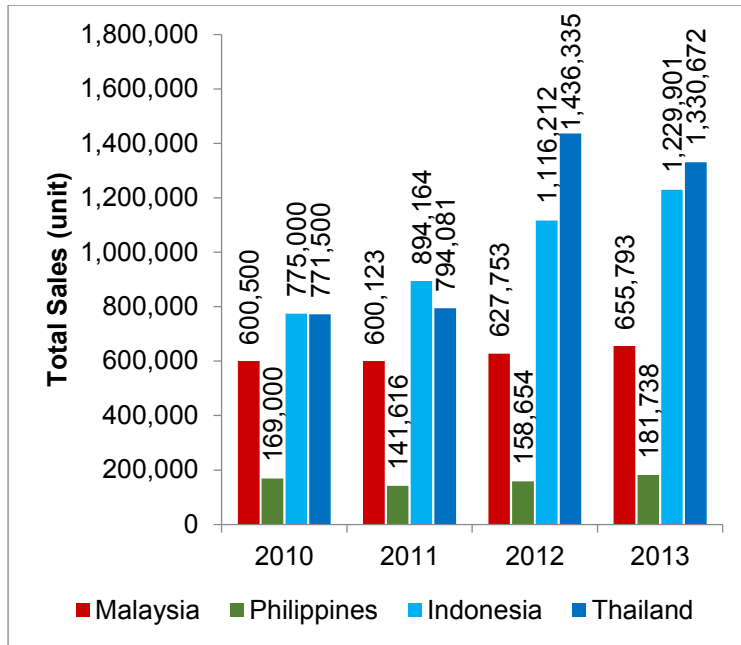


Figure 1.3: Vehicle sales in four major ASEAN countries from 2010 to 2013

(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 MSDs among 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 vehicle service 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 Klang Valley.

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 Klang Valley.

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 analysed 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 study done 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 analysed 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 analysed 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.

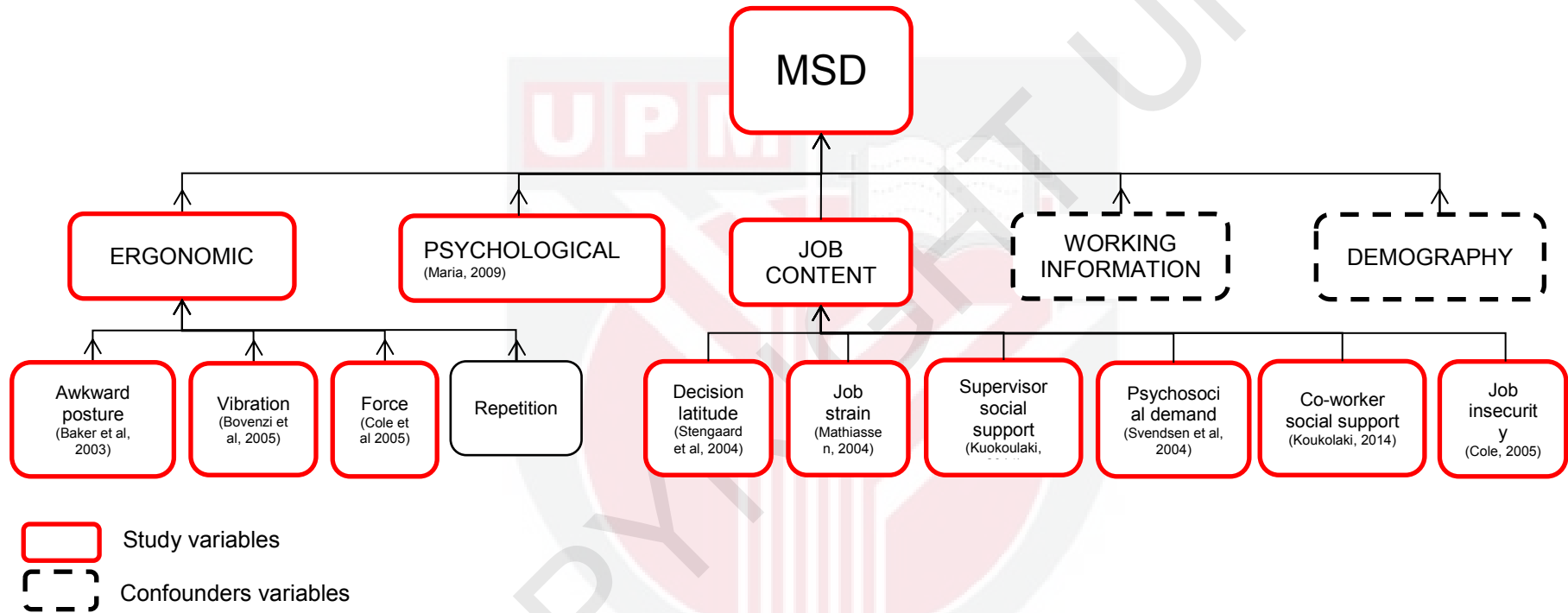


Figure 1.4: Conceptual frameworks of factors contributing to musculoskeletal disorder among vehicle technicians in Klang Valley.

1.5 Research objective

1.5.1 General objective

To identify the association between risk factors and the prevalence of MSD among vehicle technicians in Klang Valley.

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 vehicle service 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 vehicle service 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 vehicle service 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 of vibration 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 level of 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/s² A(8)



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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 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.

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 Coronary Artery 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 psychological demands), with the formula below (Karasek, 1985).

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

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:

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



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