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MUSCULOSKELETAL DISORDER: THE ASSESSMENT AMONG PALM OIL MILL WORKERS IN SELECTED PALM OIL MILLS IN MALAYSIA

MUHAMMAD SHAHMI BIN RAZAK

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MUSCULOSKELETAL DISORDER: THE ASSESSMENT AMONG PALM OIL MILL WORKERS IN SELECTED PALM OIL MILLS IN MALAYSIA

BY

MUHAMMAD SHAHMI BIN RAZAK

Thesis submitted in fulfilment of the requirement for the degree of Bachelor Science (Environmental and Occupational Health) from the Faculty of Medicine and Health Sciences, Universiti Putra Malaysia

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ABSTRACT

MUSCULOSKELETAL DISORDER: THE ASSESSMENT AMONG PALM OIL MILL WORKERS IN SELECTED PALM OIL MILLS IN MALAYSIA

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Introduction: Palm oil mill production process involved awkward posture, repetitive movement and heavy load lifting which may significantly contribute to musculoskeletal disorders (MSD). However, there have been less studies on MSD has been done among this group of workers. The objective of this study was (a) to determine the prevalence of MSD among the palm oil mill workers, (b) to determine their perception of exertion while performing work tasks, (c) to determine their respective postural MSD risks , and (d) to investigate the association of the risk factors with one-year prevalence of MSD. **Methodology:** A cross-sectional study was done in three selected palm oil mills. A set of questionnaire which included Standardized Nordic Questionnaire and Borg's CR-10 Scale was used. Rapid Entire Body Assessment (REBA) (to determine postural MSD risks) was also used. Association tests between the risk factors and one-year MSD reporting was done. **Results:** The one-year prevalence of MSD among the palm oil workers was 50.8%. The highest MSD symptom was reported at the waist/thigh (21.7%). Work sections with the highest MSD symptoms reported was Loading Ramp (78.6%) and Grading Area (72.7%). The Shooters in the Grading Area reported the most MSD symptoms on their body parts (36.4% to 45.5%) included neck, shoulder, hand/wrist, ankle/legs, upper back, lower back, and waist/thigh. Majority of the workers had low average perception of exertion (≤4) in respect to their work tasks (75.6%). However, the shooters from the Grading Area and Press Area reported highest average perception of exertion (>4). Majority of the workers reported a very high postural MSD risk level (55.6%). Workshop, Grading Area, and Boiler Area were reported with the most critical levels of postural MSD risks (REBA score: 11 to 14). There are significant association between one-year MSD reported of history on previous injury (OR 2.35, CI 1.12 to 4.93), Osteoarthritis (OR 3.90, CI 1.57 to 9.70), and level of perceived exertion (OR 8.09, CI 1.36 to 48.17) **Conclusion:** More than half of the palm oil mill workers reported MSD symptoms for the past 12 months. REBA indicated that workers are subjected to very high postural MSD risk level. The most affected workers by MSD are shooters from the Grading Area. History of previous injury, Osteoarthritis, and level of perceived exertion was found to be important risk factors for MSD among the workers.

Keywords: musculoskeletal disorder, palm oil mill, REBA, Borg's scale, standardized Nordic questionnaire

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ABSTRAK

MASALAH MUSKULOSKELETAL: PENILAIAN DALAM KALANGAN PEKERJA KILANG-KILANG SAWIT TERPILIH DI MALAYSIA

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Latar Belakang: Pemprosesan minyak sawit mentah di kilang-kilang minyak sawit melibatkan postur janggal, pergerakan yang berulang-ulang, dan keperluan mengangkat beban yang berat, yang berkemungkinan besar mampu menyumbang kepada masalah muskuloskeletal (MSD). Walau bagaimanapun, tidak terdapat banyak kajian yang dilakukan berkaitan masalah ini dalam kalangan pekerja kilang minyak sawit. Objektif kajian ini adalah (a) untuk mengenalpasti prevalens MSD dalam kalangan pekerja kilang minyak sawit, (b) untuk mengenal pasti persepsi kerahan tenaga dalam kalangan mereka, (c) untuk mengenal pasti risiko postur MSD mereka, dan (d) untuk mengkaji kaitan di antara faktor risiko MSD dan prevalens masalah MSD dalam setahun. **Metodologi:** Satu kajian keratan rentas telah dilakukan di tiga kilang minyak sawit terpilih. Satu set soal selidik telah digunakan, termasuk borang soal selidik standard Nordic dan Skala CR-10 Borg. Penilaian Rapid untuk Keseluruhan Badan (REBA) juga telah dijalankan, termasuklah ujian untuk mengenal pasti kaitan di antara faktor-faktor risiko MSD laporan setahun MSD **Keputusan:** Prevalens MSD setahun dalam kalangan pekerja minyak sawit ialah 50.8 %. Gejala MSD tertinggi dilaporkan pada bahagian pinggang / paha (21.7 %). Bahagian kerja dengan gejala MSD tertinggi dilaporkan adalah *Loading Ramp* (78.6 %) dan *Grading Area* (72.7 %). *Shooters* di *Grading Area* melaporkan gejala MSD tertinggi berdasarkan bahagian badan (36.4 % kepada 45.5 %) termasuk leher, bahu, tangan / pergelangan tangan, buku lali / kaki, belakang atas, belakang, dan pinggang / paha. Majoriti pekerja mempunyai persepsi kerahan tenaga yang rendah (Skala CR-10 Borg $\leq$ 4) apabila melakukan tugasan (75.6 %). Walau bagaimanapun, *Shooters* dari *Grading area* dan pekerja dari *Press Area* melaporkan purata persepsi kerahan tenaga paling tinggi (Skala CR-10 Borg > 4). Majoriti pekerja terlibat dengan tahap risiko postur MSD yang amat tinggi (55.6 %). *Workshop*, *Grading Area*, dan *Boiler Area* terlibat dengan tahap paling kritikal risiko postur MSD (skor REBA: 11 hingga 14). Terdapat hubungan yang signifikan di antara laporan MSD setahun dengan sejarah kecederaan (OR 2.35, CI 1.12-4.93), Osteoartritis (OR 3.90, CI 1.57-9.70), dan tahap persepsi kerahan tenaga (OR 8.09, CI 1.36-48.17). **Kesimpulan:** Lebih dari separuh pekerja kilang minyak sawit yang dikaji melaporkan simptom MSD untuk 12 bulan yang lalu. REBA menunjukkan bahawa majoriti pekerja terlibat dengan tahap risiko postur MSD yang sangat tinggi. Pekerja yang paling terjejas oleh MSD adalah *Shooters* dari *Grading Area*. Sejarah kecederaan, Osteoartritis, dan persepsi kerahan tenaga dilihat sebagai faktor risiko penting bagi MSD di kalangan pekerja yang dikaji.

Kata kunci: masalah musculoskeletal, kilang minyak sawit, REBA, Skala Borg, borang soal selidik standard Nordic

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LIST OF ABBREVIATIONS

BMI	Body Mass Index
CCOSH	Canadian Centre of Occupational Safety and Health
CDC	Centre of Disease Controls
CPO	Crude Palm Oil
CR-10	Category Ratio 10
DOS	Department of Statistics
EFB	Empty Fruit Bunch
FFB	Fresh Fruit Bunches
GDP	Gross Domestic Product
MPOC	Malaysia Palm Oil Council
MSD	Musculoskeletal Disorders
POME	Palm Oil Mill Effluent
REBA	Rapid Entire Body Assessment
RPE	Ratings of Perceived Exertion
RULA	Rapid Upper Limb Assessment
SNQ	Standardized Nordic Questionnaire
SOCSO	Social Security Organisation
UKIOSH	United Kingdom Institution of Occupational Safety and Health

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CHAPTER 1

INTRODUCTION

1.1 Research Background

1.1.1 World's Oil and Fats

Oil and fats are essential nutrient for human being. Fats and oils consist of chains of molecules known as the fatty acids. It is a high energy food, which is twice the amount of energy found in starch and sugars. High quality oil and fats are needed for fully functional of human's brain and nervous system, for production of energy, and also vital for hormones production (Wilson, 2013).

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There are several type and source of oil and fats in the world such as rapeseed oil, sunflower oil, butter, palm oil, and many more. In 2012, Oil World (as cited by Sime Darby, 2013) stated that among all different types of oil and fats, palm oil was the highest consumed in 2011, consumed by up to three billion people in 150 countries. The Figure 1.1 below shows the pattern of consumption of oil and fats for the year 2011.

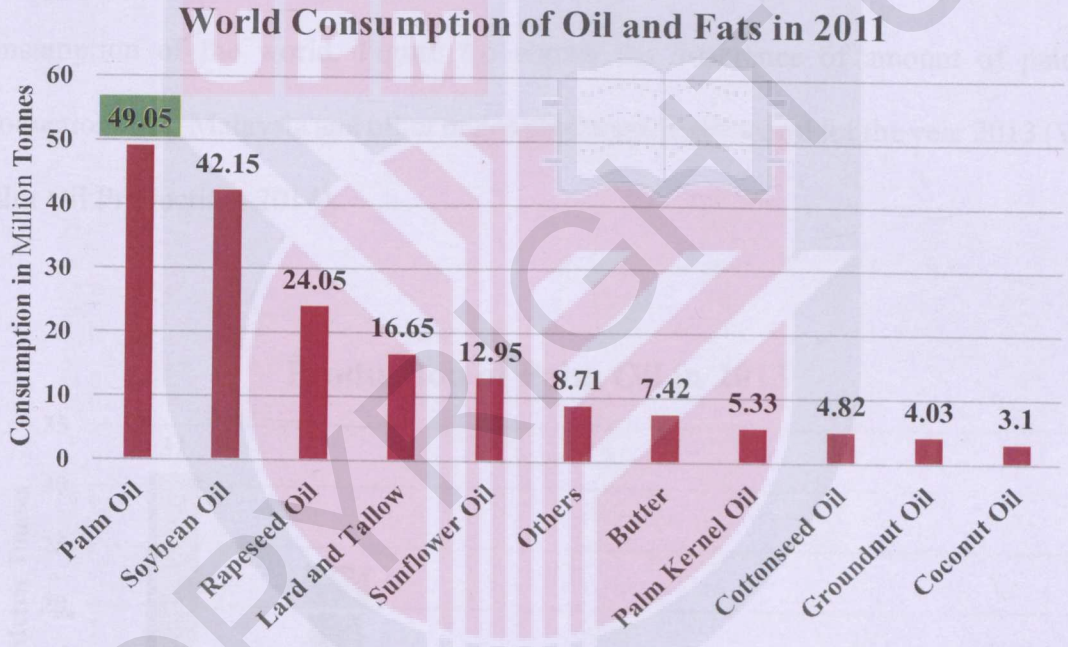

Figure 1.1: World consumption of oil and fats in the year 2011

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1.1.2 Malaysian Oil Palm Industry

Palm oil industry is the top contributor of Gross Domestic Product (GDP) for Agriculture Sector in Malaysia (Department of Statistics, 2010). Malaysia and Indonesia are the world biggest oil palm producers where Malaysia currently accounts for 39% of world palm oil production and 44% of world exports (Malaysian Palm Oil Council, 2012). Until the year 2013, Malaysia had produced 19 400 000 metric tonnes of palm oil for the consumption of the world. Figure 1.2 shows the difference of amount of palm oil production from Malaysia and other major producers in the world for the year 2013 (World Palm Oil Production, 2014).

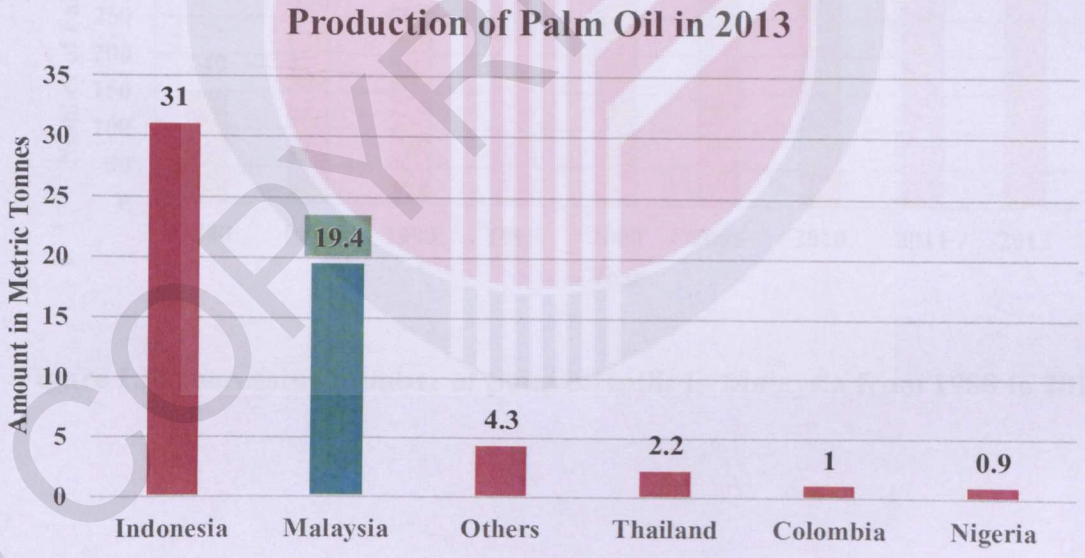

Figure 1.2: World production of palm oil by its producers in the year 2013

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In 2011, there are 426 palm oil mills in Malaysia, with the capacity to process 99.85 million tons Fresh Fruit Bunches (FFB) per year. According to Malaysian Palm Oil Board in 2012 (as cited by Asis, 2013), there is steady increase in palm oil mills number in Malaysia. Furthermore, the number is kept on increasing until present. The increasing number of palm oil mills means increasing production of palm oil. This proves the rapid development of Malaysian palm oil industry. Figure 1.3 shows the trend of increasing number of palm oil mills in Malaysia.

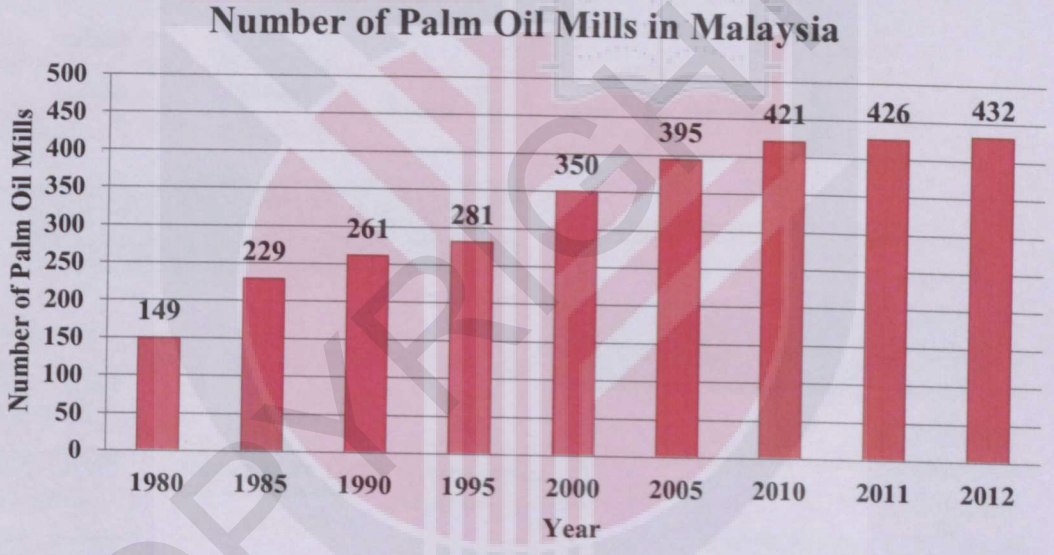

Figure 1.3: Increasing number of palm oil mills in Malaysia from 1980 to 2012.

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1.1.3 Palm Oil Milling to Produce Crude Palm Oil (CPO)

Production of CPO in palm oil mills involves series of steps. Generally, it involves preparation, oil extraction, purification, and kernel extraction (Ariffin, n.d.). Figure 1.4 summarized the steps involved in the production of CPO.

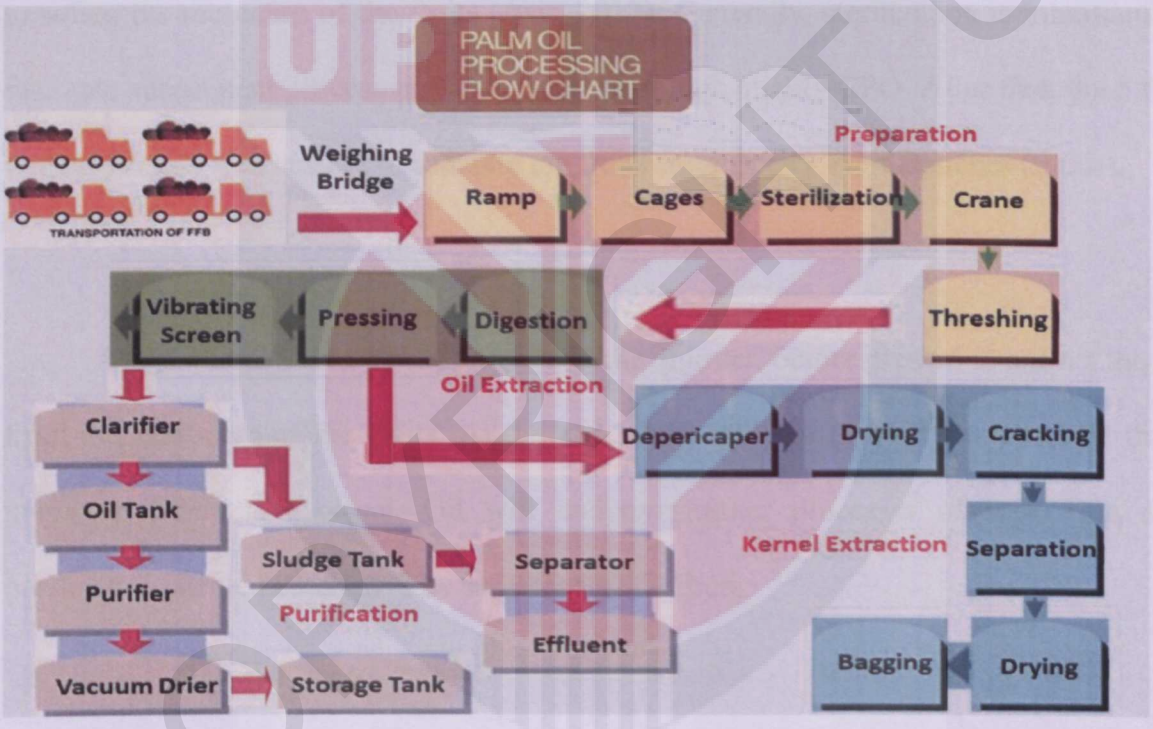

Figure 1.4: Flow chart of the processes involved in palm oil mill to produce CPO from Fresh Fruit Bunches (FFBs) (adapted from Malaysian Palm Oil Council, 2013 and Ariffin, n.d.)

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Preparation process involved transportation in of FFBs from the plantation, weighing, and grading. In grading process, the FFBs will be graded and unwanted FFBs (unriped, spoilt, empty, etc.) will not be allowed to enter further process of CPO production. Present of unwanted FFBs will negatively affect the Oil Extraction Rate (OER). After grading process, the FFBs will enter the loading ramp, before sterilized in the sterilizer. The function of sterilization process is to loosen the fruits from the bunches, to terminate enzymatic Free Fatty Acids (FFA) rise, to dehydrate the fruits and nuts, and to soften the mesocarp of the fruits (Asis, 2013). Generally, sterilization is important to facilitate subsequent process in the production of high quality CPO. After that, the FFBs will be put into the thrasher to separate the fruits from Empty Fruit Bunches (EFBs).

The fruits will then be conditioned in the digester, before pressed to extract the oil from the mesocarp of the fruits. At the end of this process oil will be separated from mesocarp fibers and kernel. Oil will undergo further processes of separation and purification, while kernels will be separated from fibers.

The oil will then undergo several process of clarification, separation, and purification to produce CPO which will then be stored in the storage tanks. The by-product of these processes are sludge, which will again undergo the same process as mentioned

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before to extract the residual oil, and at the same time to decrease oil loss. The final sludge produced will be treated as one of the Palm Oil Mill Effluent (POME).

In kernel extraction process, the mixed fibers and kernels will be separated. The kernel will be dried and bagged or stored in the kernel silo. Further processing of kernel to produce kernel oil will be done in kernel processing mills.

1.1.4 Musculoskeletal Disorders (MSD) in the Industries

MSD are conditions that affect the tendons, nerves, muscles, and supporting structures, such as discs on the back of the body due to working activity. This problem occurs when one or more of these tissues having to work harder than they're designed to. The symptoms and signs might be back pain, joint stiffness, muscle tightness, numbness, and skin color changes on the affected area. Various risk factors are known to be associated with MSD, including repetitive movement, heavy lifting, bending and twisting, uncomfortable working condition, exerting too much force, working too long without break, and also psychosocial factors (UKIOSH, 2013). Other risk factors may be the workplace design, long working hour, age, BMI, and smoking (Choobineh et al., 2009).

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MSD continues to present challenge in virtually every sectors of industry (Silverstein and Clark, 2004). Many published studies had discussed the high prevalence of MSD in different type or settings of industries, such in sugar factory (Choobineh et al., 2009), transportation (Shamsul et al., 2012), rubber factory (Choobineh et al., 2007), electronics, pharmaceuticals, metal production, printing (Yu et al., 2012), and also in oil palm harvesters (Ng et al., 2014). In the United States, the incidents of MSD among manufacturing workers are 41 for every 10 000 workers, by which the impacts can be seen in term of productivity, workers compensation claims, and healthcare costs (USNIOSH, 2010).

1.2 Problem Statement

In 2012, the palm oil industry is the fourth largest contributor to Malaysian Gross National Income (GNI). This information, together with the fact that this industry is steadily developing as an important economical contributor for Malaysia, increase the importance to not excluding this industry from the risk of being affected by occurrence MSD among their workers. This can be supported with the fact that MSD is one of the most important cause of occupational injury and disability in industrially developed and developing countries including Malaysia (Shahnavaz H., 1987; Genaidy A. M. et al., 1993; SNIOSH, 1994; Maul A. et al., 2003). MSD is always known as the most common non-

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fatal injuries and illnesses for agriculture workers, especially who are involved in labor-intensive practices (McCurdy et al., 2003; Meyers et al., 1997). It is also costly and the most prevalent of all work related injury (Bernard et al., 1997). In the industry, MSD can possess problems in many forms toward the workers and employers such as disability, lost work time, and increase the production cost. MSD increase production costs from worker absence, insurance and medical costs, decreased work capacity, and loss of employees from other less physically demanding industries (Kirkhorn et al., 2010).

In Malaysian setting, the Social Security Organization (SOCSO, 2012) published that MSD cases reported due to occupational causes are continuously increasing every year (this information can be obtained in Figure 1.5 below). Even though this available information does not described specifically on palm oil mill workers, this general description can provide an overall overview on the current situation in the industries, including the palm oil industry.

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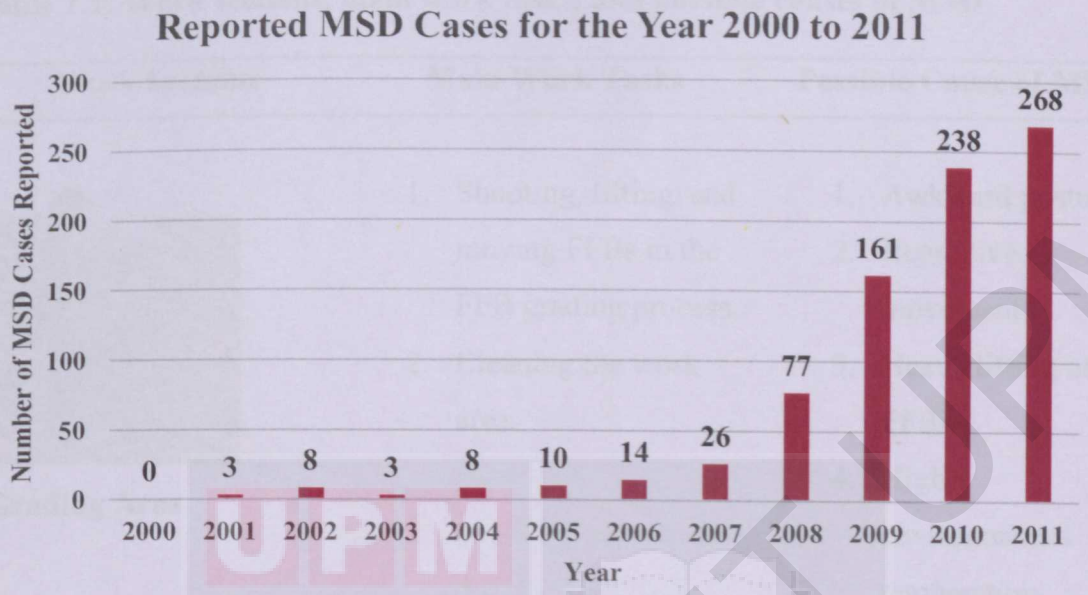

Figure 1.5: Number of MSD cases reported to SOCSO from the year 2000 to 2011

Specifically in palm oil mills, the workers are actually exposed to MSD risk factors such as awkward posture, repetitive movement, and heavy lifting. These problems must be assessed before any prevention and control steps can be taken. Table 1.1 below shows the main work tasks for every work sections involved and the possible causes of MSD.

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Table 1.1: Work sections, main work tasks, and possible causes of MSD

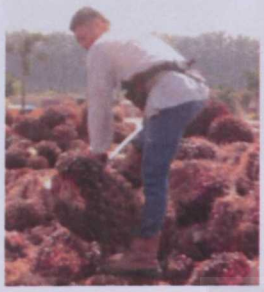
Work Sections	Main Work Tasks	Possible Cause of MSD
 **Grading Area**	1. Shooting, lifting, and moving FFBs in the FFB grading process. 2. Cleaning the work area.	1. Awkward posture. 2. Repetitive movement. 3. Heavy lifting of FFBs. 4. High environmental temperature.
Loading Ramp	1. Pulling FFB which stuck on the ramp. 2. Controlling ramp gates opening for FFB releasing into the conveyor. 3. Cleaning the station area.	1. Awkward posture. 2. Repetitive movement. 3. Heavy pulling.

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Table 1.1: (Continue)

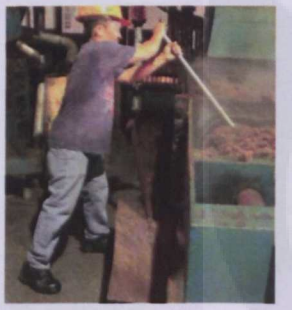
Work Sections	Main Work Tasks	Possible Cause of MSD
Sterilizer	1. Cleaning inside and outside of the sterilizer. 2. Controlling switches for sterilizer operations. 3. Installing packing on the sterilizer door.	1. Static posture while cleaning. 2. Awkward posture. 3. High surrounding temperature.
 **Press Area**	1. Poking and pulling fibers when jammed in the press machine / when the shift ended. 2. Controlling press machine operation switches. 3. Cleaning the station area.	1. Awkward posture. 2. Repetitive movement. 3. Heavy pulling of stuck fibers. 4. High surrounding temperature.
Oil Room	1. Cleaning the separator and purifier machines. 2. Cleaning the station area.	1. Repetitive movement. 2. Heavy lifting. 3. Awkward posture.

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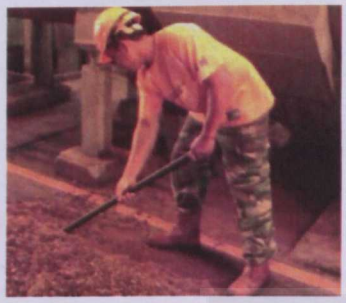
Table 1.1: (Continue)

Work Sections	Main Work Tasks	Possible Cause of MSD
 **Kernel Plant**	1. Scoping spilled kernel / fibers / fruit bunches on the floor. 2. Taking out fruit bunches from the polishing drums. 3. Cleaning the station area.	1. Awkward body posture. 2. Repetitive movement.
Workshop	1. Overhauling press machines. 2. Grinding, cutting, welding, and drilling works. 3. Servicing vehicles.	1. Awkward body posture. 2. Heavy lifting. 3. Work involved in stations with high surrounding temperature.
Boiler Area	1. Removing stones from the boiler furnace. 2. Mixing fibers in the boiler furnace. 3. Poking stuck fibers. 4. Cleaning station area.	1. Heavy pushing, pulling, and mixing. 2. Repetitive movements.

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1.3 Study Justification

MSD are known to be chronic and require long treatment period and may interfere worker's performance and overall production. By addressing the problem of MSD, compensation and medical cost can be reduced, while business profits and productivity can be increased.

Currently, there is less attention given to MSD related studies among palm oil mill workers in Malaysia. The only studies available regarding this subject are focusing more on the oil palm plantations rather than on palm oil mills. Thus, by conducting this study, it can help in providing the most basic baseline data on the prevalence of MSD and its association with their risk factors for future reference. The data may be useful for other studies and also for managers, government agencies, and policy makers, as they can design an appropriate intervention program to overcome the problem of MSD among palm oil mill workers.

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1.4 Objectives

1.4.1 General Objective

To study the prevalence of Musculoskeletal Disorder (MSD) and association of MSD with its risk factors among workers in selected palm oil mills.

1.4.2 Specific Objectives

1.4.2.1 To determine the personal / sociodemographic data of the palm oil mill workers.

1.4.2.2 To determine the one-year prevalence of MSD among the palm oil mill workers, which includes overall one-year prevalence, one-year prevalence by body parts, and one-year prevalence by work sections.

1.4.2.3 To determine the perception of exertion while performing work tasks among the palm oil mill workers.

1.4.2.4 To evaluate the whole body postural MSD risks associated with work tasks for the palm oil mill workers.

1.4.2.5 To determine the association between MSD risk factors and MSD.

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1.5 Hypothesis

1.5.1 There is a significant association between MSD risk factors and MSD.

1.6 Definition of Terms

1.6.1 Conceptual Definitions

1.6.1.1 Musculoskeletal Disorders (MSD)

MSD is a condition which effects muscles, tendons, nerves, and supporting structures of the body (Ling et al., 2005). MSD occurs when one of the muscles worked more than it was designed to (UKIOSH, 2013). This condition usually cause by highly repetitive works, forceful exertions, whole body vibrations, awkward posture or movement, badly fitted chairs and equipment, and fast-paced workload (UKIOSH, 2013; Medical Dictionary for Dental Professions, 2012). The symptoms of MSD includes but not limited to pain, joint stiffness, muscle tightness, and numbness at one or more body parts such as neck, shoulder, upper and lower back, elbow, wrist, hand, waist, thigh, knee, ankle, and leg (UKIOSH, 2013).

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1.6.1.2 Perception of Exertion

Perception of exertion (or perceived exertion, perceived forceful exertion) is how hard an individual feel when that individual is doing a task or job. It reflects individual experience of physical sensation while doing physical activities which includes increased heart rate, sweating, and muscle fatigue (CDC, 2011). It also integrates a huge amount of information, such as cues from the muscles, joints, cardiovascular and respiratory function, and central nervous system (Borg, 1990).

1.6.1.3 Postural MSD Risk

Postural MSD risk refers to the possibility of developing any of the MSD symptoms due to the characteristics or the way in which someone hold their body when standing, sitting, or while performing tasks or works (Oxford Dictionaries, 2014). In other word, postural MSD risk refers to the likelihood of getting MSD from different body positioning.

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1.6.1.4 MSD Risk Factors

MSD risk factors refers to the conditions by which when it is present, it will cause the MSD symptoms to develop in an individual. The risk factors can be divided to occupational factors or non-occupational factors (including individual factors and psychosocial factors) (Middlesworth, 2013; CCOSH, 2014). There are many risk factors of MSD present, but only several MSD risk factors were included and tested in this study. For this study, the occupational MSD risk factors are working tenure, overtime work, perception of exertion, working posture, and repetitive movement. Non-occupational MSD risk factors are age, BMI, smoking, educational level, physical activity, and Osteoarthritis. Another MSD risk factor, which is history of previous injury is combination of both occupational and non-occupational history of injury.

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1.6.2 Operational Definitions

1.6.2.1 Musculoskeletal Disorders (MSD)

Prevalence of MSD in this study will be determined by using the Standardized Nordic Questionnaire (SNQ) adapted from Kuorinka et al. (1987). The questionnaire set enable the researcher to obtain information about MSD symptoms experienced by the respondents in their lifetime, in the past 12 months, in the past 4 weeks, in the past 7 days, and in the present day. The specific body parts affected by MSD includes neck, shoulders, elbows, upper and lower back, wrists and hands, hips and thighs, knees, and ankles and feet. This questions can be answered either by self-administration or by interview. The questionnaire focus on MSD symptoms which are most common in the occupational setting, with an acceptable reliability (Kuorinka, 1987).

1.6.2.2 Perception of Exertion

Perception of exertion was measured by using Borg's CR-10 (Category Ratio) Scale adapted from Borg (1990). This scale was the latest version from the Borg's RPE (Ratings of Perceived Exertion) Scale. Different from the older version with 20 rating

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scale, the latest one only uses 10 rating scales, by which '0' means no exertion at all and '10' means very, very hard exertion. The Borg's CR-10 Scale measures the person's perception of exertion, which corresponds to how hard that person is doing their tasks.

1.6.2.3 Postural MSD Risk

In this study, postural MSD risk was measured by using Rapid Entire Body Assessment (REBA) method developed by Hignett and McAtamney (2000). REBA is a systematic process to evaluate whole body postural MSD and risks associated with work tasks, as one of the ergonomic assessment method. Video recording was taken while the workers are doing their work tasks (worst posture tasks). The video recordings were used as a reference to calculate the postural MSD risks using the REBA checklist. The outcomes are either negligible, low, medium, high, or very high postural MSD risks.

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1.6.2.4 MSD Risk Factors

Occupational and non-occupational MSD risk factors information was obtained by using the self-constructed questionnaire. Perception of exertion information was obtained by using Borg's CR-10 Scale, while working posture information was obtained by using REBA.

1.7 Conceptual Framework

The oil palm industry in Malaysia consist of Downstream and Upstream Activities. Upstream activities involved seed nursery, collecting, planting the palm, FFB harvesting, and palm oil milling. Downstream activities consist of palm oil based food processing, biodiesel, biofuel, and oleochemicals. The interest of this study are towards the milling process in palm oil mills which involved the famous five occupational hazards, which are physical, chemical, biological, psychosocial, and ergonomic hazards. This study are interested in the area of ergonomic hazards, specifically on one of the most important outcome of uncontrolled ergonomic hazards, which is MSD. MSD symptoms can occur to the workers if the risk factors are present and does not being assessed and controlled. These factors can be divided into occupational risk factors (such as previous injury-which may also combined with non-occupational injuries, working posture, working tenure,

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overtime work, and perception of exertion) and non-occupational risk factors (such as age, smoker, BMI, education levels, involvement in physical activities, and osteoarthritis). Figure 1.6 in the next page visualized the conceptual framework for this study.

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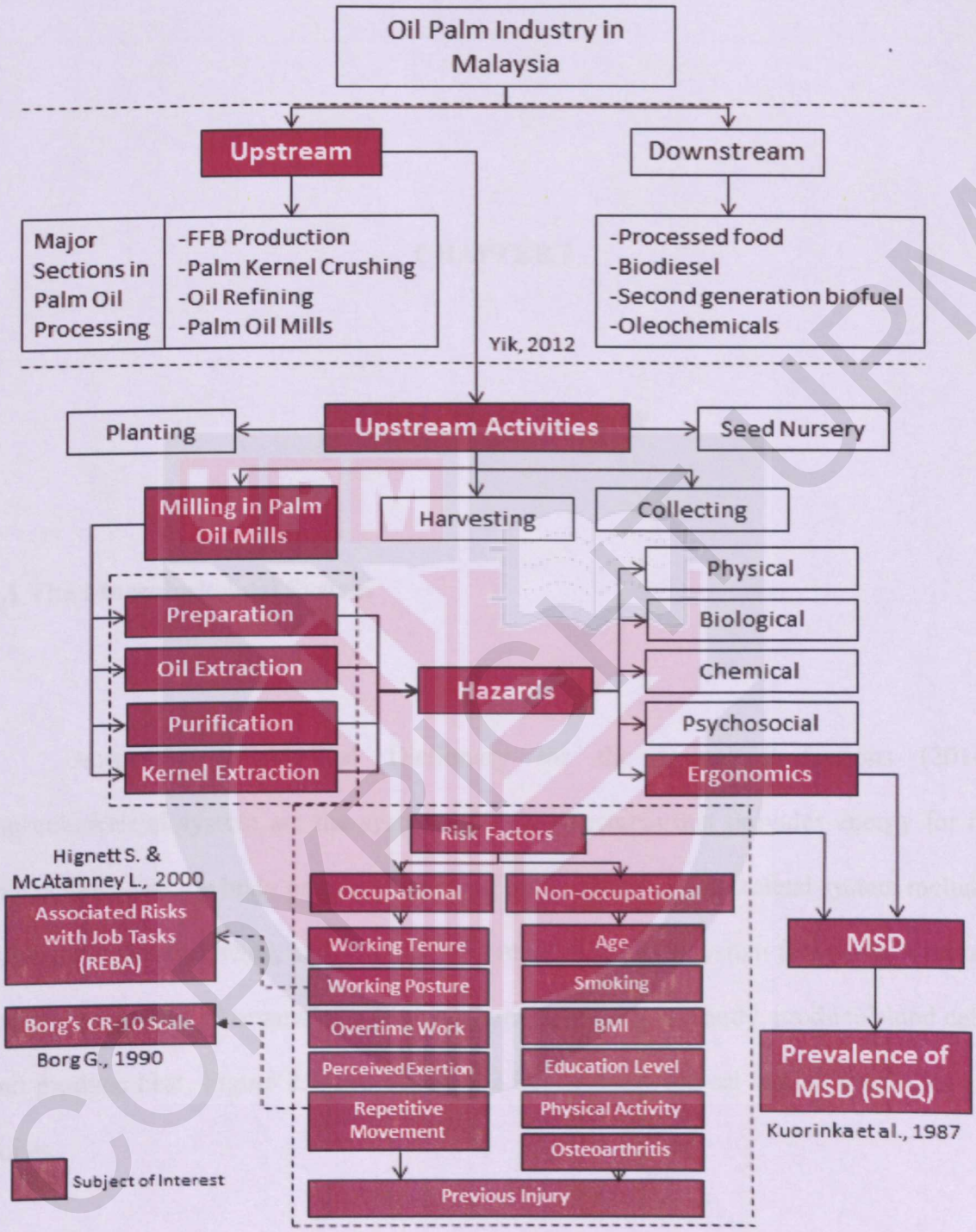

Figure 1.6: The Conceptual Framework

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CHAPTER 2

LITERATURE REVIEW

2.1 The Musculoskeletal System

According to Medical Dictionary for the Dental Professions (2014), musculoskeletal system are the system of body structures that provides energy for the movement of all the body parts in the human body. The musculoskeletal system includes bones, muscle, ligaments, and tendons. The musculoskeletal system functions to protect internal structure and organs, to enable movement, shaping the body, produce blood cells, and produce heat. Figure 2.1 and Figure 2.2 below show typical human's muscles and bones.

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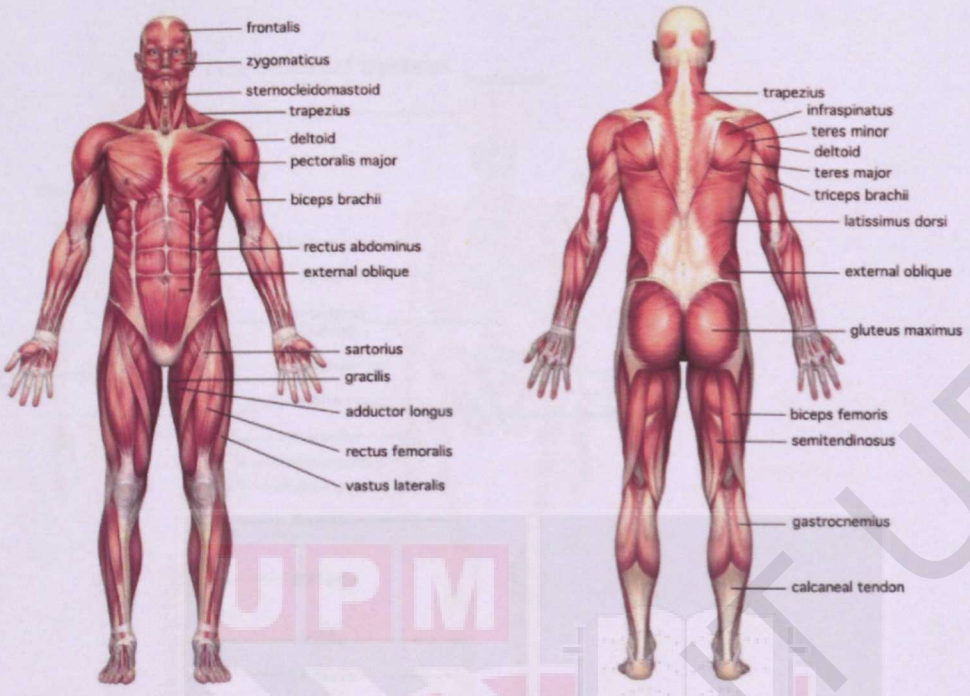

Figure 2.1: Human's muscle

There are 206 bones in the adult human body. Each bone contains two forms of tissue which is compact bone and spongy bone. Compact bone found on the external part, while spongy bone found in the internal part. Spongy bone is much lighter, which helps in reducing the overall weight of the skeleton and make it easier for the muscles to move the bones (Claveland Clinic, 2013).

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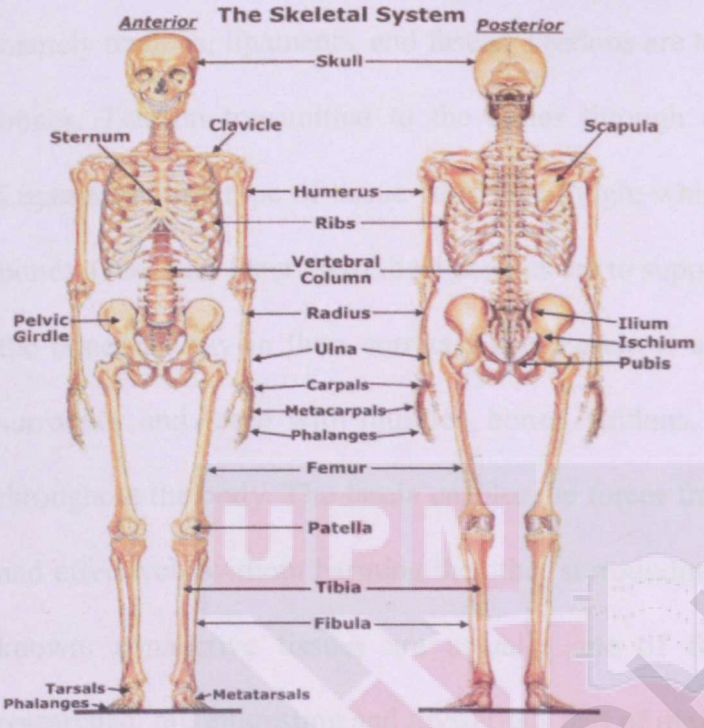

Figure 2.2: Human's bone

There are 3 types of muscle in the human body, namely cardiac muscle (muscle of the heart), smooth muscle (such as muscle of the gut and blood vessels), and skeletal muscle (muscle attached to bones and tendons). Skeletal muscle is the only concern when we talk about musculoskeletal disorders. Movement occurs when the muscles contract or shorten, pulling together the bones. Muscles work in pair, or known as the 'antagonistic movement'. When one muscle shortens, the corresponding muscle will lengthens (Department of Education and Training, 2008).

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Bones and muscles are connected between one and another by connective tissues, namely tendons, ligaments, and fascia. Tendons are tough cords which attach muscles to bones. Tension transmitted to the bones through the tendons, and produce motion. Ligaments are a type of tissue which are tough, which connects bones directly to other bones. One main function of the ligaments are to support and stabilize the joints, to ensure the bones to stay in their correct place. Fascia is a thin, gelatinous membrane which surrounds and fused with muscles, bones, tendons, tissues, blood vessels, and organs throughout the body. The fascia enables the forces from muscles to be transmitted safely and effectively without harming the other surrounding tissues. Even this information are known, connective tissues are actually one of the most poorly understood, least researched, but interesting and mysterious part of the human body (Lipman, 2014).

2.2 Musculoskeletal Disorders (MSD)

2.2.1 The Overview

Musculoskeletal Disorders (MSDs) is defined as an injury of the muscles, nerves, cartilage, ligaments and joints which functioning as supporting structures of the upper and lower limbs, neck, and lower back. This usually happened when the body are exposed to the physical activities that involved repetition, force, vibration or awkward posture (CDC,

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2012). Before 18th century, MSDs were not recognized as having occupational etiologic factors until it was appearing regularly in the International Scientific Literature in 1970's (Rosenstock et al., 1997) which is known as work-related MSDs (WMSDs). The example for the WMSDs are carpal tunnel syndrome (Figure 2.3), tendonitis (Figure 2.4), thoracic outlet syndrome (Figure 2.5), and tension neck syndrome (Figure 2.6) (CCOHS,2014).

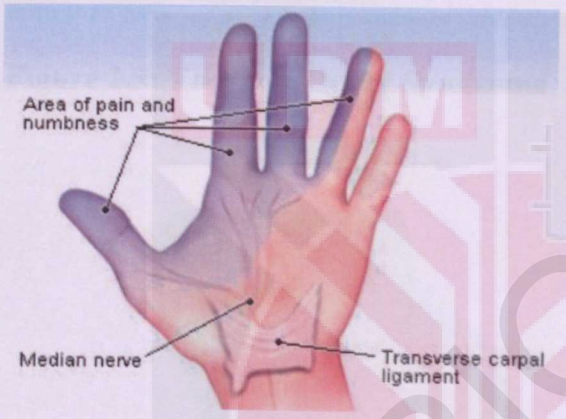

Figure 2.3: Carpal Tunnel Syndrome

Figure 2.4: Tendonitis

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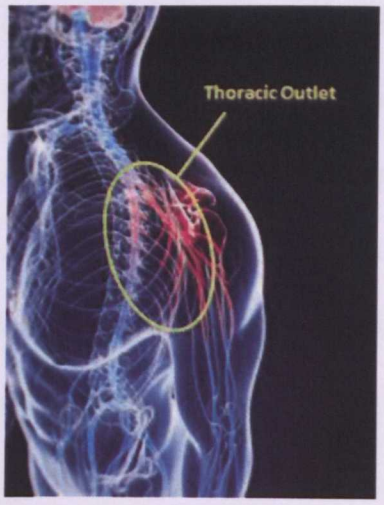

Figure 2.5: Thoracic Outlet Syndrome

Figure 2.6: Tension Neck Syndrome

In situations where repeated exposure to risk factors results in increasing level of tissue damage and symptom severity, the allocation of a presenting disorder to acute injury

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or chronic condition can arbitrary, especially in the earlier stages. However, most of the WMSDs are often cannot be diagnosed with respect to a clinical pathology, but they may still result in physical impairment and disability (EASHW, 2000). Symptoms of WMSDs may include local or generalised pain, discomfort; loss or hypersensitivity of sensation to touch, heat and pressure, loss of muscle strength, and loss of ability to perform controlled movements or balance reactions (Punnet & Wegman 2004; Riihimaki 1995).

Many of previous studies reported that the prevalence of MSD in various type of industries to be half or more than the study population. A study done in a rubber factory found that the prevalence of MSD for the past 12 months are 73.6%, with the highest prevalence reported in the lower back (50.2%), knees (48.5%), and upper back (38.1%) (Choobineh et al., 2007). Another study done among frontline workers in 60 factories reported the prevalence of MSD for the past 12 months is at about half the population studied (Yu et al., 2012). A study done among workers in a sugar producing factory found that the prevalence of MSD for the past 12 months is at 87.1%, with the highest prevalence reported in knees (58.6%) and lower back (54.3%) (Choobineh et al., 2009). A study among workers in one of Malaysian automotive manufacturing company revealed that the highest MSD prevalence occurred are at the lower back, feet/ankle, and upper back of the body (Deros et al., 2010). Another study done among Malaysian male commercial bus drivers concluded that the overall prevalence of MSD is at 81.8%, with lower back as the highest complaints of lifetime MSD (58.5%) (Tamrin et al., 2012).

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2.2.2 The Risk Factors

2.2.2.1 Occupational Risk Factors

The association of between occupational risk factors have been examined and reviewed with MSDs (National Research Council-Institute of Medicine, 2001) which the forceful exertion, repetitive movement and awkward posture of the hands and wrist were major contributor factors for Upper Extremity MSDs (UEMSDs) (Bernard, 1997). Previous studied had proved that, physically demanding work, such as an intensified work load, monotonous and repetitive work tasks, including psychosocial factors, such as time pressure, overtime, low control, and low job satisfaction have been found as possibly predisposing for upper extremity disorders among workers (Bongers et al, 1993 & Bogners et al., 2002). Besides, Bernard (1997) also stated that the risk factors for low back musculoskeletal disorders (LBDs) were identified in work-related lifting objects, forceful exertion and awkward posture. The impact of MSD on employees' health may affect from the length and the intensity of work that the workers exposed (Ksenia et al., 2012).

Meanwhile, previous study had found that workers who involved in Whole Body Vibrations (WBVs) activities were directly exposed to ergonomic stressor such as awkward posture and lifting object. This statement was supported by Mats et al., (2006)

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where there was a strong relationship between WBVs and MSDs in neck, shoulder and hand. Exposure to contact stress also one of the work-related MSDs which contribute from poorly designed or sharp-edged tools and materials (ACCSH, 1999). This is because when tools and materials are pressed against soft tissue in the body, the stress will be experienced from compressed soft blood vessels and nerves which will lead to the numbness and tingling (Christopher, 2002).

2.2.2.2 Non-Occupational Risk Factors

The non-occupational activities also can contribute to the MSDs (Putz-Anderson, 1997). It has been found that physical activity such as playing football; hobbies such as fishing; diseases such as diabetes; accidents and ages are contributing factors to the MSDs (Putz-Anderson, 1990; OSHA, 2014; Armstrong & Chaffin, 1979; Barnes & Currey, 1967; Sabour & Fadel, 1970). This all of the factors causes difficulty in determining the differences between occupational and non-occupational MSDs. Meanwhile, Layne and Pollack, (2008) reported overall increases in the number of hospitalisations due to injury in MSDs were among patients in low educational status compared with a high educational status.

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Based on the Vern (1990), he discovered that the co-workers who were performing similar tasks did not experience the same symptoms of MSDs since they have difference susceptibility, physical activity and work history. Previous study stated that giving counselling to the employees on the non-occupational factors and control the occupational stress, can reduce the frequency of MSDs (Putz- Anderson, 1997 & McGlothlin, 1984).

Aging is the most related risk factors with the MSDs since it involved changed in musculoskeletal due to age by a reduction in joint mobility, decrease in muscular strength and the slowing of reaction and movement times (HSE, 2010). Leaviss et al. (2008) revealed the data that indicates the physical work capacity of a 65-year old is around half compared to the average 25-year old worker. Welch *et al.* (2008) found that increasing age was associated with reduced physical functioning independent of the presence of medical conditions or MSDs. Changes in physical abilities that are encountered with ageing, are however, influenced by individual genetics and lifestyle, as well as the environment in which individuals work and live (Buchman *et al.,* 2007; Kenny *et al.*, 2008).

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2.2.3 Prevention and Controls

Reducing physical demands is often the first preventive step to be taken at the workplace. This can change by making adjustments in the workplace, use of mechanical devices or aids with the aim to reduce the stresses imposed on the musculoskeletal system (EASHW, 2000). It is important to mention that MSDs are also found in jobs where the amount of force is reduced. Therefore, further attention has to be given to duration and frequency of exposure. Messing (1999) suggested that the best approach to eliminate the MSDs at the workplace are by implementing the good control such as changes in workstation, job design, equipment and product design in the context of good ergonomics practice from all levels of participants enterprise.

Besides, work-related MSDs also can be prevented by providing education and training to reduce the physical risks (CDC, 2013). There are three types of training that can be applied to prevent the MSDs which are training involved the specific techniques to reduce the risk of MSDs; teaching biomechanics, thus increasing the understanding and the awareness of the occurrence of MSDs; and training the body via physical fitness so that it is less susceptible to injury.

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However, the most important things are employers who should play the important roles and give good commitment by supporting the workplace adjustments where it can give comfortable to the employee by following public health guidance on workplace health (NICE, 2009). Manager in production area should also have open conversations with affected employees about the impact of their MSD, and offer necessary workplace adjustments since they are important people that connect the employees with top management (Ksenia et al., 2012.). They should remember that the intrinsic quality of jobs must be preserved, even where change of duties or working patterns is introduced, in order to avoid the consequences of underemployment.

Employees also need to play their role with MSDs where they need to take a proactive approach to self-management of their condition and recognise that informed communications between their health care professionals and their employer is in everyone's interest. They should seek advice from patient support groups (Ksenia et al., 2012).

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2.2.4 Implication of MSDs

Globally, MSDs are one of the leading causes of morbidity and disability, giving rise to enormous healthcare expenditures and loss of work (WHO 2003), and reducing the quality of life of affected employees and their families. This statement was supported by Takala (2010), where MSD may lead to the high costs to enterprise and the society. Thus, it showed that, the overall cost implications may be involving not only industries, but individual and society also will be included to this problems.

Besides, MSDs also are still the most common occupational disorder (EODS,2000) and one of the major cause for the MSDs effect are long-term sickness absences (EU OSHA,2007). One study from the USA indicated that significant impairment persisted seven months after injury in approximately half of persons hospitalized for a major hand injury. These impairments generally translated into poor hand functioning, and one-fifth of the patients reported significant disability. Those who had been working before injury, 37% had not returned to work seven months after the event (McCarthy et al., 1998). This can be related to the facts that it was a barriers at work that prevents or delays a return to work which they need a better encouragement within the workplace to support positive work outcomes for individuals with MSDs (HSE, 2010). Besides, the workers with MSDs also have problem in making decision to remain at work

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due to physically demanding work, high job strain, and low support from co-workers (Geuskens et al., 2008).

According to the CIPD (2008), the majority of absence among manual workers, back pain, musculoskeletal injuries, stress and home and family responsibilities may also result in short-term absence from work. Long-term absence on the other hand tends to accounts for 5% of all sickness absence cases, but is responsible for around 40% of all time lost (Leaker, 2008). The studies generally suggest that older workers typically take more long-term absences from work due to injury than their younger colleagues. Filipovic et al. (2011) stated that, there was 80% of workers having disabling pain and stiffness in the first year of being diagnosed in MSDs which reduce the abilities of the workers. This was supported by Gardner et al. (2008), who identified limited ability to work, decreased work productivity and functional limitation as the most commonly reported function impairments due to upper extremity symptoms for 1,108 workers employed in a new job.

Pransky et al. (2005a) identified that 11% of the employees were reported intent to retire early due to their work injury. Gleeson and Gallagher (2005) were also agreed with this problem where they found that, ill-health retirement was high (38%) in MSDs which overall incidence rate was 2.9 per 1000 employees per annum.

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2.3 The Instruments for Assessment of MSD

2.3.1 Standardized Nordic Questionnaire (SNQ)

SNQ is a method developed under a project funded by the Nordic Council of Ministers, with the purpose for screening of MSD in an ergonomics context and occupational healthcare services (Kuorinka et al., 1987). Screening of MSD is important to know the prevalence of MSD, and in diagnosing the work environment, work station, and tools design. The questionnaire consist of questions related to the MSD experience of the respondents for lifetime, past 12 months, past 4 weeks, past 7 days, and in the current day. The body parts involved are neck, shoulder, upper and lower back, elbows, hands/wrists, waist/thighs, knees, and ankle/legs. The questionnaire also asks about obstruction, medicine consumption, and off day due to the MSD symptoms experienced. In the original paper by Kuorinka et al. (1987), it was cleared that the reliability of this questionnaire has been found to be acceptable to be utilized. However there are still some limitations present, such as the issue of the accuracy of MSD experienced recalls by the respondents. The latest and the most severe experience of MSD might be remembered well by the respondents, compared to the earlier and less severe ones. Kuorinka et al. (1987) also stated that this kind of questionnaire is most suitable for cross-sectional type

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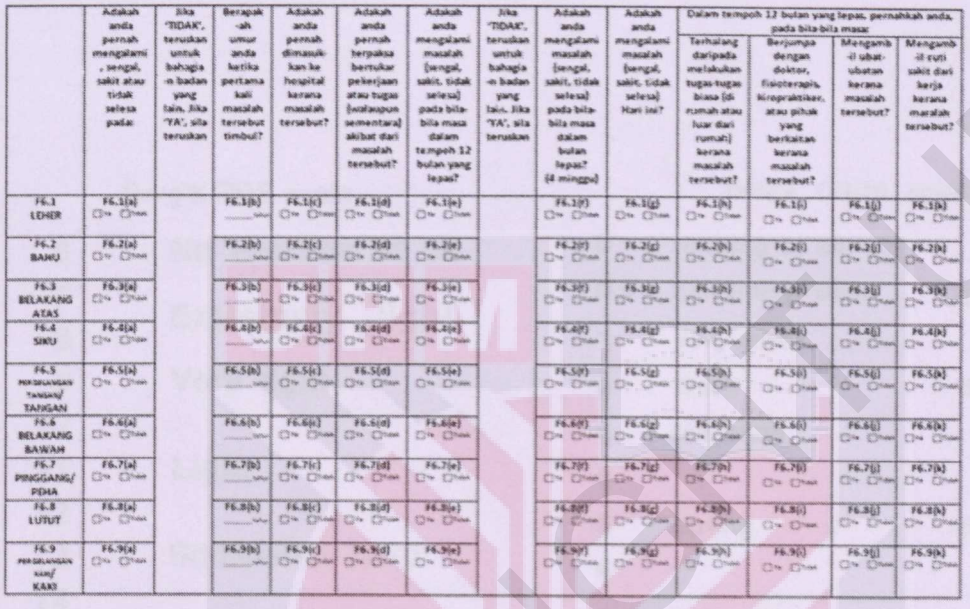
of study. Figure 2.7 below shows an example of the SNQ (Malay Language translated version).



	Adakah anda pernah mengalami , sengal, sakit atau tidak selesa pada:	Jika 'TIDAK', teruskan untuk bahagia n badan yang lain. Jika 'YA', sila teruskan	Berapak ah umur anda ketika pertama kali masalah tersebut timbul?	Adakah anda pernah dimasuk kan ke hospital kerana masalah tersebut?	Adakah anda pernah terpaksa bertukar pekerjaan atau tugas [walaupun sementara] akibat dari masalah tersebut?	Adakah anda mengalami masalah [sengal, sakit, tidak selesa] pada bila-bila masa dalam tempoh 12 bulan yang lepas?	Jika 'TIDAK', teruskan untuk bahagia n badan yang lain. Jika 'YA', sila teruskan	Adakah anda mengalami masalah [sengal, sakit, tidak selesa] pada bila-bila masa dalam bulan lepas? [4 minggu]	Adakah anda mengalami masalah [sengal, sakit, tidak selesa] Hari ini?	Dalam tempoh 12 bulan yang lepas, pernahkah anda, pada bila-bila masa:			
										Terhalang daripada melakukan tugas-tugas biasa (di rumah atau luar dari rumah) kerana masalah tersebut?	Berjumpa dengan doktor, fisioterapis, kiropraktikar, atau pihak yang berkaitan kerana masalah tersebut?	Mengambil ubat-ubatan kerana masalah tersebut?	Mengambil cuti sakit dari kerja kerana maralah tersebut?
F6.1 LEHER	F6.1[a]		F6.1[b]	F6.1[c]	F6.1[d]	F6.1[e]		F6.1[f]	F6.1[g]	F6.1[h]	F6.1[i]	F6.1[j]	F6.1[k]
F6.2 BAHU	F6.2[a]		F6.2[b]	F6.2[c]	F6.2[d]	F6.2[e]		F6.2[f]	F6.2[g]	F6.2[h]	F6.2[i]	F6.2[j]	F6.2[k]
F6.3 BELAKANG ATAS	F6.3[a]		F6.3[b]	F6.3[c]	F6.3[d]	F6.3[e]		F6.3[f]	F6.3[g]	F6.3[h]	F6.3[i]	F6.3[j]	F6.3[k]
F6.4 SIKU	F6.4[a]		F6.4[b]	F6.4[c]	F6.4[d]	F6.4[e]		F6.4[f]	F6.4[g]	F6.4[h]	F6.4[i]	F6.4[j]	F6.4[k]
F6.5 PERGELANGAN TANGAN/ TANGAN	F6.5[a]		F6.5[b]	F6.5[c]	F6.5[d]	F6.5[e]		F6.5[f]	F6.5[g]	F6.5[h]	F6.5[i]	F6.5[j]	F6.5[k]
F6.6 BELAKANG BAWAH	F6.6[a]		F6.6[b]	F6.6[c]	F6.6[d]	F6.6[e]		F6.6[f]	F6.6[g]	F6.6[h]	F6.6[i]	F6.6[j]	F6.6[k]
F6.7 PINGGANG/ PEHA	F6.7[a]		F6.7[b]	F6.7[c]	F6.7[d]	F6.7[e]		F6.7[f]	F6.7[g]	F6.7[h]	F6.7[i]	F6.7[j]	F6.7[k]
F6.8 LUTUT	F6.8[a]		F6.8[b]	F6.8[c]	F6.8[d]	F6.8[e]		F6.8[f]	F6.8[g]	F6.8[h]	F6.8[i]	F6.8[j]	F6.8[k]
F6.9 PERGELANGAN KAKI/ KAKI	F6.9[a]		F6.9[b]	F6.9[c]	F6.9[d]	F6.9[e]		F6.9[f]	F6.9[g]	F6.9[h]	F6.9[i]	F6.9[j]	F6.9[k]

Figure 2.7: The Standardized Nordic Questionnaire in Malay Language version

2.3.2 Borg's CR-10 Scale

Borg's CR-10 Scale was developed by Gunnar Borg in 1990 to measure the physical activity intensity levels or perception of exertion (can also be refers to perceived exertion). Perceived exertion is how hard an individual feels when the individual is performing physical activities (CDC, 2011). The CR-10 scale is the derivation from

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previous version of Borg's rating of perceived exertion scale (RPE), which used the scale of 6 to 20. The latest Borg's CR-10scale is measured from 0 to 10 scales, by which 0 means no exertion at all and 10 means extremely strong exertion. Figure 2.8 shows the Borg's scales mentioned.

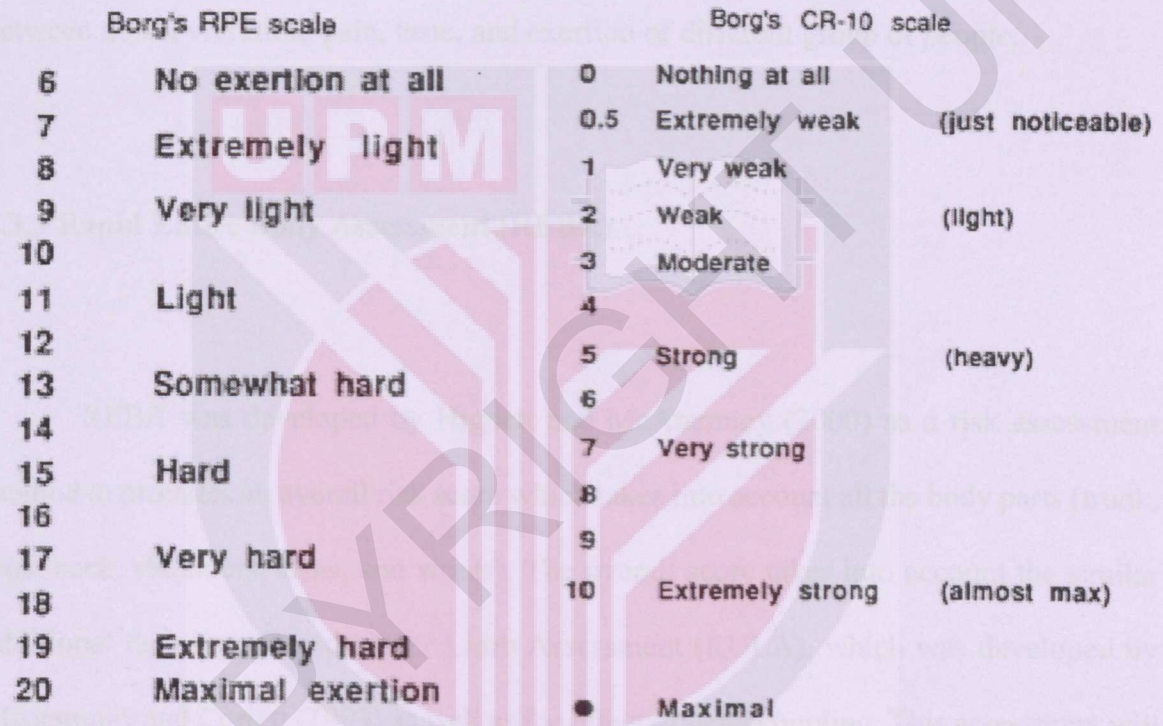

Figure 2.8: The Borg's RPE scale and Borg's CR-10 scale (Borg, 1990)

The literature shown that the Borg's CR-10 Scale were used in several studies, but in most of the studies, the applications were usually for testing before and after effects of ergonomics intervention programs or designs improvement, and to compare work

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methods. One of the studies meant are a study done by Marklin et al. (1999), which investigated the ergonomic risks before and after an ergonomics intervention program at an electric utility's warehouse system. Another study investigated the comparison of perceived exertion and muscle activation during rehabilitation exercise which compared use of dumbbells and elastic resistance (Andersen et al., 2010). Borg (1990) stated that the use of this scale are wide, includes for interindividual and intermodal comparisons between noise, vibration, pain, taste, and exertion of different group of people.

2.3.3 Rapid Entire Body Assessment (REBA)

REBA was developed by Hignett and McAtamney (2000) as a risk assessment method to provides an overall risk score which takes into account all the body parts (trunk, legs, neck, shoulders, arms, and wrists). The overall score takes into account the similar additional factors as Rapid Upper Limb Assessment (RULA), which was developed by Mcatamney and Corlett (1993) as well as the effect of hand coupling. This assessment will produced the postural MSD risk levels (Negligible, low, medium, high, and very high risk), and the equipment needed is just a video recording or picture of the subject while performing tasks, pen and a REBA checklist. The analysis process only take 27 $\pm$ 16.2 minutes (Chiasson et al., 2012). Figure 2.9 shows the REBA checklist.

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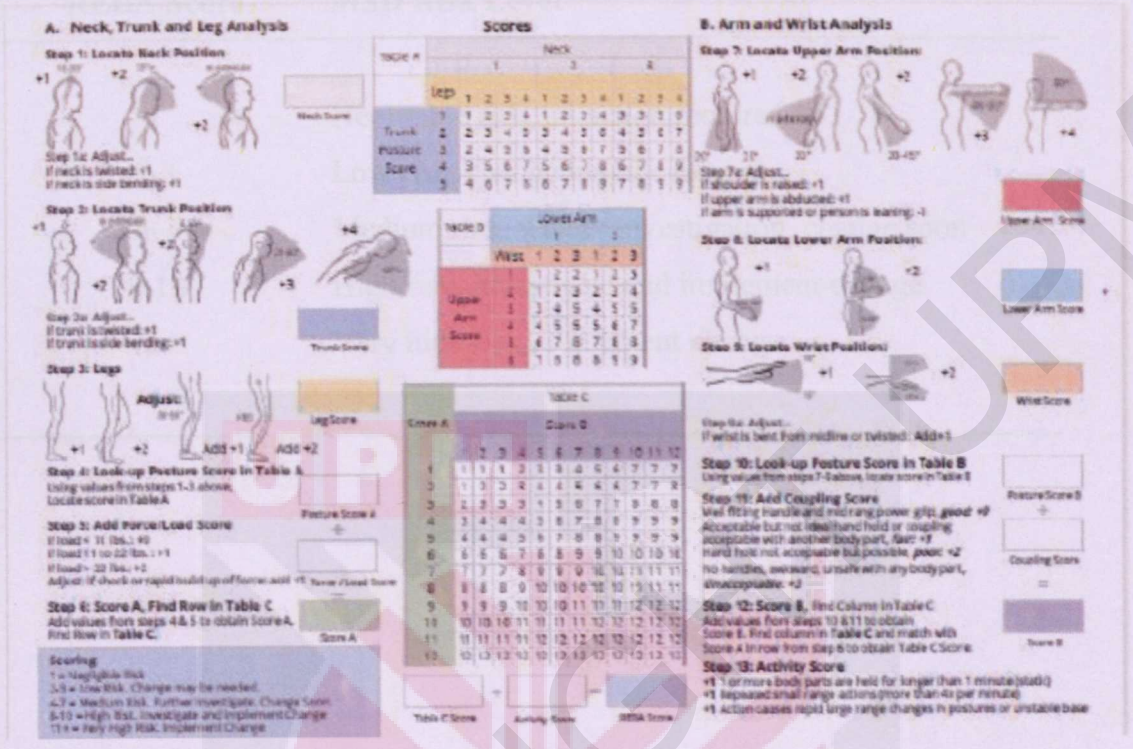

Figure 2.9: The REBA checklist

In the REBA method, the postures selected for assessment are selected based on: 1) the most difficult postures and work tasks based on interview and observation, 2) the posture sustained for the longest period of time, or 3) the posture where the highest force loads occur (Middlesworth, 2013). The outcome of REBA can be seen in the Table 2.1 below, including their scores and risks levels.

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Table 2.1: Scores and risk levels based on REBA method

REBA Score	MSD Risk Level
1	Negligible risk, no action required
2-3	Low risk, change may be needed
4-7	Medium risk, further investigation, change soon
8-10	High risk, investigate and implement change
11+	Very high risk, implement change

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CHAPTER 3

METHODOLOGY

3.1 Study Design

This study is a cross-sectional study, where the variables were studied in one specific point of time.

3.2 Study Location

This study was conducted at three selected palm oil mills in Malaysia. Specifically, it was located in Negeri Sembilan, Selangor, and Perak.

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3.3 Study Population

The population studied are the production workers working in the three selected palm oil mills, from eight different work sections.

3.4 Sampling

3.4.1 Sampling Frame

The sampling frame was the workers name lists from every palm oil mills. As the name lists consisted of all the workers working in the respective palm oil mills, only workers from eight work sections (Grading Area, Loading Ramp, Sterilizer Area, Press Area, Kernel Plant, Oil Room, Boiler Area, and Workshop) were selected from the name list which was obtained from the management of the palm oil mills. Office workers were not included.

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3.4.2 Sampling Method

The sampling method for respondent selection was the purposive sampling method, where the respondents will be chosen based on the selection criteria. The three palm oil mills were selected by using convenient sampling method, where the inclusion are depends on the access permission by the respective palm oil mills management.

3.4.3 Sampling Unit

The palm oil mill workers who involved in the production area was selected as the sampling unit. Below are the selection criteria.

Selection Criteria:

a) Workers from the eight work sections in the palm oil mills.
b) Have working tenure of not less than one year.
c) Aged not more than 60 years old.

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3.4.4. Sampling Size

The sample size was determined by using the following formula (Kirkwood, 1988):

$$N = \frac{p\,(1-p)}{e^2}$$

$$N = \frac{0.871\,(1-0.871)}{(0.05)^2}$$

$$= 44.94$$

$$\approx 45 \text{ respondents}$$

45 x 10% = 50 respondents for each palm oil mill

Where;

N = Sample Size

p = Prevalence of MSD which was 87.1% (Choobineh et al., 2009)

e^2 = Standard error (0.05)

Based on the calculation above, the sample size needed is 45. 10% from the sample size was added to making it total up to 50 respondents for each palm oil mill. The reason for this addition was to overcome the problem of low response rate. Thus, the total sample size suitable for this study was 150 respondents.

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3.5 Study Instrumentation

3.5.1 Questionnaire

A set of questionnaire was used to achieve a part of the objectives of this study. The questionnaire consist of 7 parts, which are:

Part A: **Sociodemographic Information** such as general personal information on demographic background, age, education level, height and weight (BMI).

Part B: **Working Information** such as designation, type of job, work duration, working area, and duration of employment.

Part C: **Lifestyle Information** such as smoking and leisure activity.

Part D: **Health Information** such as current health status, treatment, and medication.

Part E: **Injury Information** including type of injury and body part affected.

Part F: **Standardized Nordic Questionnaire** which help in determining the prevalence of MSD.

Part G: **Borg's CR-10 Scale** which asked for information related with perception of exertion while performing work tasks.

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3.5.2 Rapid Entire Body Assessment (REBA)

REBA is an ergonomic assessment method adapted from Hignett and McAtamney (2000) to evaluate whole body postural MSD and risks associated with job tasks. A score was generated to determine the level of MSD risk. The calculation was done based on the video recorded during the workers performing their work tasks, the one with the worst posture among all the work tasks. The risk levels generated ranged from negligible postural MSD risk to very high postural MSD risk.

3.5.3 Data Analysis

The data obtained was analyzed by using the IBM SPSS (Statistical Package for the Social Sciences) version 22. The type of analysis which was used for this study are shown in the Table 3.1, based on the objectives of this study.

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Table 3.1: Data analysis methods done based on the study objectives

Objectives	Data Analysis Methods
1. To determine personal / sociodemographic data of the respondents.	Descriptive Analysis
2. To determine the one-year prevalence of MSD among the palm oil mill workers.	Descriptive Analysis
3. To determine the perception of exertion while performing work tasks among the palm oil mill workers.	(Borg's CR-10 Scale)
4. To evaluate the whole body postural MSD risks associated with work tasks for the palm oil mill workers.	(REBA)
5. To determine the association between MSD risk factors and MSD	Chi-square Test Logistic Regression Analysis

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3.6 Study Ethics

This study was permitted for ethical clearance by University Ethics Committee for Researches Involving Human of Universiti Putra Malaysia (Reference number: FPSK_November (13)44). Permission from respondents who was selected to participate in this study was also obtained from written consents of the respondents before study is conducted. Privacy of information and confidential of respondents are, and will always be protected.

3.7 Study Limitation

This study contents some limitations due to the design itself, which is cross-sectional study design. This study design reflected only the snapshot of the conditions studied. As this study determine the specific objectives at one point of time, the variables may change as the time pass. Recall bias may also occurred. Besides, the needed sample size was not achieved due to time and budget constraints.

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CHAPTER 4

RESULTS

4.1 Personal Information of the Respondents

The respondent's personal data was tabulated in Table 4.1 below. All 120 study subjects are Malaysian male, with mean age of 38.44 $\pm$ 11.35 years old. Their BMI lies at an average of 24.69 $\pm$ 4.67. Majority (81.7%) of the respondents received education up to secondary level. Majority (67.5%) among them are smokers. About quarter (27.7%) of them are currently having Osteoarthritis. Forty five point eight percent of them have history of previous injury, either originated from their occupation or from other activities out from their occupation. About half of the respondents (53.3%) have salary ranged between RM 1000 and RM 1999. These information can be obtained from Table 4.1.

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Table 4.1: Personal information of the palm oil mill workers studied (n=120)

Variables	Frequency	%	Mean ± S.D	Median	Range
Age (Years)			38.44 ± 11.35	41.0	38
<27	32	26.7			
28-37	20	16.7			
38-47	33	27.5			
>47	35	29.3			
Total	120	100.0			
Nationality					
Malaysian	120	100.0			
Non-Malaysian	0	0			
Total	120	100.0			
Ethnicity					
Malay	120	100.0			
Chinese	0	0			
Indian	0	0			
Other	0	0			
Total	120	100.0			
Marital Status					
Single	29	24.2			
Married	90	75.0			
Divorced	1	0.8			
Total	120	100.0			

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Table 4.1: (Continue)

Variables	Frequency	%	Mean ± S.D.	Median	Range
Number of Household Members			4.8 ± 2.04	5.0	11
<4	55	48.2			
5-8	53	46.5			
>8	6	5.3			
Total	114	100.0			
Body Mass Index (BMI)			24.69 ± 4.67	24.14	25
Underweight (<18.5)	7	5.8			
Normal (18.5-24.9)	61	50.8			
Overweight (25-29.9)	40	33.3			
Obese (≥30)	12	10.0			
Total	120	100.0			
Salary (RM)			1344 ± 485.88	1250	3085
<999	48	40.0			
1000-1999	64	53.3			
2000-2999	7	5.8			
≥3000	1	0.8			
Total	120	100.0			

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Table 4.1: (Continue)

Variables	Frequency	%	Mean ± S.D.	Median	Range
Education Level					
Not in school	3	2.5			
Primary Education	13	10.8			
Secondary Education	98	81.7			
Higher Education	6	5.0			
Total	120	100.0			
History of Previous Injury					
Yes	55	45.8			
No	56	54.2			
Total	111	100.0			

Missing Data: Number of Household Members (6), History of Previous Injury (9).

4.2 Occupational Information of the Respondents

The palm oil mill workers studied belong to eight work sections, which are Grading Area, Loading Ramp, Sterilizer Area, Press Area, Oil Room, Kernel Plant, Workshop, and Boiler Area. Most of them worked in the respective palm oil mills at an average of 9.5 ± 10.11 years. Vast majority (91.7%) of them involved with overtime work. Thirty-two point seven percent of them worked as manufacturing operator before they

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came and worked in the palm oil mill. Majority (77.5%) of them involved which shift work in the palm oil mill, where 90.0% of them involved with works with repetitive tasks. These information is shown in Table 4.2.

Table 4.2: Occupational information of the palm oil mill workers studied (n=120)

Variables	Frequency	%	Mean ± S.D	Median	Range
Work Sections					
Grading Area	11	9.2			
Loading Ramp	14	11.7			
Sterilizer Area	12	10.0			
Press Area	11	9.2			
Oil Room	12	10.0			
Kernel Plant	13	10.8			
Workshop	24	20.0			
Boiler Area	23	19.2			
Total	120	100.0			
Working Tenure			9.5 ± 10.11	5.0	37
1-9 years	75	62.5			
10-19 years	22	18.3			
20-29 years	11	9.2			
>30 years	10	8.3			
Total	118	100.0			

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Table 4.2: (Continue)

Variables	Frequency	%	Mean ± S.D.	Median	Range
Previous Work Experience					
Yes	59	49.2			
No	61	50.8			
Total	120	100.0			
Working History					
Car Mechanic	4	7.7			
Manufacturing Operator	17	32.7			
Labour Worker	1	1.9			
Shopkeeper	3	5.8			
Technician	4	7.7			
Shipment	1	1.9			
Hotel Service	1	1.9			
Private Palm Oil Mill	3	5.8			
Oil Palm Harvester	3	5.8			
Lorry Driver	2	3.8			
Clerk	1	1.9			
Village Works	3	5.8			
Contract Worker	4	7.7			
Construction	1	1.9			
Security Guard	1	1.9			
Air Force	1	1.9			
Welder	2	3.8			
Total	52	100.0			

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Table 4.2: (Continue)

Variables	Frequency	%	Mean ± S.D.	Median	Range
Years of Previous Employment			3.83 ± 3.92	2.0	19
1-10	51	92.7			
11-20	4	7.3			
Total	55	100.0			
Work Duration Per Day (Hours)			9.19 ± 1.9	8.0	10
≤4	2	1.7			
5-8	51	42.5			
≥9	67	55.8			
Total	120	100.0			
Shift Work					
Yes	93	77.5			
No	27	22.5			
Total	120	100.0			
Overtime Work					
Yes	110	91.7			
No	10	8.3			
Total	120	100.0			

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Table 4.2: (Continue)

Variables	Frequency	%	Mean ± S.D.	Median	Range
Part Time Work					
Yes	8	6.7			
No	112	9.3			
Total	120	100.0			
History of Workplace Injury					
Yes	29	24.2			
No	91	75.8			
Total	120	100.0			
Repetitive Tasks					
Yes	108	90			
No	12	10			
Total	120	100			

Missing Data: Working Tenure (2), Working History (7), and Years of Previous Employment (4).

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4.3 Lifestyle Information of the Respondents

Table 4.3 summarized the information about lifestyle of the respondents. Sixty-seven point five percent of them are smokers. Forty-five percent of them are physically active, and they choose to involve with sports activities such as football and jogging, and also with farming and fishing.

Table 4.3: Lifestyle information of the palm oil mill workers studied (n=120)

Variables	Frequency	%
Smoking		
Yes	81	67.5
No	39	32.5
Total	120	100.0
Physical Activity		
Yes	54	45.0
No	66	55.0
Total	120	100.0

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Table 4.3: (Continue)

Variables	Frequency	%
Type of Physical Activities		
Sports (Football, cycling, jogging, etc.)	44	83.0
Farming	7	13.2
Fishing	2	3.8
Total	53	100.0
History of Injury from Leisure / Physical Activity		
Yes	40	33.3
No	80	66.7
Total	120	100.0

Missing Data: Type of Physical Activities (1).

4.4 Health Information of the Respondents

The health information of the respondents was tabulated in Table 4.4. Small proportion of them are having Hypertension and Diabetes (8.5% and 3.4% respectively). Less than 1.0% are having heart disease, and 27.7% of them are having Osteoarthritis.

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Table 4.4: Health Information of the palm oil mill workers studied (n=120)

Diseases	Frequency	%
Hypertension		
Yes	10	8.5
No	108	91.5
Total	118	100.0
Diabetes		
Yes	4	3.4
No	114	96.6
Total	118	100.0
Asthma		
Yes	4	3.4
No	114	96.6
Total	118	100.0
Heart Disease		
Yes	1	0.8
No	118	99.2
Total	119	100.0

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Table 4.4: (Continue)

Variables	Frequency	%
Osteoarthritis		
Yes	33	27.7
No	86	72.3
Total	119	100.0

Missing Data: Hypertension (2), Diabetes (2), Asthma (2), Heart Disease (1), and Osteoarthritis (1).

4.5 Prevalence of MSD

As shown in the Table 4.5, the lifetime prevalence of MSD among the palm oil mill workers studied was 71.7%. However, the one-year prevalence of MSD among the same population was lower, at 50.8%. Other information such as the one-year prevalence by body parts and work sections was also summarized in the Table 4.5.

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Table 4.5: Prevalence of MSD among the palm oil mill workers studied

Variables	Frequency	%
MSD at Any Body Parts (Lifetime Prevalence)		
Yes	86	71.7
No	34	28.3
Total	120	100.0
MSD at Any Body Parts (One-Year Prevalence)		
Yes	61	50.8
No	59	49.2
Total	120	100.0
Body Parts Affected by MSD (Past 12 Months)		
Neck	23	19.2
Shoulder	23	19.2
Upper Back	13	10.8
Elbow	6	5.0
Hand/Wrist	14	11.7
Lower Back	13	10.8
Waist/Thigh	26	21.7
Knee	22	18.3
Leg/Ankle	16	13.3
Total	156	100.0

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Table 4.5: (Continue)

Variables	Frequency		%
MSD by Work Sections/Job Tasks (Past 12 Months)			
	MSD		**Prevalence among the same work (%)**
	Have	**Do Not Have**	
Shooter	8	3	72.7
Loading Ramp	11	3	78.6
Sterilizer Area	5	7	41.7
Press Area	7	4	63.6
Oil Room	8	4	66.7
Kernel Plant	5	8	38.5
Workshop	12	12	50.0
Boiler Area	5	18	21.7

By dividing the prevalence of MSD according to body parts, which are neck, shoulder, upper back, elbow, hand/wrist, lower back, waist/thigh, knee, and leg/ankle, the highest prevalence was found at the waist/thigh (21.7%), and this was followed by neck

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and shoulder at the second highest (19.2%). Prevalence of MSD for all the body parts was plotted in the bar chart below (Figure 4.1).

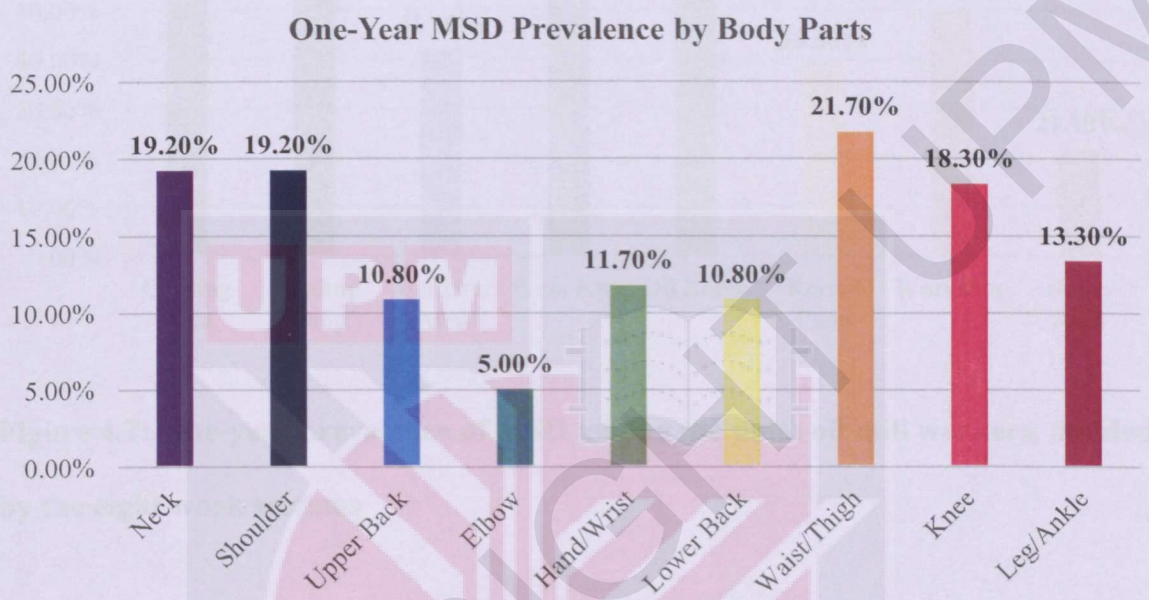

Figure 4.1: One-year prevalence of MSD among the respondents, divided by body parts

Figure 4.2 summarized the prevalence of MSD for every work sections. It was found that the work sections with the highest prevalence of MSD was Loading Ramp (78.6%), and followed by Grading Area (72.7%).

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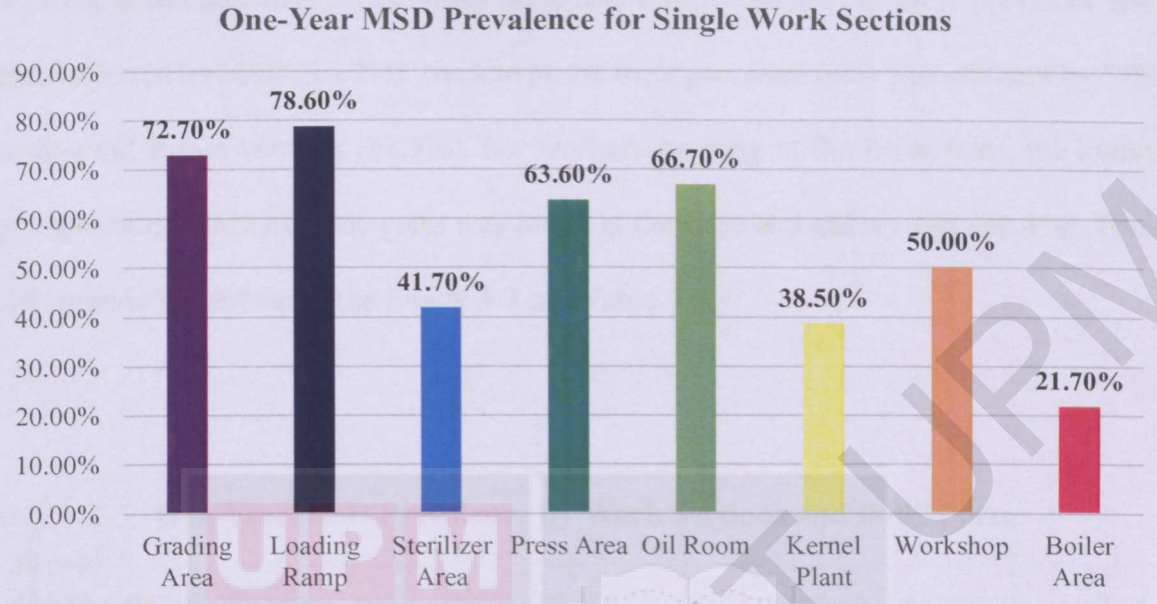

Figure 4.2: One-year prevalence of MSD among the palm oil mill workers, divided by the eight work sections

For the prevalence of MSD by body parts for every work sections, shooters in Grading Area was found to be the highest for the majority of body parts if compared to workers in other work sections, except for elbow and knee. Neck, shoulder, hand/wrist, and leg/ankle was found to be the highest prevalence of MSD among shooters in the Grading Area (45.5%). Shoulder was found to be most affected by MSD among workers at the Loading Ramp (35.7%). For Kernel Plant workers, MSD at the upper back and hand/wrist was found to be most prevalent (15.4%). Among workers in Boiler Area, neck, shoulder, upper back, and knee was found to be most affected by MSD (8.7%). Workers from Workshop reported the highest prevalence of MSD at their ankles/legs (29.2%). For

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workers at the Sterilizer Area, lower back and waist/thigh are the most prevalent body parts affected by MSD (16.7%). Neck to be the most prevalent body part affected by MSD among Oil Room workers (41.7%). For workers working at the Press Area, the highest prevalence of MSD by body parts was found at the knee and ankles/legs (36.4%). These information are shown in the Figure 4.3 and Table 4.6.

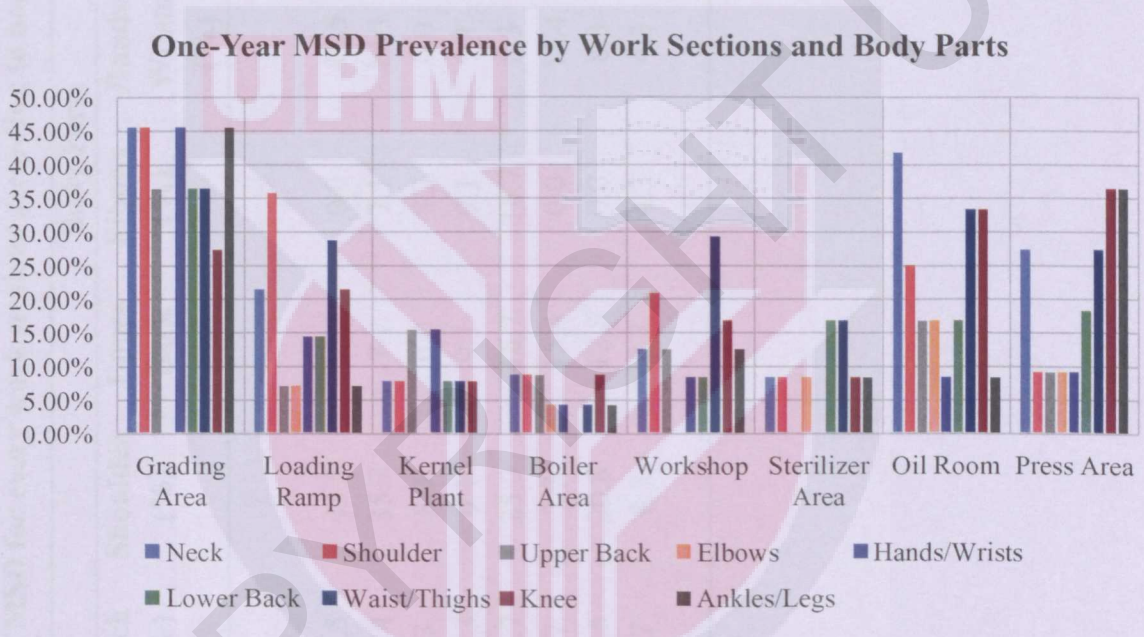

Figure 4.3: The pattern of one-year MSD prevalence among the palm oil mill workers studied, shown by work sections and body parts affected.

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Table 4.6: One-year prevalence of MSD for every work sections according to body parts affected

	Frequency	Body Parts								
		Neck (%)	Shoulder (%)	Upper Back (%)	Elbows (%)	Hands/ Wrists (%)	Lower Back (%)	Waist/ Thighs (%)	Knee (%)	Ankles/ Legs (%)
Work Sections										
Grading Area	11	45.5	45.5	36.4	0.0	45.5	36.4	36.4	27.3	45.5
Loading Ramp	14	21.4	35.7	7.1	7.1	14.3	14.3	28.6	21.4	7.1
Sterilizer Area	12	8.3	8.3	0.0	8.3	0.0	16.7	16.7	8.3	8.3
Press Area	11	27.3	9.1	9.1	9.1	9.1	18.2	27.3	36.4	36.4
Oil Room	12	41.7	25.0	16.7	16.7	8.3	16.7	33.3	33.3	8.3
Kernel Plant	13	7.7	7.7	15.4	0.0	15.4	7.7	7.7	7.7	0.0
Workshop	24	12.5	20.8	12.5	0.0	8.3	8.3	29.2	16.7	12.5
Boiler Area	23	8.7	8.7	8.7	4.3	4.3	0.0	4.3	8.7	4.3

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4.6 Perception of Exertion while performing Work Tasks

The average perceived exertion for every respondents while doing their works was determined by utilizing Borg's CR-10 Scale. Majority (75.6%) of them falls into Low Exertion (Borg's Scale value 4 and below), and the rest of them are categorized in High Exertion (Borg's Scale value 5 and above). Table 4.7 summarized this information.

Table 4.7: Average perceived exertion while performing work tasks among the palm oil mill workers studied

Average Perceived Exertion	%	Mean ± S.D.
		3.91 ± 1.232
Low Exertion (≤4)	75.6	
High Exertion (≥5)	24.4	
Total	100.0	

By work sections, the Figure 4.4 below shows that workers working at the Grading Area and Press Area perceiving high exertion by average. For other work sections, the average amount of exertion are considered low.

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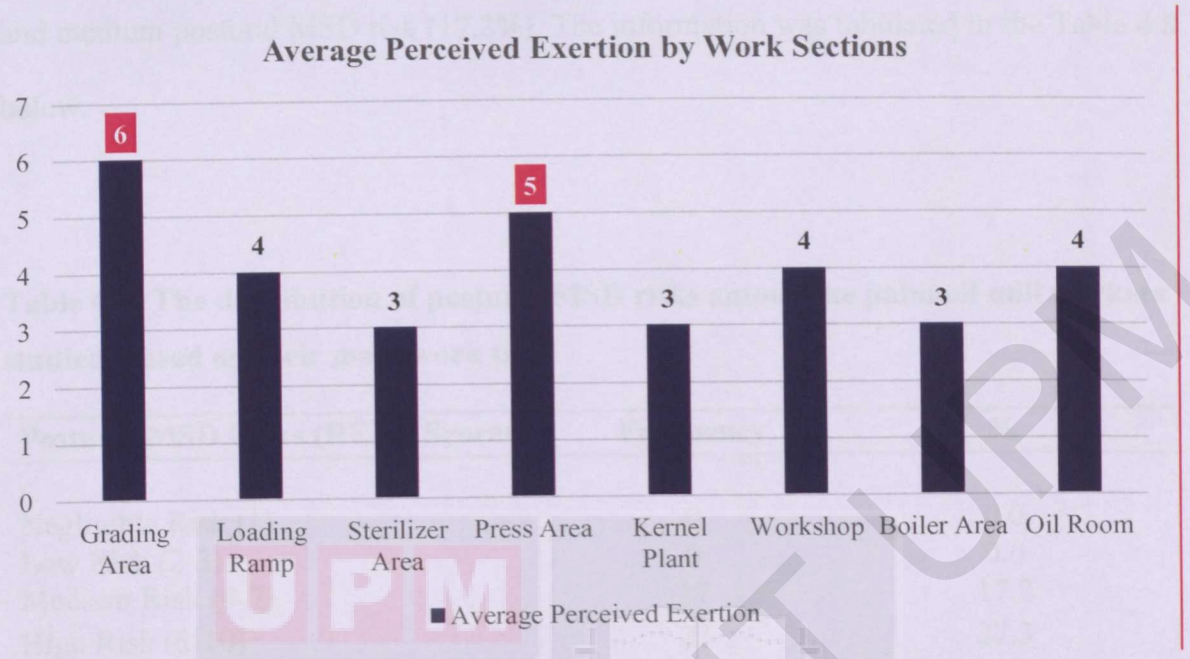

Figure 4.4: The average perceived exertion of the palm oil mill workers, separated according to work sections. The values with red marks are the level which are categorized as High Exertion (Borg's CR-10 Scale 5 and above) and can be consider risky for the workers.

4.7 Postural MSD Risks

Rapid Entire Body Assessment (REBA) was done among 99 workers in the palm oil mills to determine their postural risk levels associated with MSD. The result shows that the workers fall into medium, high, and very high risk which correspondence to REBA scores range 4 to 7, 8 to 10, and more than 10 respectively. Majority of the workers fall into a very high postural MSD risk (55.0%), followed by high postural MSD risk (27.3%),

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and medium postural MSD risk (17.2%). The information was tabulated in the Table 4.8 below.

Table 4.8: The distribution of postural MSD risks among the palm oil mill workers studied, based on their main work task

Postural MSD Risks (REBA Scores)	Frequency	%
Negligible Risk (1)	0	0.0
Low Risk (2-3)	0	0.0
Medium Risk (4-7)	17	17.2
High Risk (8-10)	27	27.3
Very High Risk (>10)	55	55.6
Total	99	100.0

Missing Data: REBA Scores (21)

By work sections, the average REBA scores can be seen in the Figure 4.5 below. Work sections with the highest postural MSD risk are Workshop, Grading Area, and Boiler Area. This was followed by Loading Ramp, Sterilizer Area, Kernel Plant, and Press Area with high postural MSD risk. Only Oil Room has average REBA score categorized as medium postural MSD risk.

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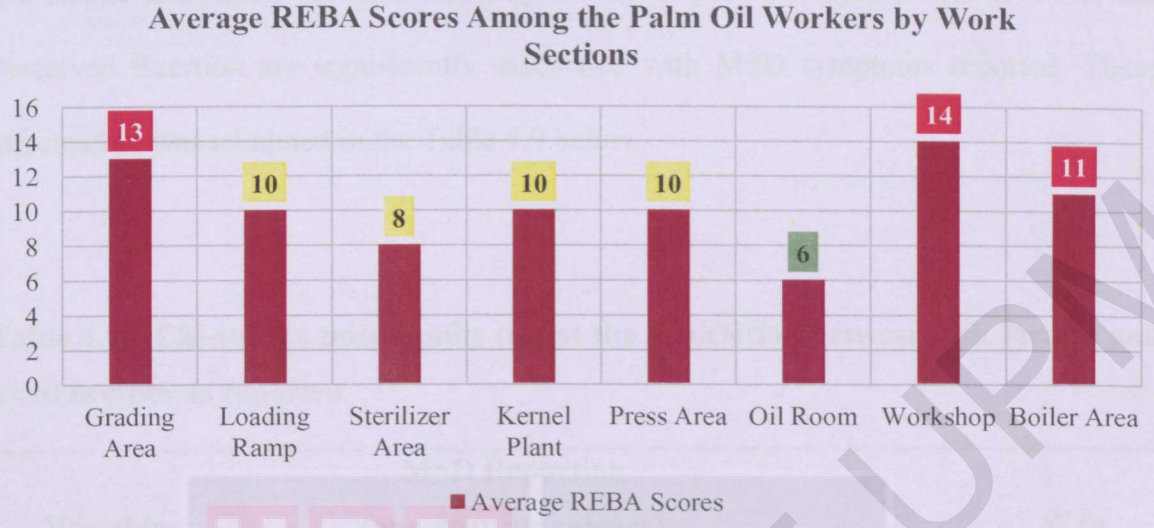

Figure 4.5: The average REBA Scores for every single work sections in the palm oil mills. (Scores 4 to 6 are considered as Medium Postural MSD Risk – green values; 8 to 10 considered as High Postural MSD Risk – yellow values; and scores more than 10 are considered as Very High Postural MSD Risk – red values).

4.8 Association of Risk Factors with One-year MSD Symptoms Reported

Chi-square tests was done to determine whether the risk factors of MSD are significantly associated with the MSD symptoms reported for the past 12 months by the workers working in the palm oil mills. The risk factors involved including age, BMI, physical activity, history of previous injury, Osteoarthritis, and smoking. Risk factors originated from the occupation itself were also tested, including working tenure, overtime work, perception of exertion while performing work tasks, and postural MSD risks. The

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Chi-square test results revealed that only history of previous injury, Osteoarthritis, and Perceived Exertion are significantly associated with MSD symptoms reported. These information was tabulated in the Table 4.9 below.

Table 4.9: Chi-square tests results to test the association between risk factors and MSD symptoms reported

Variables	MSD Reporting (one-year prevalence)				Frequency (%)	X^2 (p Value)
	Yes		No			
	Frequency	%	Frequency	%		
Age						
<27	17	53.1	15	46.9	32 (26.7)	
28-37	8	40.0	12	60.0	20 (16.7)	3.965
38-47	14	42.4	19	57.6	33 (27.5)	(0.265)
>48	22	62.9	13	37.1	35 (29.3)	
Body Mass Index (BMI)						
Underweight	4	57.1	3	42.9	7 (5.8)	0.991
Normal	32	52.5	29	47.5	61 (50.8)	(0.804)
Overweight	18	45.0	22	55.0	40 (33.3)	
Obese	7	58.3	5	41.7	12 (10.0)	

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Table 4.9: (Continue)

Variables	MSD Reporting (One-year prevalence)				Frequency (%)	X^2 (p Value)
	Yes		No			
	Frequency	%	Frequency	%		
Working Tenure						
1-9 years	39	52.0	36	48.0	75 (62.5)	2.941
10-19 years	8	36.4	14	63.6	22 (18.3)	(0.401)
20-29 years	7	63.6	4	36.4	11 (9.2)	
>30 years	6	60.0	4	40.0	10 (8.3)	
Smoking						
Yes	40	49.4	41	50.6	81 (67.5)	0.210
No	41	69.5	18	30.5	39 (32.5)	(0.647)
History of Previous Injury						4.902 (0.027)*
Yes	34	38.2	21	61.8	55 (45.8)	
No	27	41.5	38	58.5	56 (54.2)	

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Table 4.9: (Continue)

Variables	MSD Reporting (one-year prevalence)				Frequency (%)	X^2 (p Value)
	Yes		No			
	Frequency	%	Frequency	%		
Education Level						
Not in school	2	66.7	1	33.3	3 (2.5)	0.418 (0.937)
Primary education	6	46.2	7	53.8	13 (10.8)	
Secondary education	50	51.0	48	49.0	98 (81.7)	
Higher education	3	50.0	3	50.0	6 (5.0)	
Physical Activity						
Yes	27	50.0	27	50.0	54 (45.0)	0.027 (0.869)
No	34	51.5	32	48.5	66 (55.0)	
Overtime work						3.713 (0.054)
Yes	53	48.2	57	51.8	110 (91.7)	
No	8	80.0	2	20.0	10 (8.3)	

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Table 4.9: (Continue)

Variables	MSD Reporting (one-year prevalence)				Frequency (%)	X^2 (p Value)
	Yes		No			
	Frequency	%	Frequency	%		
Perceived Exertion						
Low Exertion (Average scale ≤4)	10	55.6	21	91.3	31 (75.6)	6.998 (0.008)**
High Exertion (Average scale ≥5)	8	44.4	2	8.7	10 (24.4)	
Osteoarthritis						
Yes	24	39.3	9	15.5	33 (27.7)	8.422
No	37	60.7	49	84.5	86 (72.3)	(0.004)**
Repetitive Tasks						
Yes	56	91.8	52	88.1	108 (90.0)	0.448
No	5	8.2	7	11.9	12 (10.0)	(0.503)

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Table 4.9: (Continue)

Variables	MSD Reporting (one-year prevalence)				Frequency (%)	X^2 (p Value)
	Yes		No			
	Frequency	%	Frequency	%		
Postural MSD Risk (REBA Scores)						
Medium Risk (4-7)	11	20.4	6	13.3	17 (17.2)	1.610 (0.447)
High Risk (8-10)	16	29.6	11	24.4	27 (27.3)	
Very High Risk (>10)	27	50.0	28	62.2	55 (55.6)	

*Significant level at $p < 0.05$
**Significant level at $p < 0.01$

4.9 Logistic Regression Analysis

Three of the risk factors of MSD, which are history of previous injury, Osteoarthritis, and perception of exertion was found to be significantly associated with

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MSD symptoms reporting in the past 12 months among the respondents. These risk factors were further analyzed using Logistic Regression Analysis, adjusted for age, BMI, and smoking. The results shown that palm oil mill workers with history of previous injury are 2.35 (95% CI 1.12 to 4.93) times more likely to experience MSD symptoms compared to palm oil mill workers who does not have history of previous injury ($p<0.05$). It was also found that palm oil mill workers with Osteoarthritis are 3.9 (95% CI 1.568 to 9.708) times more likely to experience MSD symptoms compared to palm oil mill workers who does not have Osteoarthritis ($p<0.01$). Another finding shown that workers with high perception of exertion (very effort demanding tasks) are 8.09 (95% CI 1.358 to 48.170) times more likely to experienced MSD symptoms compared to workers who have low perception of exertion (low effort tasks). Table 4.10 in the next page shows the Logistic Regression Analysis data.

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Table 4.10: Logistic Regression Analysis for previous injury, Osteoarthritis, and perceived exertion with MSD, adjusted for age, BMI, and smoking.

Variables	Odds Ratio	95% Confident Interval		p Value
		Lower	Upper	
MSD in the past 12 months				
With Previous Injury	2.35	1.120	4.930	0.024*
Without Previous Injury	1.00			
MSD in the past 12 months				
With Osteoarthritis	3.90	1.568	9.708	0.003**
Without Osteoarthritis	1.00			
Perceived Exertion				
Low Exertion (Average scale ≤4)	1.00	1.358	48.170	0.022*
High Exertion (Average scale ≥5)	8.09			

*Significant level at $p<0.05$
**Significant level at $p<0.01$

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CHAPTER 5

DISCUSSION, CONCLUSION, AND RECOMMENDATION

5.1 Discussion

5.1.1 Personal Information of the Palm Oil Mill Workers

The questionnaire revealed that all the respondents are Malay, male, with mean age of 38.44 (± 11.35) years old. The present of only Malay workers in all the palm oil mills may be due to the location of the palm oil mills which are located inside or besides FELDA Settlements, in which huge majority of the settlers are Malays. No variation in term of gender can be explained by the nature of the work tasks in the palm oil mills, which are very demanding in term of effort and resistance. This kind of heavy work are more suitable for male rather than female. The other reason can be the culture of the Malay

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people living in those areas, in which males are usually working as the main provider of the family, and females only do the house works or working from or near the home with lighter works such as in restaurants or grocery shops. The mean age are at 38.44 years old, and the highest group of age are 47 years old and above. This age value is quite high, as the Department of Statistics Malaysia (2012) reported that the highest labour force participation was by age group 25 to 34 years old. This can happened due to the preservation and migration of more experienced workers in the palm oil mills as most of the operations in the palm oil mills are demanding for experience and competencies (such as in Boiler Area and Workshop).

The mean average BMI of the respondents are 24.69 (± 4.67) which is categorized as normal BMI. This is aligned with the fact that vast majority of the respondents were categorized in normal BMI (50.8%), even though 10.0% of them are obese and 33.3% are overweight. This can be explained by the state of physical inactivity of more than half of the population studied (55.0%). Physical inactivity can cause increase in body weight, and eventually can lead to obesity (Harvard, 2012).

The mean salary of the workers are RM 1344 (± 485.88) which is quite consistent with the average salary for plant and machine operators, and for manufacturing industry in Malaysia (Malaysian DOS, 2013), which was at RM 1216 and RM 1647 respectively.

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About half of the respondents have history of previous injuries (45.8%). The injuries came from occupational and non-occupational sources. Examples of the cause of injuries are accidents involving motorcycles, during sports, and fall at the workplace.

5.1.2 Occupational Information of the Palm Oil Mill Workers

There are eight work sections involved. Majority of the workers worked in the palm oil mills in between 1 to 9 years (62.5%) with an average of 9.5 ($\pm$ 10.11) years. 49.2% of them have working experience before working in the respective palm oil mills. Most of their previous works are of technical type, such as manufacturing operator, technician, and mechanic.

Ninety-one point seven percent of them involved with overtime work. This is aligned with the fact that most (55.8%) of them worked for more than 9 hours per day. Seventy-seven point five percent of them are involved with shift work. In this palm oil mills setting, the workers are common to involve with shift work of more than 8 hours per day, especially when the FFBs are more in the harvesting season. Shift work means that they have to work for twelve hours a shift, before other workers replaced them in the next shift. Shift work are only officially applicable for workers other than from Grading Area and Workshop (however, usually only one or two workers from workshop have to rotate

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in shift, just to prepare if any emergency happen during the night). Workers from Grading Area and Workshop works in normal working hour (eight hours per day). The results also shown that only small amount of the respondents whom do part time work because of not having enough time to do so.

Most of the workers in the palm oil mills involved with repetitive works (90%). The example of the work sections are Grading Area, where the shooters have to shoot the FFBs, lift, and separate it away (separation between wanted and unwanted FFBs). This cycle of action are being done in less than 30 seconds, so it is considered as a repetitive task (CCOSH, 2014). Another good example is from the Boiler Area. The workers in the Boiler Area have to mix the fibers (the fuel for the boiler), and removing stones from the boiler furnace. This work was being done by using long and heavy mixing rods, and the work task can be categorized as a repetitive task as it needs less than 30 seconds to complete each cycle of this task.

5.1.3 Lifestyle Information of the Palm Oil Mill Workers

More than half (67.5%) of the population studied are smokers. One of the reasons for smoking can be the work design which is quite demanding physically. This can lead to stress which can be released by smoking. Previous study which was done among United

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States' workers found that higher levels of smoking were observed among male workers with high school or less education, with age group in between 18 and 24 years old, and those with no health insurance coverage (CDC, 2012). This was also supported by the findings from Niaura et al. (2002), Tiffany and Drobes (1990), Perkins and Grobe (1992), Kassel et al. (2003), and McCormick (1990) (as cited by Xiaobo et al., 2012), which concluded that stress induced cigarette smoking. This conclusion was supported by observational and laboratory studies. Besides that, addiction can also be the additional factor for tobacco smoking among the respondents studied.

Less than half (45.0%) of the study population was physically active. Those individuals chose to do sports, farming, or fishing when they are outside of their working hours. However, the value of respondents who are physically inactive was more (55.0%). This can be caused by the majority of the respondents who had long working hours (more than nine hours per day) and they were not able to find suitable time to be involved in physical activities. Tiredness from the working activities can also be the reason, which causing them to rest during their off-day.

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5.1.4 Health Information of the Palm Oil Mill Workers

The results shown that only small amount of the respondents were having Diabetes (3.4%). However, 27.7% of the respondents were having Osteoarthritis. Osteoarthritis are also known as degenerative joint disease, which was known as a risk factor for MSD (Bush, 2011). The proportion of the palm oil mill workers studied who were having hypertension, asthma, and heart disease are generally small. This can be caused by their working regime which are generally quite heavy and forcing them to exert more effort and sweat.

5.1.5 Prevalence of MSD

The one-year prevalence of MSD among palm oil mill workers studied was more than half of the population, which was 50.8%. This is aligned with many other studies done in many type of industries which also reported that the prevalence of MSD was at more than 50% of the population studied. One of the studies was done by Choobineh et al. (2009), which focused on petrochemical industry setting, with the prevalence of 73%. Another study was done by Yu et al. (2012) which comprehensively included workers from many type of industries including printing industries, metal industries, and electronics industries which reported the MSD prevalence at 51.3%.

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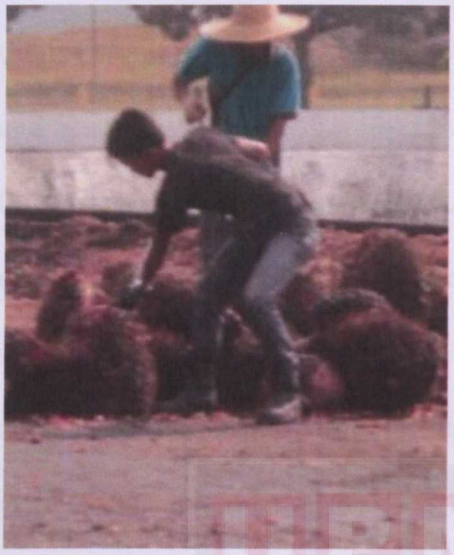

Figure 5.1: A shooter in the Grading Area is performing his task. Notice the awkward posture of the body. The FFBs to be lifted and removed repeatedly using the hook can reach up to 30 kg each.

Figure 5.2: A worker in Loading Ramp is performing his task. In this picture, he is pulling FFBs which are stuck in the ramp by using a hook. A high amount of energy is needed to perform this task. Awkward posture is also involved.

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According to body parts, the highest prevalence of MSD was found at waist and thigh (21.7%), and then followed by neck and shoulder (19.2%). A study done by Hou and Shiou (2006) among nurses found that numbness was commonly reported in thighs, lower legs, hands, and lower back. However, they found that the highest prevalence was reported at the lower back, shoulder, lower leg, and wrist. Not much literature shown the same pattern for MSD symptoms related to waist and thigh. Thus, this pattern can be considered unique for palm oil mill settings according to this study. For MSD symptoms in neck and shoulder, there is a lot of literature shown parallel finding, in which the prevalence of MSD in the neck and shoulder are among the highest in the population studied. Some of this studies were done by Yu et al. (2012) which focus on various industries in China, by Widanarko et al. (2011) which focus on various occupations and industries in New Zealand, by Ozturk and Esin (2011) which focus on sewing machine operators in Turkey, and by Ng et al. (2014) which focus on oil palm harvesters in Malaysia.

In palm oil mill setting by work sections, overall prevalence of MSD was found to be highest among workers in Loading Ramp and shooters in Grading Area with the prevalence of 78.6% and 72.7% respectively. This can be explained by the work tasks which is very demanding in term of its exertion, which involved lifting and pulling FFBs which can reach the weight up to 30 kg, awkward body posture while performing the tasks, and repetitive movements (Choobineh et al., 2007 and 2009; Middlesworth, 2013).

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The descriptive data shows that majority of the highest MSD symptoms by body part was reported by shooters in Grading Area. The body parts involved are neck, shoulder, hand/wrist, and ankle/legs (45.5%), and upper back, lower back, and waist/thigh (36.4%). Highest MSD symptoms at the elbows was reported by workers at the Oil Room (16.7%), while for highest MSD symptoms at the knee was reported by the workers in the Press Area (36.4%).

Shooters in the Grading Area are critically exposed to many occupational risk factors which may contribute to high prevalence of MSD by body parts. The occupational risk factors of MSD are heavy load lifting, forceful exertions, and repetitive movements (Middlesworth, 2013). Heavy load involved are the FFBs itself, which can achieve a weight of 30 kg per FFB. The shooters need to lift and move the FFBs for grading purpose. This is a repetitive process as each cycle of FFB lifting and moving utilizes less than 30 seconds period (PSHSA, 2010). Among all the work sections involved in this study, only shooters at the Grading Area are involved with fully manual work during the FFB grading process.

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5.1.6 Perceived Exertion while Performing Work Tasks

The literature shown that the Borg's CR-10 Scale were used in several studies, but in most of the studies, the applications were usually for testing before and after effects of ergonomics intervention programs or designs improvement, and to compare work methods. One of the studies meant are a study done by Marklin et al. (1999), which investigated the ergonomic risks before and after an ergonomics intervention program at an electric utility's warehouse system. Another study investigated the comparison of perceived exertion and muscle activation during rehabilitation exercise which compared use of dumbbells and elastic resistance (Andersen et al., 2010). Thus, in this study, the researchers tried to investigate the direct relationship of perceived exertion by using Borg's CR-10 Scale.

The Borg's CR-10 Scale values obtained from the respondents were averaged for every individual and were categorized to low exertion (scale value 4 and less) and high exertion (scale value 5 and above). The result shown that the majority of the respondents perceived low exertion (75.6%), while 24.4% of the respondents perceived high exertion while performing their respective tasks. The Borg's CR-10 Scale values were further averaged for different work sections. Only two work sections obtained high exertion values, which are Grading Area and Press Area. This pattern can be related to the nature

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of the work itself. Shooters in Grading Area are subjected to repetitive heavy lifting and moving of FFBs, and workers in Press Area are subjected to a demanding and high repetitive work (poking and cleaning stuck fibers in the press machine). Both work sections subjected its workers to an uncomfortable hot temperature – Press Area involved closed area and press machine which generate heat, while Grading Area is an open area with exposure to direct sunlight, by which the Malaysian temperature can reach up to about 37°C (MOSTI, 2014). Work environment with excessive heat are one of the cause of working fatigue and weakness, and it is also one of the risk factors for MSD (EASHW, 2007; WebMD, 2014).

5.1.7 Postural MSD Risks

Postural MSD risks were assessed by using REBA (Hignett and McAtamney, 2000). Before running the assessment, consultation with the workers and supervisors were done to identify the work tasks with worst body postures as required by the assessment procedures.

The REBA scores for the whole studied population lies in between medium to very high risk. Most of the workers were subjected to very high risk (55.6%) and high risk (27.3%). Only 17.2% of the workers categorized in medium risk. Awkward postures were

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found in almost all the working process in the palm oil mills. Anderson et al. (1986) and McGill et al. (1985) (as cited by Gangopadhyay et al., 2010) delivered the fact that working in extreme and awkward postures requires an individual to commit more effort and exertion and causing overused and tiredness of the muscle. The longer the awkward postures are used while performing tasks, the more likely the development of MSD (CCOHS, 2014).

Figure 5.3: An example of working posture of the workers at the Boiler Area with REBA score of 10 (high postural MSD risk)

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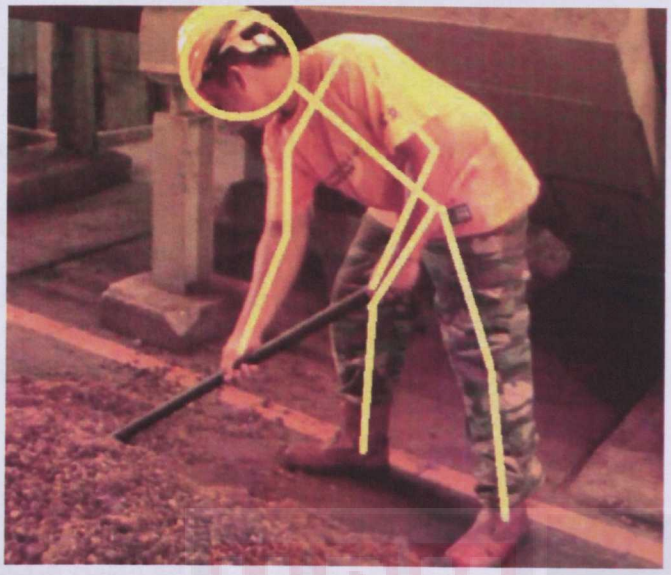

Figure 5.4: An example of working posture of the workers at the Kernel Plant with REBA score of 8 (high postural MSD risk).

The REBA scores were further divided according to work sections, and was averaged for each work sections. Very high postural MSD risks were found among workers from Workshop, Grading Area, and Boiler Area with average REBA scores 14, 13, and 11 respectively. High postural MSD risks were found among workers from Loading Ramp, Sterilizer Area, Kernel Plant (average REBA score 10 for this three work sections). Only workers from Oil Room were categorized with medium postural MSD risk (average REBA score 6).

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In REBA system, the scores indicate the actions to be taken for improvement. For work activities with medium postural MSD risks, further investigation is needed, and change must be implemented soon. For work activities with high postural MSD risks, immediate investigation and implementation of changes is needed, while for work activities categorized to very high postural MSD risks, change must be implemented immediately without any investigation (Hignett and McAtamney, 2000).

5.1.8 Association of Risk Factors with One-year MSD Symptoms Reported

Occupational and non-occupational MSD risk factors were tested by using chi-square test to determine the association of those risk factors with MSD symptoms reported for the past 12 months. Occupational MSD risk factors included working tenure, overtime work, repetitive work, postural MSD risk, and perceived forceful exertion while performing work tasks. Non-occupational risk factors included age, BMI, education level, smoking, Osteoarthritis, and involvement in physical activity. Previous injury was also tested, which was a combination of workplace and non-workplace injuries.

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5.1.8.1 Non-Occupational MSD Risk Factors

5.1.8.1.1 Association of Age with MSD

One of the risk factors of MSD which came from non-occupational side is age. Older workers generally had lower MSD risk if compared to younger workers. Their seniority may cause the older workers to expose less to the occupational hazards in the actual assignment in their workplace. Their seniority generally indicates their vast experience and familiarity with their workplace (Yu et al., 2012), and at the same time causing them to exposed to lower risk of MSD. Differently, a study done by Heiden B. et al. (2013) among nurses indicated that there were significant difference of occurrence of MSD symptoms between young/middle age-group and old age-group. Older workers are more susceptible to work-related MSDs than younger workers because of decreased functional capacity (UKHSE, 2010). However in this study, there is no significant association between age and one-year MSD symptoms reported. One of the reason is because in the palm oil mills studied, aged workers who were already experienced MSD symptoms or other diseases which could affect their work performance were transferred to other work sections which involved lighter works. By implementing this, younger workers have higher chance to also develop MSD symptoms, and this causing age to be a non-predictor for one-year MSD symptoms in this study.

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5.1.8.1.2 Association of Smoking with MSD

Previous studies found that smoking and MSD was significantly associated between one and another. From British National Survey, it was found that there is significant association between smoking and report of regional pain, by which this significant association is also obvious among ex-smokers. This could happen due to the pharmacological effects of tobacco smoke towards their nerves and musculoskeletal system (Palmer et al., 2002). This association was also supported by a study done by Leino-Arjas (1998) which studied the association between smoking and MSD in the metal industry. The study stipulated that smoking seems to predict the development of MSD signs and symptoms. However in this study, no significant association was found between smoking and one-year MSD symptoms reported. This can be explained by the interaction between smokers and non-smokers. In the palm oil mills setting, the observation shown that in many times, especially during breaks and free times, the workers often gathers with one another. Smokers in the group often smokes and leaves the non-smokers to inhale the second-hand smoke (or Environmental Tobacco Smoke-ETS). ETS is a common air pollutant. Inhaling ETS possess serious health risks for both active and passive smokers (Better Health Channel, 2014). This same exposure can leave the same MSD effects on both the smokers and non-smokers. Therefore, no significant association can be found between smoking and one-year MSD symptoms reported in this study.

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5.1.8.1.3 Association of BMI with MSD

Many of the previous studies revealed that weight, height, and BMI have been stipulated as a potential risk factor for MSD (Montero et al., 2009). In other study, Viester et al. (2013) found that musculoskeletal symptoms were reported by 52.3% and 57.6% of the overweight and obese employees, respectively. A systematic review which evaluated the studies according to four biases (selection, performance, detection, and attrition bias) included 95 studies in the systematic review and 33 studies in meta-analyses. The findings indicated that both overweight and obesity increase the risk of one of the MSD problem, which is the lower back pain (Viikari-Juntura, 2013). Another study conducted by Vieira et al., 2008 found that smoking, no exercise, and also overweight are the risk factors related to lower back disorder. However, there is no significant association found between BMI and one-year MSD symptoms reported in this study. Only descriptive comparison can be made between percentage of BMI categories and one-year MSD symptoms reported. Among respondents who reported MSD symptoms in the past 12 months, respondents with obesity reports are the highest in term of percentage (58.3%). Huge different in numbers of respondents for every BMI categories may had decreased the accuracy of this comparison and the test of association.

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5.1.8.1.4 Association of Education Levels with MSD

In term of education level and MSD, the literatures show significant associations but with different and inconsistent relationships. Xiang et al. (2000) reported that workers with lower level of education had higher risk to get injuries including MSD. On the other hand, it was reported that higher level of education possess higher risk of getting injuries including MSD (Crawford et al, 1998; Lewis et al., 1998). Different with both the studies mentioned, this study found that there is no significant association existed between education levels and one-year MSD symptoms reported.

In primary and secondary level of education, Physical Education (PE) is the platform for the students to learn about MSD. An interesting study was conducted by Timpka et al. (2010) which investigate the relationship between grade in PE in adolescent and musculoskeletal pain diagnoses three decades later. The study revealed that in women, low PE grade increases the risks to be diagnosed with MSD, especially of soft tissue pain. The study also revealed that among male, a high grade in PE associated with decrease risk of a soft tissue diagnosis. In Malaysian setting, a study was conducted to assess the implementation level of the PE Program in secondary schools in Selangor (Aboshkair et al., 2012). The results suggested that PE Program in these schools, on average, was lowly implemented, far from what was planned by the Ministry of Education. The poor

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implementation contributed to low status of PE inside school, and lack of qualified PE teachers in Malaysian Schools. This important information can be related to support the facts that education level has no significant association with the one-year MSD symptoms reported. Different outcome may be seen in the future if a serious implementation of PE during primary and secondary education had been put into place.

5.1.8.1.5 Association of Physical Activities with MSD

A study conducted by Vieira et al. (2008) concluded that there are significant relationship exist between no-exercise and low back disorders, with the odds ratio of 1.50 for welders population, and 1.60 for nurses population. Generally, physically active individuals will have a lower risks to experience MSD symptoms. Physically active persons usually have good fitness, which is reflected by high muscle endurance and strength. This can eventually prevent musculoskeletal pain and injury. This was also supported by a study among policemen which found the association between high level of muscular and aerobic fitness with low back pain (Heneweer et al., 2012). In other word, it can be said that personal fitness is an important defensive line to prevent low back pain (Stevenson et al., 2001). In a previous study, it was found that poor fitness level increased the risk of developing low back pain (Taanila et al., 2012). What is surprising is that, this study was not able to prove that well known fact. Physical activity (physically active) was

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found to be not significantly associated with one-year MSD symptoms reported. It was difficult to explain this outcome, but it might be due to the lack of information about the intensity of the exercise or physical activities that the respondents do. For example, a physical activity which are very intense can also increase the possibility for an individual to get musculoskeletal injuries. Thus, this can lead to no pattern to be observed between physical activities with MSD symptoms reported.

5.1.8.1.6 Association of Osteoarthritis with MSD

It is interesting to note that among all the non-occupational risk factors, only Osteoarthritis was found to be significantly associated with MSD symptoms reported ($p<0.001$). Osteoarthritis are also known as degenerative joint disease, which was known as a risk factor for MSD (Bush, 2011). Osteoarthritis occur due to overuse, trauma, or degeneration of the cartilage. The source may be from work activities, sports, or even from aging (AAOS, 2007). Having Osteoarthritis was also further analyzed using Logistic Regression Analysis with adjustment of age, BMI, and smoking, and it was found that respondents with Osteoarthritis are 3.9 (95% CI 1.568 to 9.708) times more likely to develop MSD symptoms. Present of Osteoarthritis lead to evolving of MSD symptoms among the palm oil mill workers studied.

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5.1.8.2 Occupational MSD Risk Factors

5.1.8.2.1 Association of Repetitive Tasks with MSD

Repetitive task is known as one of MSD risk factors. A work task is considered to be repetitive if the time needed to complete each of the cycle of work is less than 30 seconds (CCOSH, 2014). Repetitive work resulted in high frequency of pain in the neck and to the upper extremity (Bonde et al., 2005). If an individual already developed MSD, the exposure to repetitive tasks, especially if forceful, can add the intensity of the painful sensation on the body parts affected (Davis, 1999). Repetitive tasks may lead to MSD by causing the muscles to become fatigue and damaging the muscle tissue (Labortek, n.d.). Presence of heavy load and awkward postures may worsen the outcome.

In the palm oil mill setting, repetitive tasks can be seen at almost all the work sections. One good example is shooters from the Grading Area. The cycle of their task are as below:

1) Shoot the FFBs using the hook.
2) Manual lifting of the FFBs.
3) Releasing the FFBs away to separate it according to grades.

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This cycle are repeated more than hundred times per day, whereas the weight of the FFBs can reach up to 30 kg and in some rare occasions, it can be more. Theoretically, the work activities are highly repetitive, and significant association between repetitive tasks and MSD can occur. Surprisingly, the data analysis shown that there was no significant association found between repetitive tasks and MSD symptoms reported. This might happen due to the variation of other elements influencing repetitive tasks such as the duration of repetitive tasks. Table 5.1 below shows the summarization of the estimation of the duration of repetitive tasks involved.

Table 5.1: Repetitive tasks and their respective estimated performing duration

Work Sections	Repetitive Tasks	Estimated performing duration
Grading Area	Lifting and separating the FFBs	20 minutes with 10 minutes breaks. Working hour from 8 a.m to 5 p.m.
Loading Ramp	Pulling stuck FFBs on the ramp gates	20 minutes with 10 minutes breaks. Working hour from 8 a.m to 8 p.m.

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Table 5.1: (Continue)

Work Sections	Repetitive Tasks	Estimated performing duration
Press Area	Poking and pulling fibers in the press machine	30 minutes, being performed when the press machine is jammed, and when the process for the day is finished
Oil Room	Hammering, loosening and tighting parts of the separator machines, which involved big and heavy parts	Separator machine cleaning usually took 2 hours to finish. Only being performed in the beginning of day shift
Kernel Plant	Scoping spilled kernel / fibers on the floor	Frequency of once for every 2 hours, 20 minutes duration for every session
Boiler Area	Removing stones from the boiler	Frequency of once for every 2 hours, 30 minutes duration for every session

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The information in the Table 5.1 above can justify why there are no significant association found between repetitive tasks and MSD symptoms reported. To produce a different outcome, duration and frequency might also be included into the analysis.

5.1.8.2.2 Association of Working Tenure with MSD

In this study, working tenure is the amount of working years of the workers in respective palm oil mills. Previous studies reported significant association between working tenure and MSD. A study done by Park et al. (2010) found that a number of risk factors (including working tenure) are influencing the occurrence of musculoskeletal disease among shipyard workers with significant value at $p<0.05$. Another study done by (Inbaraj et al., 2013) among Brick Kiln workers revealed that working tenure of more than 10 years of work was significantly associated with acute knee pain and low back pain ($p<0.05$). However, this study shows no significant association between working tenure and MSD symptoms reported. Descriptively, the outcome in this study are contradicting the study done by Inbaraj et al. (2013). In current study, workers with working tenure of 1 to 9 years reported more symptoms of MSD compared to workers with working tenure of 10 years and above. To explain this insignificant association between working tenure and MSD symptoms reported, one alternative reason must be considered. Healthy workers effect might occur among the sample population studied. Healthy workers effect refers to

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a condition where there are only healthy workers present in a particular workplace. Unhealthy workers are generally quitting from that particular job, especially if known exposure which will cause illness are present. In this study situation, it might be happened that the palm oil mill workers with working tenure more than 10 years whom already affected by MSD were quit from this work, left only healthy workers in that working tenure group. Same thing might also happened to the other working tenure group (less than 10 years working tenure), which causing unrealistic characteristic of the data. Thus, insignificant association was concluded.

5.1.8.2.3 Association of Overtime Work with MSD

The results in current study indicated that 91.7% of the palm oil mill workers studied were involved with overtime work. However, the association test shown insignificant association between overtime work and MSD symptoms reported. This outcome are contradicting with an outcome from a previous study by Dembe et al. (2005), which concluded that working in job with overtime schedules were associated with 61% higher injury hazard rate compared to job with no overtime schedules. They also concluded that working at least 12 hours per day was associated with 37% increased hazard rate. However, the outcome of current study is aligned with Johnson and Sharit (2001) which concluded there is no significant changes in term of occupational injury rate

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between workers working for 8 hours or 12 hours. In current study, almost all the workers work over the normal working time. It can be said that the palm oil mill workers studied are 'adapted' to overtime work. All of them might have a high mentality towards their work, and were having strong intention to make additional income from the overtime work. An alternative explanation can be due to the location of that area which is lack of entertainment venues such as in cities. This might cause the workers to have a mentality that working is better thing to do to fill in their time.

5.1.8.2.3 Association of Postural MSD Risks with MSD

Awkward body posture during work activities is one of the risk factors of MSD. As an evidence, with respect to dental hygienists, Atwood and Michalak (1992) reported that the prevalence of musculoskeletal pain ranged from 63 to 93%, with the low back, neck, shoulder, and hand being the most frequent sites. Researchers have confirmed the presence of awkward postures specifically in the neck, back, shoulders, hand and wrist for dental professionals (Occupational Health Clinics for Ontario Workers). Repetitive movements with awkward postures were especially hazardous when they involved the same joints and muscle groups and when workers did the same motion too often, too quickly and for too long (Mehdi Ghasemkhani et al., 2008). However, there are no significant association found between postural MSD risk levels and MSD symptoms

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reported among the palm oil mill workers studied. This can be explained by the absent of other factors to be included in this assessment, such as duration and frequency which are also known as a contributing factors to worsen the effects of awkward body posture towards MSD.

Descriptively, the current study found that the majority of the palm oil mill workers studied are involved with very high postural MSD risks (55.6%). In term of work sections, workers from Workshop, Grading Area, and Boiler Area were the most critical. This can be explained by the nature of the job itself, which requires the workers to work with awkward body postures at most of the time. Workers from workshop involves with mechanical job, such as welding, grinding, and overhauling press machines. Workers (shooters) from Grading Area involves with twisting, bending, and abducting of the body parts while separating the FFBs according to grades. Workers from Boiler Area involves with quite similar body 'treatment', when they are mixing the fibers and cleaning out the stones in the boiler furnace.

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5.1.8.2.4 Association of Perception of Exertion with MSD

This study found that a high perceived exertion was significantly associated with one-year MSD symptoms reported among the palm oil mill workers. Even though the proportion of respondents reported to experienced high perceived exertion are low (24.4%), the logistic regression analysis shown that workers with high perceived exertion have 8.09 times likelihood to report one-year MSD symptoms compared to workers with low perceived exertion ($p<0.05$). This finding was supported by a study conducted among employee in Iranian petrochemical industry (Choobineh et al., 2009) which concluded that perceived physical demands were significantly associated with musculoskeletal symptoms with OR ranged from 1.45 to 2.33. Another study done by Heiden et al. (2013) which focused on nurses also can be referred to support this finding. The study found that physical job demands significantly increased the risk of MSD to 5.7 times more. Even though the exertion / job demands that were investigated in current study was only in term of 'perception', the relationship between 'perception' and reality cannot be exempted. Physiological and perceptual responses should be used as indicators of both physical and mental work load (Borg, 1990).

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5.1.8.3 Association of History of Previous Injury with MSD

About one-third (38.2%) of the palm oil mill workers studied had experienced previous injuries. The injuries were originated from workplace and also non-workplace. Various parts of the body were affected by previous accidents, which resulted in injuries such as broken limbs, cracks, or other. This variables were further analyzed by using Logistic Regression Analysis (adjusted for age, BMI, and smoking) and the result shown that workers with history of previous injury are 2.35 (95% CI 1.12 to 4.93) times more likely to experience MSD symptoms. This significant association agreed to a study conducted by Yu et al. (2012) which found the association between the same variables, which focus on the population of factory workers in various type of industries in major cities in China. A study done by Daltroy et al. (1997) found that workers with previous injuries are prone to get similar injury, but with a higher rate.

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5.2 Conclusion

This study concluded that the one-year prevalence of MSD was at 50.8% among the palm oil mill workers studied, with waist/thigh as the most reported body part affected by MSD. The highest prevalence of MSD reported according to work sections was from Loading Ramp and Grading Area. Most of the workers perceived low exertion while performing their work tasks, with the highest averaged perceived exertion found from workers at Grading Area and Sterilizer Area. Postural MSD risks for majority of the workers were critical, where majority of the workers categorized with very high postural MSD risk. Work sections with highest averaged postural MSD risks are Workshop, Grading Area, and Boiler Area. Osteoarthritis, history of previous injury, and perception of exertion are the important predictor for reporting of MSD symptoms in this study.

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5.3 Recommendation

It is recommended for the employer of the respective palm oil mills to do further investigation based on the fact that slightly more than half of the workers studied reported MSD symptoms in the past 12 months. The investigation may include health / medical investigation by medical personnel such as Occupational Health Doctors to confirm these MSD symptoms reported. This may be done before further preventive or control measures can be taken to tackle the MSD problems in their workplaces.

Based on this study, the work sections which can be considered as risky to develop MSD (which was always appear to be critical in term of postural MSD risk, perception of exertion, and prevalence of reported MSD) are shooters from Grading Area. Thus, any intervention programs must focus on the workers from this work section first, before proceeding to other less critical work sections.

For the employers, the intervention programs to be organized may include training program, which focus on the management of MSD among the workers. Further investigation on the work processes involved in the palm oil mills may also be considered, including the implications to workers musculoskeletal health. The data can be used to

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redesign the workplace or administrative aspects, to ensure that the works involved are fit to the workers.

For future research, it is recommended that medical data (secondary data) on MSD to be included to support the self-reported MSD symptoms. Bigger sample size may be needed to produce a more reliable result. Besides, other contributing factors may be put in together in this kind of research, such as the duration and frequency of the exposure to the MSD risks, instead of only focusing on the intensity and posture. Other risk assessment method can also be utilized, such as Rapid Upper Limb Assessment (RULA) and Quick Exposure Check (QEC) to observe the variation between the results.

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APPENDICES

WORK SECTIONS IN PALM OIL MILLS

Grading Area

Loading Ramp

Sterilizer Area

Oil Room

Press Area

Kernel Plant

Boiler Area

Workshop

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JAWATANKUASA ETIKA UNIVERSITI UNTUK
PENYELIDIKAN MELIBATKAN MANUSIA (JKEUPM)
UNIVERSITI PUTRA MALAYSIA,
43400 UPM SERDANG, SELANGOR, MALAYSIA

BORANG B1: PENERANGAN DAN PERSETUJUAN RESPONDEN

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

1. TAJUK KAJIAN

Masalah Muskuloskeletal: Penilaian Dalam Kalangan Pekerja di Kilang-Kilang Sawit Terpilih Di Malaysia

2. PENGENALAN

Kajian ini bertujuan untuk mengenalpasti kejadian gangguan otot kerangka dalam kalangan pekerja kilang minyak sawit di Malaysia. Menurut kajian-kajian yang lepas, masalah otot kerangka merupakan masalah yang biasa berlaku dalam kalangan pekerja industri pembuatan. Kesannya adalah kemerosotan dari segi produksi kilang adan juga masalah-masalah lain kepada individu tersebut. Walaubagaimanapun, kajian sedemikian di kilang minyak sawit di Malaysia masih belum pernah dijalankan. Oleh itu, kajian ini akan menjadi penanda aras awal untuk isu ini.

3. APAKAH YANG PERLU ANDA LAKUKAN?

Anda dikehendaki menandatangani borang penyertaan yang menyatakan minat anda untuk menyertai kajian ini selepas anda membaca dan memahami segala penerangan yang diberikan. Anda diminta untuk menjawab soal selidik untuk mendapatkan maklumat mengenai kajian ini. Borang penyertaan dan borang soal selidik perlu dikembalikan kepada penyelidik. Rakaman video sekurang-kurangnya 20 minit semasa anda bekerja akan diambil untuk pemerhatian dalam proses analisis.

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4. SIAPAKAH YANG TIDAK BOLEH MENYERTAI KAJIAN INI?

Pekerja yang berumur lebih dari 60 tahun.

5. APAKAH FAEDAH MENYERTAI KAJIAN INI?

a) KEPADA ANDA SEBAGAI PESERTA?

Melalui penyertaan ini, beberapa program dapat dilaksanakan oleh pihak majikan dalam usaha untuk meningkatkan status kesihatan anda.

b) KEPADA PENYELIDIK?

Ia akan membantu penyelidik untuk menentukan kejadian gangguan otot kerangka dan faktor risikonya dalam kalangan pekerja di kilang minyak kelapa sawit.

6. ADAKAH IA BERISIKO?

Tiada risiko didalam kajian ini.

7. ADAKAH MAKLUMAT DAN IDENTITI SAYA KEKAL RAHSIA?

Maklumat dan identiti yang digunakan dalam kajian ini akan kekal sulit.

8. SIAPA YANG SAYA PERLU HUBUNGI SEKIRANYA SAYA MEMPUNYAI SOALAN TAMBAHAN SEMASA MENGIKUTI PENYELIDIKAN INI?

Jika anda mempunyai sebarang soalan tambahan, anda boleh menghubungi Dr Karmegam Karrupiah, Penyelia kajian penyelidikan di 013-5818331 atau Muhammad Shahmi bin Razak, penyelidik di 017-7755967

*Sila tandatangan di sini sekiranya anda telah membaca dan memahami kandungan halaman ini*_____

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9. PERSETUJUAN

Saya..... No Kad Pengenalan. .....

beralamat.....

.....dengan ini bersetuju untuk mengambil bahagian secara sukarela dalam penyelidikan yang tersebut di atas *(kajian klinikal/percubaan ubat-ubatan/rakaman video/kumpulan sasaran/temuduga/ soal selidik).

Saya telah diberi penjelasan secara menyeluruh mengenai penyelidikan ini dari segi metodologi, risiko dan komplikasi (seperti tertulis pada Helaian Penerangan Responden). Saya memahami bahawa saya berhak menarik diri dari penyelidikan ini pada bila-bila masa tanpa memberi sebarang alasan.Saya juga memahami bahawa sebarang maklumat yang berkaitan identiti saya akan dirahsiakan.

Saya* berminat / tidak berminat untuk mengetahui keputusan kajian yang melibatkan saya.

Saya bersetuju/tidak bersetuju untuk imei/gambar/rakaman video/ rakaman suara digunakan dalam apa jua bentuk penerbitan atau pembentangan. (sekiranya berkaitan).

*potong yang tidak berkenaan

Tandatangan ..... Tandatangan.....
(*Responden*) (*Saksi*)

Tarikh :.....

Nama :.....

No. K/P: .....

Saya mengesahkan bahawa saya telah menerangkan kepada responden ini sifat dan tujuan penyelidikan yang tersebut di atas.

Tarikh ..... Tandatangan.....
(*Penyelidik*)

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PENYELIDIKAN MELIBATKAN MANUSIA (JKEUPM)
UNIVERSITI PUTRA MALAYSIA,
43400 UPM SERDANG, SELANGOR, MALAYSIA

FORM B1: RESPONDENT'S INFORMATION SHEET AND CONSENT

Please read the following information carefully and do not hesitate to discuss any questions you may have with the researcher.

1. STUDY TITLE

Musculoskeletal Disorder: The Assessment among Palm Oil Mill Workers in Selected Palm Oil Mills in Malaysia.

2. INTRODUCTION

Purpose of this study is to determine the prevalence of MSD among palm oil mill workers in Malaysia. MSD is a common problem among workers in manufacturing industries, which may cause decrease in production and problems to the workers itself. However, similar researches was never been done in palm oil mills in Malaysia. Thus, this study will be the baseline study on this topic.

3. WHAT WILL YOU HAVE TO DO?

You must sign consent form which is stated that you interest to participate in this study after you read and understand all the explanation given. You will need to answer a questionnaire for obtaining information about this study. Then, consent form and questionnaires should be returned to the researcher before blood pressure, heart rate and body temperature test are carried out. Video recording of at least 20 minutes duration will be taken during your working process to be used as a material for observation in the analysis process.

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4. WHO SHOULD NOT PARTICIPATE IN THE STUDY?

Workers who are 60 years old and above.

5. WHAT WILL BE BENEFITS OF THE STUDY:

a) TO YOU AS THE SUBJECT?

Through this participation, some programs will be implemented by the employer in an effort to improve your health status.

b) TO THE INVESTIGATOR?

It will help the investigator to determine the prevalence and risk factors of MSD among workers in palm oil mill.

6. WHAT ARE THE POSSIBLE RISKS?

There is no risks available in the study.

7. WILL THE INFORMATION THAT YOU PROVIDE AND YOUR IDENTITY REMAIN CONFIDENTIAL?

The information and identity used in this study will remain confidential.

8. WHO SHOULD YOU CONTACT IF YOU HAVE ADDITIONAL QUESTIONS DURING THE COURSE OF THE RESEARCH?

If you have any additional questions, you may contact to Dr Karmegam Karrupiah, Supervisor of the study research at 013-5818331 or Muhammad Shahmi bin Razak, the researcher at 017-7755967.

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*Please initial here if you have read and understood the contents of this page*_____

9. CONSENT

I.....Identity Card No.

.....address.....

.....

hereby voluntarily agree to take part in the research stated above *(clinical /drug trial/video recording/ focus group/interview-based/ questionnaire-based).

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

I* wish / do not wish to know the results related to my participation in the research

I* agree/do not agree that the images/photos/video recordings/voice recordings related to me be used in any form of publication or presentation (if applicable)

* 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 research.

Date ..... Signature .....
(Researcher)

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PROJEK ILMIAH TAHUN AKHIR
B.S. KESIHATAN PERSEKITARAN DAN PEKERJAAN
FAKULTI PERUBATAN DAN SAINS KESIHATAN
UNIVERSITI PUTRA MALAYSIA
SERDANG SELANGOR

UNIVERSITI PUTRA MALAYSIA
BERILMU BERBAKTI

BORANG SOAL SELIDIK BAGI KAJIAN PENILAIAN GANGGUAN OTOT RANGKA DALAM KALANGAN PEKERJA KILANG MINYAK SAWIT DI MALAYSIA

ARAHAN SOALAN:

1. Borang soal selidik ini mengandungi tujuh (7) bahagian iaitu:

   BAHAGIAN A: MAKLUMAT SOSIODEMOGRAFI
   BAHAGIAN B: MAKLUMAT PEKERJAAN
   BAHAGIAN C: MAKLUMAT GAYA HIDUP
   BAHAGIAN D: MAKLUMAT KESIHATAN
   BAHAGIAN E: MAKLUMAT KECEDERAAN
   BAHAGIAN F: BORANG SOAL SELIDIK OTOT KERANGKA STANDARD NORDIC
   BAHAGIAN G: BORANG MAKLUMAT KERAHAN TENAGA

2. Anda diminta untuk menjawab semua soalan.
3. Untuk menjawab, sila tandakan jawapan di bahagian jawapan yang telah disediakan.
4. Borang soal selidik hendaklah dikembalikan kepada pengkaji setelah selesai menjawab semua soalan.
5. Semua maklumat yang diperoleh didalam kajian ini adalah rahsia dan hanya digunakan untuk tujuan pembelajaran semata-mata.

Sekian, terima kasih.

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ID Responden: _____

BAHAGIAN A: MAKLUMAT SOSIODEMOGRAFI

1.1 Nama : _____

1.2 Tarikh Lahir : ☐☐ ☐☐ ☐☐☐☐

1.3 No. K/Pasport : ☐☐☐☐☐☐☐☐☐☐☐☐☐☐

1.4 No. Telefon : ☐☐☐☐☐☐☐☐☐☐☐☐☐☐

1.5 Umur : ☐☐ tahun

1.6 Bangsa :
1. ☐ Melayu
2. ☐ Cina
3. ☐ India
4. ☐ Lain-lain

1.7 Warganegara :
1. ☐ Warganegara
2. ☐ Bukan warganegara

1.8 Status :
1. ☐ Bujang
2. ☐ Berkahwin
3. ☐ Bercerai

1.9 Pendidikan :
1. ☐ Tidak Bersekolah
2. ☐ Rendah/UPSR
3. ☐ Menengah/PMR/SPM/STPM
4. ☐ Sijil/Diploma/Ijazah

1.10 Gaji Pokok : RM ☐☐☐☐☐☐

1.11 Gaji Komisyen : RM ☐☐☐☐☐☐

1.12 Tinggi : ☐☐☐ cm

1.13 Berat : ☐☐ kg

1.14 Isi rumah : ☐☐ orang

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1.15 Jumlah Tanggungan: ☐☐ orang

(Termasuk ayah, ibu, isteri, anak, dll.)

BAHAGIAN B: MAKLUMAT PEKERJAAN

2.1 Pernahkah anda bekerja di tempat lain sebelum ini?

1. ☐ Ya 2. ☐ Tidak

Jika Ya, nyatakan jenis pekerjaan dan tempoh bekerja:

Jenis Pekerjaan	Tempoh Bekerja (Jumlah Tahun)	Tahun Bekerja (Contoh: 2002)

2.2 Apakah jawatan anda sekarang?

_____

2.3 Di bahagian mana anda bekerja sekarang?

1. ☐ Loading Ramp
2. ☐ Sterilization
3. ☐ Thresher
4. ☐ Digester
5. ☐ Nut Silo
6. ☐ Nut Cracker
7. ☐ Oil Room
8. ☐ Stor
9. ☐ Press
10. ☐ Kernel Plant
11. ☐ Boiler Room
12. ☐ Depericaper
13. ☐ Workshop
14. ☐ Effluent
15. ☐ Rumah Abu
16. ☐ Lain-lain. Natakan:_____

2.4 Berapa lamakah anda telah bekerja sebagai (pekerjaan seperti di atas)?

_____ tahun

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2.5 Berapa lamakah anda bekerja di kilang sawit ini?

_____ tahun

2.6 Shift kerja:

1. ☐ Normal
2. ☐ Shift

2.7 Berapa hari anda bekerja dalam seminggu?

_____hari

2.8 Adakah anda bekerja lebih masa (OT)?

1. ☐ Ya 2. ☐ Tidak

2.9 Jika Ya, secara purata, berapa kerap anda bekerja lebih masa?

1. ☐ Tiada 2. ☐ 1-3 kali sebulan
3. ☐ 3-5 kali sebulan 4. ☐ Lebih dari 5 kali sebulan

2.10 Berapa harikan anda bekerja dalam seminggu?

_____ hari

2.11 Berapa jamkah anda bekerja dalam sehari?

_____ jam

2.12 Adakah anda membuat kerja sambilan?

1. ☐ Ya 2. ☐ Tidak

Jika Ya, isikan maklumat berkaitan kerja sambilan di bawah:

Jenis Pekerjaan	Jam Bekerja Sehari	Kekerapan bekerja dalam seminggu (hari)

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2.13 Adakah latihan mengelakkan masalah otot rangka semasa bekerja diberikan?

1. ☐ Ya 2. ☐ Tidak

2.1 Bilangan pekerja yang menjalankan skop kerja yang sama:

_____ orang

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BAHAGIAN C: MAKLUMAT GAYA HIDUP *(LIFESTYLE)*

3.1 Adakah anda mengambil sebarang jenis dadah?

1. ☐ Ya 2. ☐ Tidak

3.2 Adakah anda pernah merokok?

1. ☐ Ya 2. ☐ Tidak

Jika Tidak, sila langkau ke soalan 3.4

3.3 Adakah anda masih merokok?

1. ☐ Ya 2. ☐ Tidak

Bilangan batang rokok sehari:_____

Jika Tidak, nyatakan tempoh telah berhenti merokok:_____

3.4 Adakah anda mengambil minuman beralkohol?

1. ☐ Ya 2. ☐ Tidak

3.5 Dalam masa terluang, adakah anda melakukan aktiviti-aktiviti berikut?

1. Berburu ☐
2. Berkebun ☐
3. Memasak ☐
4. Kerja-kerja rumah ☐
5. Memancing ☐
6. Berolahraga ☐
7. Lain-lain aktiviti fizikal ☐
   Nyatakan:_____

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BAHAGIAN D: MAKLUMAT KESIHATAN

4.1 Adakah anda menghidap penyakit berikut dan telah disahkan oleh doktor?

Penyakit (a)	1. Ya (b)	2. Tidak (c)	Adakah anda pernah mengambil sebarang ubat-ubatan untuk penyakit tersebut?	
			1. Ya (d)	2. Tidak (e)
4.1.1 Darah Tinggi				
4.1.2 Kencing Manis				
4.1.4 Jantung				
4.1.5 Schizopernia (mental)				
4.1.6 Insomnia (susah tidur)				
4.1.7 Rheumatic Arthritis (sakit sendi)				

4.2 Adakah anda mengambil sebarang ubat-ubatan selain dari yang tersebut di atas?

1. ☐ Ya
2. ☐ Tidak

Jika Ya, nyatakan jenis ubat:_____

4.3 Adakah anda menghidap apa-apa penyakit yang lain?

1. ☐ Ya
2. ☐ Tidak

Jika Ya, nyatakan:_____

4.4 Adakah penyakit tersebut mengganggu pekerjaan dan menyakitkan otot rangka semasa bekerja?

1. ☐ Ya
2. ☐ Tidak

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BAHAGIAN E: MAKLUMAT KECEDERAAN

5.1 Adakah anda pernah mengalami kemalangan di tempat kerja semasa bekerja?

1. ☐ Ya 2. ☐ Tidak

5.2 Adakah anda pernah mengalami kemalangan selain dari di tempat kerja? (Contoh: semasa melakukan kerja-kerja rumah)

1. ☐ Ya 2. ☐ Tidak

5.3 Lokasi kemalangan (jika pernah mengalami kemalangan):_____.

5.4 Aktiviti dilakukan ketika kemalangan berlaku:_____.

5.5 Punca berlaku kemalangan:

1. ☐ Tidak sengaja
2. ☐ Sengaja
3. ☐ Serangan
4. ☐ Tidak dapat dikenal pasti

5.6 Jenis kecederaan:

1. ☐ Tulang patah/retak
2. ☐ Terseliuh
3. ☐ Luka dan calar
4. ☐ Lebam
5. ☐ Lecur
6. ☐ Lain-lain. Nyatakan:_____

5.7 Bahagian badan manakah yang terlibat?

1. ☐ Leher
2. ☐ Bahu
3. ☐ Belakang atas
4. ☐ Siku

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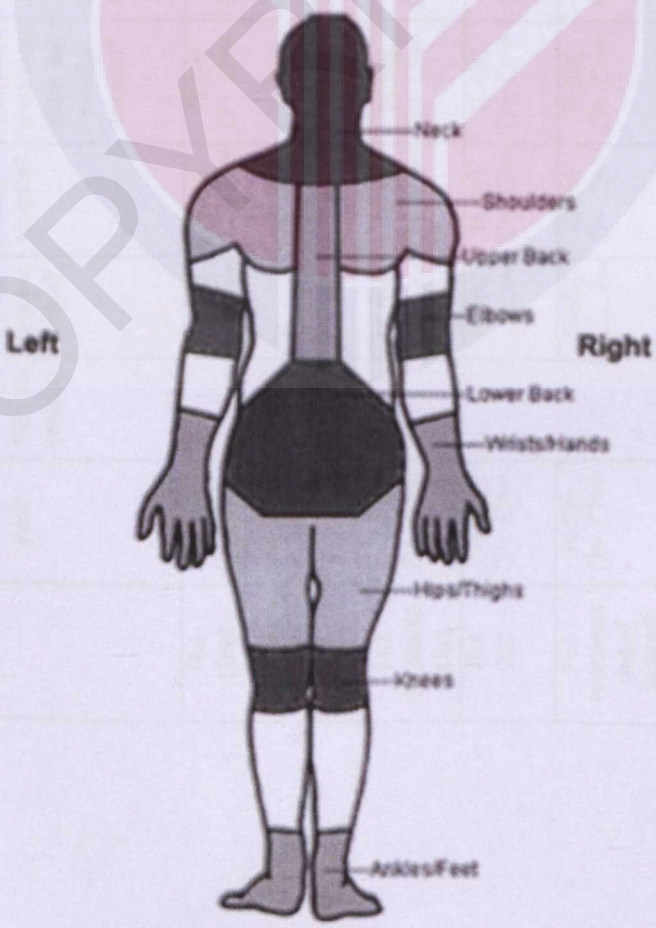
5. ☐ Pergelangan tangan / tangan
6. ☐ Belakang bawah
7. ☐ Pinggang / peha
8. ☐ Lutut
9. ☐ Pergelangan kaki / kaki

5.8 Kecacatan akibat kecederaan:

1. ☐ Kecacatan kekal
2. ☐ Kecacatan separa kekal
3. ☐ Tiada kecacatan.

BAHAGIAN F: BORANG SOAL SELIDIK OTOT KERANGKA STANDARD NORDIC



Back View

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	Adakah anda pernah mengalami, sengal, sakit atau tidak selesa pada:	Jika 'TIDAK', teruskan untuk bahagian badan yang lain. Jika 'YA', sila teruskan	Berapakah umur anda ketika pertama kali masalah tersebut timbul?	Adakah anda pernah dimasukkan ke hospital kerana masalah tersebut?	Adakah anda pernah terpaksa bertukar pekerjaan atau tugas (walaupun sementara) akibat dari masalah tersebut?	Adakah anda mengalami masalah (sengal, sakit, tidak selesa) pada bila-bila masa dalam tempoh 12 bulan yang lepas?	Jika 'TIDAK', teruskan untuk bahagian badan yang lain. Jika 'YA', sila teruskan	Adakah anda mengalami masalah (sengal, sakit, tidak selesa) pada bila-bila masa dalam bulan lepas? (4 minggu)	Adakah anda mengalami masalah (sengal, sakit, tidak selesa) Hari ini?	Dalam tempoh 12 bulan yang lepas, pernahkah anda, pada bila-bila masa:			
										Terhalang daripada melakukan tugas-tugas biasa (di rumah atau luar dari rumah) kerana masalah tersebut?	Berjumpa dengan doktor, fisioterapis, kiropraktiker, atau pihak yang berkaitan kerana masalah tersebut?	Mengambil ubat-ubatan kerana masalah tersebut?	Mengambil cuti sakit dari kerja kerana masalah tersebut?
F6.1 LEHER	F6.1(a) ☐Ya ☐Tidak		F6.1(b) _____tahun	F6.1(c) ☐Ya ☐Tidak	F6.1(d) ☐Ya ☐Tidak	F6.1(e) ☐Ya ☐Tidak		F6.1(f) ☐Ya ☐Tidak	F6.1(g) ☐Ya ☐Tidak	F6.1(h) ☐Ya ☐Tidak	F6.1(i) ☐Ya ☐Tidak	F6.1(j) ☐Ya ☐Tidak	F6.1(k) ☐Ya ☐Tidak
F6.2 BAHU	F6.2(a) ☐Ya ☐Tidak		F6.2(b) _____tahun	F6.2(c) ☐Ya ☐Tidak	F6.2(d) ☐Ya ☐Tidak	F6.2(e) ☐Ya ☐Tidak		F6.2(f) ☐Ya ☐Tidak	F6.2(g) ☐Ya ☐Tidak	F6.2(h) ☐Ya ☐Tidak	F6.2(i) ☐Ya ☐Tidak	F6.2(j) ☐Ya ☐Tidak	F6.2(k) ☐Ya ☐Tidak
F6.3 BELAKANG ATAS	F6.3(a) ☐Ya ☐Tidak		F6.3(b) _____tahun	F6.3(c) ☐Ya ☐Tidak	F6.3(d) ☐Ya ☐Tidak	F6.3(e) ☐Ya ☐Tidak		F6.3(f) ☐Ya ☐Tidak	F6.3(g) ☐Ya ☐Tidak	F6.3(h) ☐Ya ☐Tidak	F6.3(i) ☐Ya ☐Tidak	F6.3(j) ☐Ya ☐Tidak	F6.3(k) ☐Ya ☐Tidak
F6.4 SIKU	F6.4(a) ☐Ya ☐Tidak		F6.4(b) _____tahun	F6.4(c) ☐Ya ☐Tidak	F6.4(d) ☐Ya ☐Tidak	F6.4(e) ☐Ya ☐Tidak		F6.4(f) ☐Ya ☐Tidak	F6.4(g) ☐Ya ☐Tidak	F6.4(h) ☐Ya ☐Tidak	F6.4(i) ☐Ya ☐Tidak	F6.4(j) ☐Ya ☐Tidak	F6.4(k) ☐Ya ☐Tidak
F6.5 PERGELANGAN TANGAN/ TANGAN	F6.5(a) ☐Ya ☐Tidak		F6.5(b) _____tahun	F6.5(c) ☐Ya ☐Tidak	F6.5(d) ☐Ya ☐Tidak	F6.5(e) ☐Ya ☐Tidak		F6.5(f) ☐Ya ☐Tidak	F6.5(g) ☐Ya ☐Tidak	F6.5(h) ☐Ya ☐Tidak	F6.5(i) ☐Ya ☐Tidak	F6.5(j) ☐Ya ☐Tidak	F6.5(k) ☐Ya ☐Tidak
F6.6 BELAKANG BAWAH	F6.6(a) ☐Ya ☐Tidak		F6.6(b) _____tahun	F6.6(c) ☐Ya ☐Tidak	F6.6(d) ☐Ya ☐Tidak	F6.6(e) ☐Ya ☐Tidak		F6.6(f) ☐Ya ☐Tidak	F6.6(g) ☐Ya ☐Tidak	F6.6(h) ☐Ya ☐Tidak	F6.6(i) ☐Ya ☐Tidak	F6.6(j) ☐Ya ☐Tidak	F6.6(k) ☐Ya ☐Tidak
F6.7 PINGGANG/ PEHA	F6.7(a) ☐Ya ☐Tidak		F6.7(b) _____tahun	F6.7(c) ☐Ya ☐Tidak	F6.7(d) ☐Ya ☐Tidak	F6.7(e) ☐Ya ☐Tidak		F6.7(f) ☐Ya ☐Tidak	F6.7(g) ☐Ya ☐Tidak	F6.7(h) ☐Ya ☐Tidak	F6.7(i) ☐Ya ☐Tidak	F6.7(j) ☐Ya ☐Tidak	F6.7(k) ☐Ya ☐Tidak
F6.8 LUTUT	F6.8(a) ☐Ya ☐Tidak		F6.8(b) _____tahun	F6.8(c) ☐Ya ☐Tidak	F6.8(d) ☐Ya ☐Tidak	F6.8(e) ☐Ya ☐Tidak		F6.8(f) ☐Ya ☐Tidak	F6.8(g) ☐Ya ☐Tidak	F6.8(h) ☐Ya ☐Tidak	F6.8(i) ☐Ya ☐Tidak	F6.8(j) ☐Ya ☐Tidak	F6.8(k) ☐Ya ☐Tidak
F6.9 PERGELANGAN KAKI/ KAKI	F6.9(a) ☐Ya ☐Tidak		F6.9(b) _____tahun	F6.9(c) ☐Ya ☐Tidak	F6.9(d) ☐Ya ☐Tidak	F6.9(e) ☐Ya ☐Tidak		F6.9(f) ☐Ya ☐Tidak	F6.9(g) ☐Ya ☐Tidak	F6.9(h) ☐Ya ☐Tidak	F6.9(i) ☐Ya ☐Tidak	F6.9(j) ☐Ya ☐Tidak	F6.9(k) ☐Ya ☐Tidak

BAHAGIAN G: BORANG MAKLUMAT KADAR KERAHAN TENAGA (BORG'S CR10 SCALE)

Sila jawab soalan di bawah berpandukan jadual yang disediakan.

Sila tandakan (√) pada jawapan yang anda rasakan sesuai dan sila jawab semua soalan sebaik mungkin.

Nama Responden:_____

Stesen Kerja:_____

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

No.	Proses Kerja	0	0.5	1	2	3	4	5	6	7	8	9	10
1.													
2.													
3.													
4.													
5.													
6.													
7.													
8.													

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No.	Proses Kerja	0	0.5	1	2	3	4	5	6	7	8	9	10
9.													
10.													
11.													
12.													
13.													
14.													
15.													
16.													
17.													
18.													
19.													
20.													
21.													
22.													
23.													
24.													
25.													

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TERIMA KASIH ATAS KERJASAMA ANDA UNTUK MENJAYAKAN KAJIAN INI

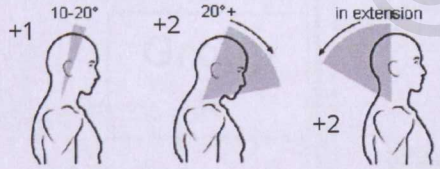
ERGONOMICS PLUS

REBA Employee Assessment Worksheet

Task Name: Date:

A. Neck, Trunk and Leg Analysis

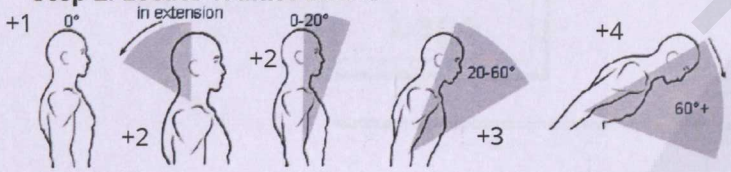
Step 1: Locate Neck Position



Step 1a: Adjust...
If neck is twisted: +1
If neck is side bending: +1

Neck Score

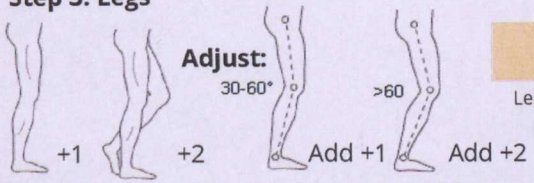
Step 2: Locate Trunk Position



Step 2a: Adjust...
If trunk is twisted: +1
If trunk is side bending: +1

Trunk Score

Step 3: Legs



Leg Score

Step 4: Look-up Posture Score in Table A

Using values from steps 1-3 above,
Locate score in Table A

Posture Score A

+

Step 5: Add Force/Load Score

If load < 11 lbs. : +0
If load 11 to 22 lbs. : +1
If load > 22 lbs.: +2
Adjust: If shock or rapid build up of force: add +1

Force / Load Score

=

Step 6: Score A, Find Row in Table C

Add values from steps 4 & 5 to obtain Score A.
Find Row in **Table C**.

Score A

Scoring
1 = Negligible Risk
2-3 = Low Risk. Change may be needed.
4-7 = Medium Risk. Further Investigate. Change Soon.
8-10 = High Risk. Investigate and Implement Change
11+ = Very High Risk. Implement Change

Scores

Table A

		Neck											
		1				2				3			
	Legs	1	2	3	4	1	2	3	4	1	2	3	4
Trunk Posture Score	1	1	2	3	4	1	2	3	4	3	3	5	6
	2	2	3	4	5	3	4	5	6	4	5	6	7
	3	2	4	5	6	4	5	6	7	5	6	7	8
	4	3	5	6	7	5	6	7	8	6	7	8	9
	5	4	6	7	8	6	7	8	9	7	8	9	9

Table B

		Lower Arm					
		1			2		
	Wrist	1	2	3	1	2	3
Upper Arm Score	1	1	2	2	1	2	3
	2	1	2	3	2	3	4
	3	3	4	5	4	5	5
	4	4	5	5	5	6	7
	5	6	7	8	7	8	8
	6	7	8	8	8	9	9

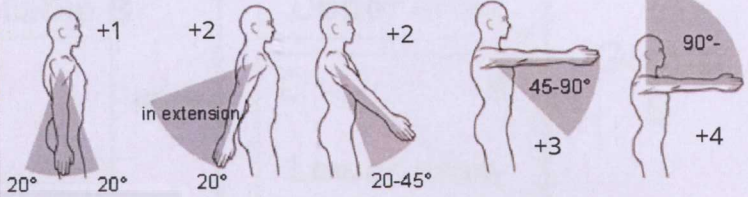
Table C

Score A	Score B											
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	2	3	3	4	5	6	7	7	7
2	1	2	2	3	4	4	5	6	6	7	7	8
3	2	3	3	3	4	5	6	7	7	8	8	8
4	3	4	4	4	5	6	7	8	8	9	9	9
5	4	4	4	5	6	7	8	8	9	9	9	9
6	6	6	6	7	8	8	9	9	10	10	10	10
7	7	7	7	8	9	9	9	10	10	11	11	11
8	8	8	8	9	10	10	10	10	10	11	11	11
9	9	9	9	10	10	10	11	11	11	12	12	12
10	10	10	10	11	11	11	11	12	12	12	12	12
11	11	11	11	11	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

Table C Score + Activity Score = REBA Score

B. Arm and Wrist Analysis

Step 7: Locate Upper Arm Position:



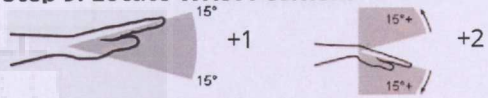
Step 7a: Adjust...
If shoulder is raised: +1
If upper arm is abducted: +1
If arm is supported or person is leaning: -1

Upper Arm Score

Step 8: Locate Lower Arm Position:

Lower Arm Score

Step 9: Locate Wrist Position:



Wrist Score

Step 9a: Adjust...
If wrist is bent from midline or twisted : Add +1

Step 10: Look-up Posture Score in Table B

Using values from steps 7-9 above, locate score in Table B

Posture Score B

+

Step 11: Add Coupling Score

Well fitting Handle and mid rang power grip, ***good: +0***
Acceptable but not ideal hand hold or coupling acceptable with another body part, ***fair: +1***
Hand hold not acceptable but possible, ***poor: +2***
No handles, awkward, unsafe with any body part, ***Unacceptable: +3***

Coupling Score

=

Step 12: Score B,

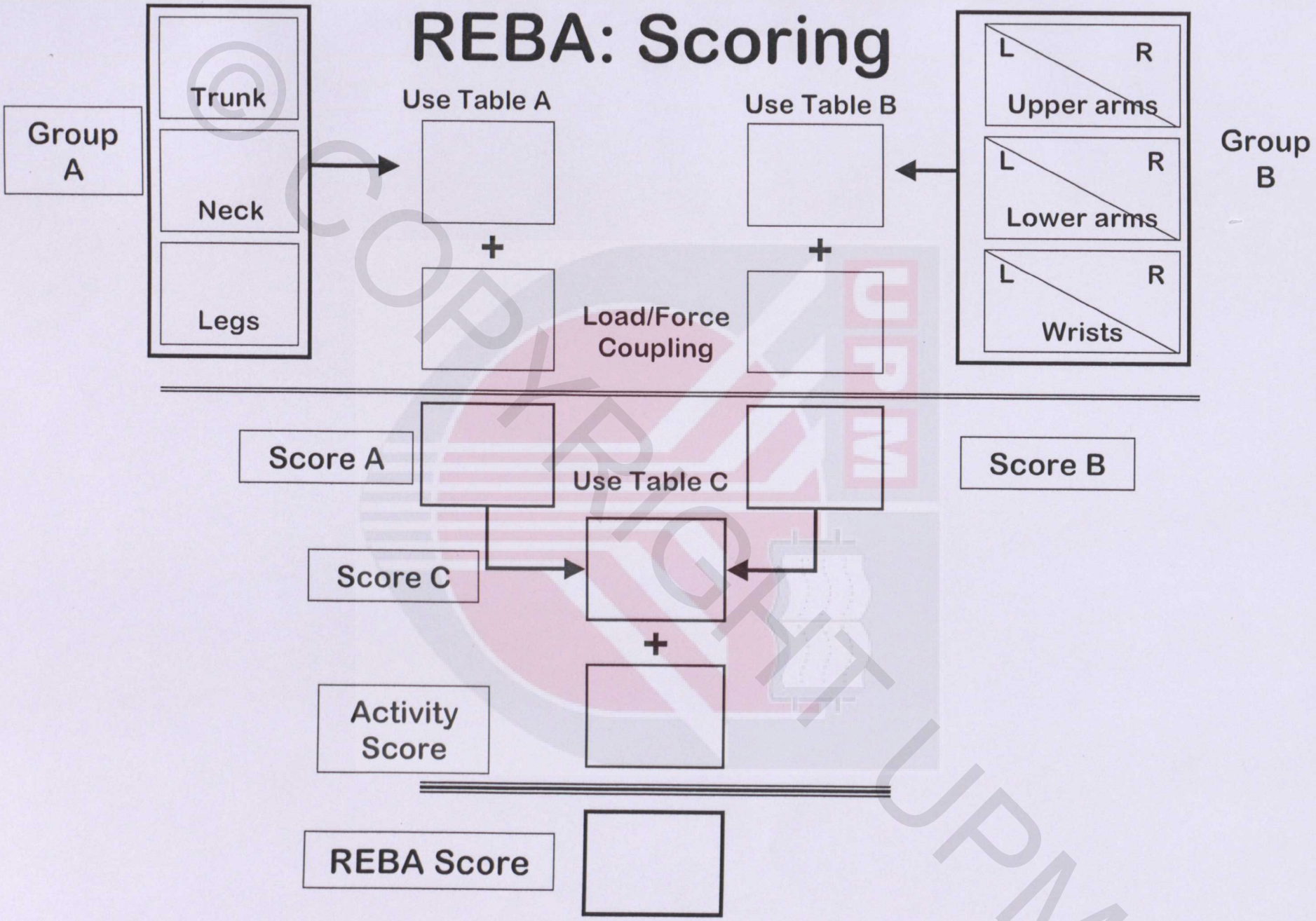
Find Column in Table C
Add values from steps 10 &11 to obtain Score B. Find column in **Table C** and match with Score A in row from step 6 to obtain Table C Score.

Score B

Step 13: Activity Score

+1 1 or more body parts are held for longer than 1 minute (static)
+1 Repeated small range actions (more than 4x per minute)
+1 Action causes rapid large range changes in postures or unstable base

REBA: Scoring



Source: Hignett, S., McAtamney, L. (2000) Applied Ergonomics, 31, 201-5.

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