UNIVERSITI PUTRA MALAYSIA

DISTRIBUTION OF MUSCULOSKELETAL SYMPTOMS (MSS), ITS RISK FACTORS AND ERGONOMIC RISK ASSESSMENT OF PINEAPPLE HARVESTING WORKERS AT THE SELECTED AREAS IN JOHOR

NUR ZAINNATUL ASHYIKIN BINTI ZAININ

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BY

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ABSTRACT

DISTRIBUTION OF MUSCULOSKELETAL SYMPTOMS (MSS), ITS RISK FACTORS AND ERGONOMIC RISK ASSESSMENT OF PINEAPPLE HARVESTING WORKERS AT THE SELECTED AREAS IN JOHOR

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Introduction: Agricultural or farming work is known as challenging occupation in which workers were involved in various work tasks and exposed to health-related problems. Some of the problems were contributed by their working condition such as bringing and lifting heavy loads, repetitive motion, excessive force, prolonged sitting and standing posture and working with the flexed back area. By conducting this research, the degree and magnitude of the exposure to that risk factor could be identified and eliminated in a proper way. **Objective:** The objectives of this study are a) to determine the sociodemographic distribution of the pineapple harvesting workers b) to determine the distribution of Musculoskeletal Symptom (MSS) among the pineapple harvesting workers c) to assess the ergonomic risk factor based on work process among the harvesting pineapple workers and d) to determine the association between occupational and non-occupational risk factors with MSS among pineapple harvesting workers. **Methodology:** A cross-sectional study was conducted at the pineapple plantations in Muar and Simpang Renggam,, Johor in February to March 2020. A set of questionnaire including the Standardize Cornell Musculoskeletal Discomfort Questionnaires was used to obtain information on sociodemographic characteristics and MSS of the workers. The ergonomic risk factor was identified and analysed by using the Ergonomic Risk Assessment (ERA) checklist. **Result:** The distribution of overall MSS reported by the workers is 76.7% (n = 46) by which shoulder part has the highest prevalence (63.3%, n= 38) followed by foot (53.3%, n=32) and lower back (46.7%, n=28). Rapid Entire Body Assessment (REBA) assessment indicates that the workers are exposed to high risk and very high risk for both loading and unloading. According to the Manual Handling Assessment Charts (MAC) assessment, it indicates that the work tasks required actions in the near future. ART assessment for repetitive movement indicates that workers were exposed to high risk level. This study found that workers without previous employment factor (OR: 0.046, 95% CI 0.005-0.391) are less likely to report MSS at lower back. **Conclusion:** The pineapple harvesting workers without experienced previous employment has less chance of getting lower back pain. The workers have experienced an awkward posture, forceful exertion, repetitive motion and extreme temperature while performing their work tasks. A preventive measure and actions are required in order to minimize workers exposure to risk factors.

Keywords: Harvesting, Musculoskeletal Symptoms (MSS), Ergonomic Risk Assessment (ERA)

ABSTRAK

TABURAN GEJALA GANGGUAN OTOT RANGKA, FAKTOR – FAKTOR RISIKO DAN PENILAIAN RISIKO ERGONOMIK DI KALANGAN PEKERJA MENUAI NANAS DI KAWASAN TERPILIH DI JOHOR

NUR ZAINNATUL ASHYIKIN BINTI ZAININ

Pengenalan: Pekerjaan pertanian atau penanaman dikenali sebagai pekerjaan yang mencabar di mana pekerja mengalami pelbagai masalah berkaitan dengan pekerjaan dan kesihatan. Petani menghadapi pelbagai masalah seperti membawa dan mengangkat beban berat, gerakan berulang, daya berlebihan, postur duduk dan berdiri yang berpanjangan dan bekerja dengan kawasan belakang yang membongkok. Dengan menjalankan penyelidikan ini, tahap pendedahan kepada faktor risiko tersebut dapat dikenal pasti dan dihapuskan dengan cara yang betul. **Objective:** Objektif kajian ini adalah untuk a) Untuk menentukan taburan sosiodemografi pekerja penuaian nanas. b) Untuk menentukan taburan Gejala Muskuloskeletal di kalangan pekerja penuaian nanas. c) Untuk menilai faktor risiko ergonomik berdasarkan proses kerja di kalangan pekerja penuaian nanas. d) Untuk menentukan perkaitan antara faktor risiko pekerjaan dan bukan pekerjaan dengan MSS di kalangan pekerja penuaian nanas. **Metodologi:** Kajian keratan rentas dilakukan di ladang nanas Johor dari Februari sehingga Mac 2020. Satu set soal selidik dan Standardisasi Kuesioner Ketidakselesaan Musculoskeletal Cornell digunakan untuk mendapatkan maklumat sosiodemografi dan MSS. Faktor risiko ergonomik dikenal pasti dan dianalisis dengan menggunakan senarai semak ERA.**Keputusan dan Perbincangan:** Taburan keseluruhan MSS yang dilaporkan oleh pekerja adalah 76.7% di mana bahu mempunyai peratusan tertinggi (63.3%) diikuti oleh kaki (53.3%) dan pinggan bawah (46.7). Penilaian REBA menunjukkan bahawa pekerja terdedah kepada risiko tinggi dan risiko yang sangat tinggi untuk memuat dan memunggah. Dari penemuan melalui penilaian MAC menunjukkan bahawa proses kerja memerlukan tindakan dalam masa terdekat. Penilaian ART untuk pergerakan berulang menunjukkan bahawa pekerja terdedah kepada tahap risiko tinggi. Pekerjaan sebelumnya (OR: 0,046 (95% CI 0,005-0,391) adalah kurang berkemubkinan untuk mendapat MSS di bawah kajian ini. **Kesimpulan:** Pekerja yang mempunyai pengelaman bekerja sebelumnya mempunyai risiko yang lebih rendah untuk mendapat sakit belakang bawah. Pekerja terdedah kepada postur yang bongkok, tenaga yang kuat, gerakan yang berulang-ulang dan suhu yang melampau. Pencegahan yang berkesan diperlukan untuk mengurangkan pendedahan pekerja terhadap faktor risiko.

Kata Kunci: Penuai, Gejala Muskuloskeletal, Penilaian faktor risiko ergonomik (ERA).

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LIST OF ACRONYMS AND ABBREVIATIONS

MPIB	Malaysia Pineapple Industry Board
MSS	Musculoskeletal Symptom
MSD	Musculoskeletal Disorder
REBA	Rapid Entire Body Assessment
DOSH	Department of Occupational Safety and Health
BMI	Body Mass Index
ILO	International Labour Organisation
GDP	Gross domestic product
WHO	World Health Organization
WRMD	Work Related Musculoskeletal Disorder
WMSD	Work Musculoskeletal Disorder
OWAS	Ovako Working Posture Assessment System
RULA	Rapid Upper Limb Assessment
ERA	Ergonomic Risk Assessment
MAC	Manual Handling Assessment
ART	Assessment of Repetitive Task
SOCSO	Social Security Organisation

CHAPTER 1

INTRODUCTION

1.1 Background

Pineapple is one of the tropical plant types firstly introduced in east area of South Africa. It was commercialised introduce into Malaysia by the Portuguese in the 16th century. On 1921, pineapple was first cultivating in Johor and Selangor Malaysia at areas as cash crop. Later, pineapple farming was further expanding in peat soil in Johor. According to Malaysia Pineapple Industry Board (MPIB), pineapple plantation recorded an increase in export from the year 2015 to 2020 to meet the market demand and high value on agricultural demand. Now, sector of agricultural is one of the primary sources of income especially among communities in the rural areas in Malaysia.

Agricultural or farming work is known as challenging occupation in which workers were suffer from various work and health related problem (Rani et. al, 2016). Farmers face various problem in the following working condition such as bringing and lifting heavy loads, repetitive motion, excessive force, prolonged sitting and standing posture, working with the flexed back area and experiences of vibration from automobiles and mechanical hand tools (Jain, Lal Meena, Dangayach, & Kumar Bhardwaj, 2018). Across a year, farming become physically demanding occupation. Escalation of workforce and demand on farmers has increased the risk related

occupational accident and disease in agricultural sectors world widely. In Malaysia, the same trend was observed where by agricultural sector is among the highest reported occupational accident and disease to Department of Occupational Safety and Health (DOSH) Malaysia (DOSH,2019).

Musculoskeletal Disorder (MSD) has been consistently shown are the most common of all occupational non-fatal injuries and illness to farm workers. These include injuries affecting muscles, bones, nerves, tendons, ligaments, joints, cartilages and spinal discs, and can incorporate sprains, strains, tears, soreness, pain, carpal tunnel syndrome, hernias and connective tissue injuries. At the meantime, it same goes to the pineapple plantation workers. This is because, the workers required to bend their body in position which are defined as awkward posture due to the short-rotation crop that grow low on the ground with the maximum height is 1. 5 meters. Besides, pineapple plantation in Malaysia are still using on manual tools instead of using the technology or modern tools.

1.2 Problem Statement

In pineapple plantations, the activities performed by the workers are known the most strenuous task in the agricultural sectors compare to other types of work as all the work is manually performed (Afifah & Ya'acob, 2017) People who are working in pineapple sectors shows of an increased odd in getting of injuries which 5.7 times compared to other plantation sectors such as rubber and vegetables. The job nature required workers to use of full force and awkwardly bend for a longer period of time to

perform the work task (Tamrin, S. B. M., & Razak, M. S. Z. A., 2014). The workers required to move their head and trunk forward with slightly inclination to cut the crops (Jain, Lal Meena, Dangayach, & Kumar Bhardwaj, 2014.)

In addition, the workers required to work and stand on peat soil which are not stable based for them (Rani et. al, 2016). According to the study conducted by Tamrin, S. B. M., & Razak, M. S. Z. A., (2014), more hazard in the pineapple field that need to be identified and eliminate compare to the product itself and the worker are still using the dangerous tolls such as machete during the harvesting which are commonly can be found in pineapple plantation. The thorny characteristic of the pineapples which is also can unconditionally hurting the worker.

Even though there are many studies that focus on the risk from the work-related MSD in agricultural sectors, but there is still lack of studies that address the occupational safety and health in pineapple farming. As a result, it's difficult to provide data and information on ergonomic risk in pineapple sectors (Fazrina, Salleh, & Sukadarin, 2018). A study conducted by Rani et. al. (2016) had mentioned that there are still limited number of studies that emphasize on the body postural risk analysis and the association between the MSS and their risk factors.

In many forms, MSD can cause problem to the workers such as disability, lost time work, and increase production cost due to the worker absences, decrease work ability and high medical cost (Razak et. al, 2014). MSD has been consistently shown the most common occupational non-fatal injuries and illnesses as well as the most prevalent and costly especially for farm worker that ore involve in labour intensive practices (Fathallah, 2010). In Malaysia, MSD cases reported due to occupational cause

are continuously increasing every year from 2005 to 2016 which is 10 and 1006 respectively as shown in Figure 1 (DOSH, 2019).

Furthermore, a study conducted by Rani and colleagues (2016) among pineapple workers trough REBA shows that the harvesting work task has the very high risk compared to other work task which is 76.2% followed by land preparation (61.5%) and weeding (23.5%). This indicates that the harvesting work task are the most high-risk work in pineapple plantation compared to others.

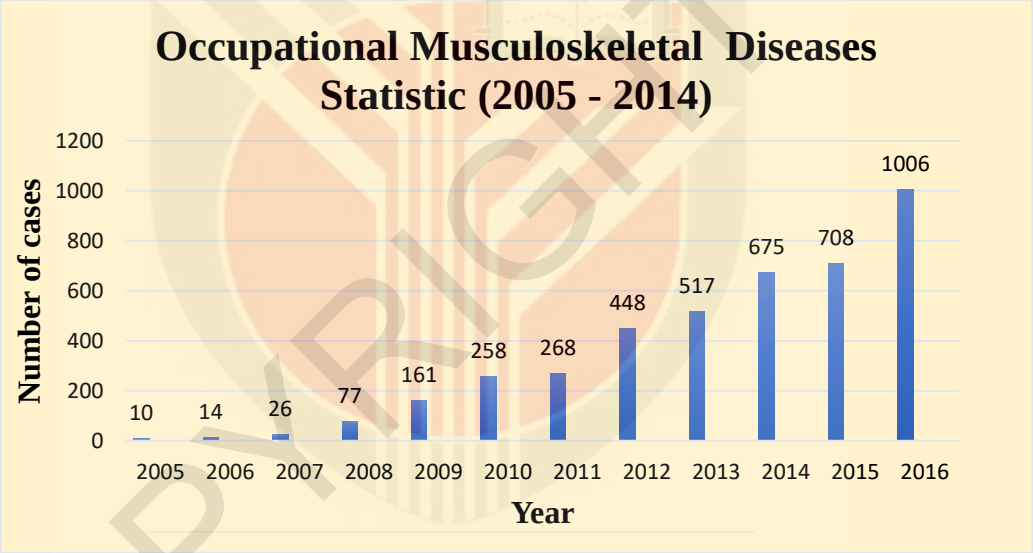


Figure 1.1: Occupational MSD statistic from 2005 to 2016 (Source: SOCSO)

In pineapple harvesting work process, it involves three main work tasks which are cutting, loading (collecting) and unloading pineapple. It requires workers to use their both right and left hand where one hand will hold the long knife while the other hand will grip the pineapple. After cutting the pineapple from its stalk, it will be thrown into a rattan basket that they carrying at their back. This process will be repeated until

the basket is full. Once the basket is full, they will unload the basket by bending over tilt the basket and the pineapple will fall out at the collection site.

Figure 1.2: Work process for pineapple harvesting work task.

1.3 Research Justification

This study was conducted to determine the distribution of Musculoskeletal Symptom (MSS), its risk factor and to conduct an ergonomic risk assessment among the harvesting workers at pineapple plantations in Muar and Simpang Renggam, Johor. The risk factors that lead to the ergonomic problems among the farmers were also identified. From the previous study, it has shown that harvesting activities are among high risk work task compare to other work task in pineapple farming. MSS is different from MSD. MSS is a collective symptom which can be assessed by self- administered questionnaire while MSD problem is needs to be diagnosed by a physician.

There is also limited previous study that specific focus on MSS on workers perform harvesting activity at pineapple plantation. By conducting this research, the degree and magnitude of the exposure to those risk factor could be identified and eliminated in a proper way. Besides that, eliminating the potential risk factors can give a greater impact not only to the workers but also to the employer, government and the nation as it could increase productivity, improve pineapple production, meet the growing demand as well as reduce the cost burdens on work-related injuries in line with the formation of my GAP formed by the government to ensure the quality of production and safe agricultural products at the same time ensuring the safety and welfare of workers.

1.4 Research Question

a) What is the prevalence of MSS and associated risk factors among pineapple harvesting workers?

b) What is the ergonomic risk factor associate with body posture related to the work tasks among pineapple harvesting workers?

1.5 Research Objective

1.5.1 General Objective

The purpose of this study is to determine the distribution of MSS, its risk factor and to conduct an Ergonomic Risk Assessment among pineapple harvesting workers in selected areas in Johor.

1.5.2 Specific Objective

a) To determine the sociodemographic distribution of the pineapple harvesting workers.

b) To determine the distribution of MSS among the pineapple harvesting workers.

c) To assess the ergonomic risk factor based on work process among the harvesting pineapple workers.

d) To determine the association between occupational and non-occupational risk factors with MSS among pineapple harvesting workers.

1.6 Hypothesis

a) There is a significant relationship between occupational and non-occupational risk factor with MSS among pineapple harvesting workers.

1.7 Conceptual Framework

In pineapple plantation, it involves six work tasks which are land preparation, cultivation, fertilizing, weeding, harvesting and pesticide spraying. The purpose of this study is to determine the distribution of MSS, its risk factor and associated ergonomic risk factors among pineapple harvesting workers. The MSS among the workers are assessed at 12 different body parts which are upper arm, fore arm, upper back, foot, thigh, lower leg, neck, lower back, wrist, shoulder, hip and knee.

The risk factors can be divided into two which are occupational risk factors and non-occupational risk factors. For occupational risk factors, it consists of ergonomic risk factors and other risk factors. This study covers five ergonomic risk factors including namely awkward posture, forceful exertion, repetitive motion, static and sustain work posture, and temperature. Meanwhile, the occupational risk factors are work duration, occupational history and employment duration. Other than that, the non- occupational risk factors is age, educational level, BMI, smoking and leisure activity as all this risk factors may lead to the MSS among the pineapple harvesting workers.

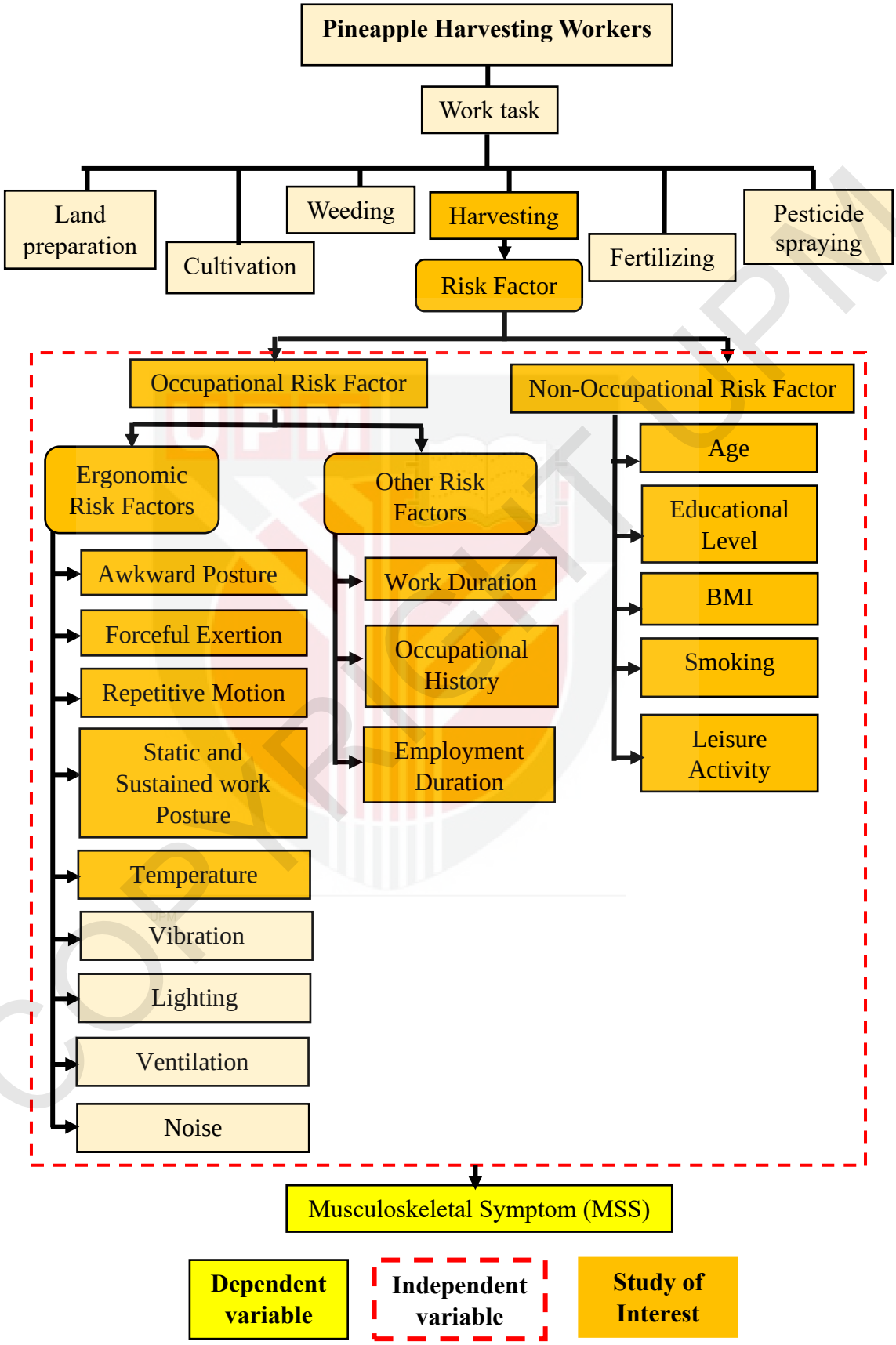


Figure 1.3: Conceptual framework of the study.

1.8 Conceptual definitions

1.8.1 Musculoskeletal Symptom (MSS)

MSS is symptom that present resulting from the prolong work duration. It consists a sign such as pain and swelling in the joints, stiffness, numbness, tingling loss of strength and coordination, skin discoloration and moving difficulty in work or activity pressure (Afifah & Ya'acob, 2017)

1.8.2 Ergonomic Risk Factors

The understanding of scientific discipline concerned with the interactions among human and other element of a system and the profession that applies theory, principle, data and method to design in order to optimize human well-being and overall system performances (*Guidelines On Ergonomics Rick Assessment At Workplace 2017_July Edited Rev.002*, 2017)

1.9 Operational definitions

1.9.1 Musculoskeletal Symptom (MSS)

Standardize Cornell Musculoskeletal Discomfort Questionnaire will be used to obtain information about the MSS experiences by the respondent during work for the past 7

days. It will be assessing on 12 different body part. The information will be obtained through face to face interview. Then, the data obtain will be analyse descriptively.

1.9.2 Ergonomic risk factors

To determine the ergonomic risk factor among the pineapple harvesting workers, the Ergonomic Risk Assessment will be conducted according to Ergonomic Risk Assessment at Workplace Guideline publish by DOSH. The work performed by the workers will be record from various perspective by using video recording. Then, the body postural risk will be analyses based on the video obtain during field work

CHAPTER 2

LITERATURE REVIEW

2.1 Agricultural sector

According to International Labour Organisation (ILO) (2003), it is estimated that about 50% of the entire workforce around worlds with an estimation of 1.3 billion of employed workers in sector of agriculture (Fathallah, 2010). To fulfil demand on workforces worldwide, the economic activity in the agricultural sectors show a significant number of employments. Asian countries such as Vietnam, Thailand, Indonesia, Sri Lanka and Philippine are estimated that about 30 to 49 percent of employment in agricultural sector (Afifah &Ya'cob, 2017). Beside services and manufacturing, agricultural sectors are also the main sources of economy income particularly in rural community in Malaysia such as smallholders' farmers and plantation workers that work in smaller scale of farming (Tamrin& Razak, 2014).

It is estimated that 12.2% of workers were employed in agricultural sector in the year 2014. According to the Department of Statistic Malaysia (2015), Malaysia has contributed a gross domestic product (GDP) with an estimated of 8.43% that is equal to RM 22.6 million in agricultural sector (Ng et al., 2015). There is an increase in the

amount of labour force approximately from 1.2 million to 1.4 million workers as reported by Agricultural Department in 2008 (Tamrin& Razak, 2014)

Ananas Comosus or a pineapple is a tropical fruit originates from the Eastern Region of South America. Pineapple was initially planted in Singapore which later began to cultivating in Malaysia as secondary crop during the period which the plantation of rubber was escalating in 1992 (Mohamad Salleh & Hani Sukadarin, 2018). Apart from Thailand, Philippine, Indonesia, Ivory Coast, Hawaii, Kenya, Brazil, Australia, Taiwan, South Africa and India, Malaysia is also one of the world main pineapple producers (Tamrin, S. B. M., & Aumran, N., 2014).

To meet the products growing demand, Malaysia has expanding the pineapple plantation areas. An export of pineapples is valued at RM161 million and targeted to increase to RM 245 million in year 2015 and year 2020 respectively (Ng et al., 2015). The local canned pineapples pose high market value in America United State, Japan, European Union, Middle East, and Singapore (Tamrin & Razak, 2014). Due to its high profit in economy, Malaysia plans to expand pineapple export by opening new land for pineapples growth (Salleh et al., 2019).

2.2 Musculoskeletal Symptom (MSS)

Pineapple workers that experiences occupational related accident and disease are normally due to human related issue and this problem occurs when a single or multiple tissue have to work rigorously from the normal (Arumagam, M. & Tamrin, S. B. M. 2014). The impact increases since the workers in the pineapple plantation are still using traditional tools and work manually. A long duration of exposure to sunlight,

manual handling, fatigue due to heavy workload, dissatisfaction in job, and long duration in awkward posture could be the risk factors lead to MSS (Mohammad Salleh & Hani Sukadarin, 2018).

According to WHO (2019), MSS involves over 150 diagnoses that disturb the locomotor system as listed in Disease International Classification that may include muscle, joints, bones, tendons and ligament. The symptom might be characterised by weakness, pain, dexterity and functional disability, joint noises, stiffness and decrease range of motion. Inflammation may result a pain, tiredness, swelling, warmth, impaired function and sometimes redness of the overlying skin.

2.3 Prevalence rate of MSD among agriculture worker

Many ergonomic studies conducted among agricultural workers have mentioned that work-related postures can result a differing rate of soreness and burden on the musculoskeletal system (Salleh et al, 2019). A study conducted by Tamrin and colleagues (2014) shows that the one-year prevalence's of MSD is about more than half of the community among palm oil mill workers which was 50.8%. Another study indicates that the prevalence of MSS was 80.40% (n=692)who were at least had one symptom measured among farm workers in eastern region of Cambodian that worked in the orchards (Thetkatheuk et al., 2018).

From the last 6 months, the greater number of participants had experienced MSD on their body parts which was in line with research finding by Osborne and colleagues (2012) accounted for 77.0%. According to a recent survey conducted by McMillan and

among farmers in Saskatchewan, Thailand the prevalence of MSD was 85.6%. A research conducted by Baksh among farmers in Trinidad, India farmers had shown that the prevalence of MSD was 61%, while 43.4% of MSD prevalence was reported in a local study (Ng et al., 2014). The result from a study summarises that 77.9% of the participants experience discomfort in at least one body part which justified that MSD are common among manual harvesting farmers (Jain et al., 2018).

In Malaysia, the reported prevalence of WRMD was comparable with the few past studies among palm plantation farmers. In China, the prevalence rate of WRMD in 2012 was reported to increase steadily from as low as 33% to 76.9%,while the prevalence of WRMD among Irish farmers in 2010 was 56% (Henry et al., 2015). During the past few years, the self-reported prevalence of MSD among harvesters in Johor was remarkably huge which accounted for 86% including complains of pain and discomfort at 9 different body parts.. Even though the prevalence of MSD for the past 7 days was low (45%),both durations distribution discovered were parallel (Mohamad Salleh & Hani Sukadarin, 2018).

A study conducted by H. Abdul Hadi (2016) which involved tea plantation workers showed a high prevalence of low back pain (64.2%)in the last 12 months duration Another study conducted by Ng et al. (2014) stated that a study form Nizam (2005) showed prevalence rate of 82.6% which was reported among plantation workers in Selangor oil palm which are similar with the study by MURUKA conducted among Kenya tea plantation workers which showed the prevalence of low back pain is 64%. A study performed among rubber tappers in Thailand have shown a higher prevalence of low back pain (52.9%) compared to other MSDs (Meksawi et al., 2012).

2.4 Associated risk factors

According to the International Ergonomics Association Executive Council, an ergonomic can be defined as an understanding of the scientific discipline which concerned on the interactions among humans and other elements of a system. It applies the theory, principles, data and methods to design which aims to advance human well-being and overall system performance. The relative causes for risk factors in agriculture sector may be different in developed and developing countries (Jain, Lal Meena, Dangayach, & Kumar Bhardwaj, 2018).

2.4.1 Occupational risk factor

Ergonomic risk factor can divide into two which is occupational risk factor and non-occupational risk factors. The WHO has declared that WMSD develop a major problem in occupational globally. The work-related postures comprise heavy manual lifting, awkward body bending, repetitive movement, awkward neck bending and daily prolonged working. In addition, the knowledge on safe and healthy working conditions are still lacking among the farmers such as the knowledge on risk from vibrations (Thetkathuek et al., 2018). According to a study by Steven and colleagues (2009), there are two types of ergonomic risk factors which primary and secondary.

The repetition, excess force, vibration and awkward posture may include as the primary ergonomic risk factors were repetition, excess force, vibration and awkward posture while cold ambient temperatures and pressure points were covered under secondary ergonomic risk factors. MSD are known to be associated with various risk

factors including repeated movement, bending and twisting, heavy workload, working too long without break, harsh working condition, apply too much strength and also psychosocial factors. Other risks factors such as any combination of fast, sustained static loading, repetitive motions, awkward posture, vibration, and apply higher force rate have been believed to be aggravating to the body regions. For example, the manual lifting of heavy workload, repetitive hand work and working in bending posture are the main utmost concern risk factors in agriculture sector (Thetkathuek et al., 2018)

One of MSD risk factors is repetitive task. A repetitive work task involves the work cycle that need to be completed within less than 30 seconds per cycle. Repetitive movements are known to be hazardous to the workers especially when the work task was frequently performed in awkward postures within longer duration and involved a quick movement on the same joints and muscle groups (Tamrin & Razak 2014). , Another risk factor for MSD is extreme temperature when the workers were exposed to excessive heat in the work environment, thus resulting working fatigue and weakness (Thetkathuek et al., 2018).

Prolonged and constant awkward postures are common ergonomic risk factors that were directly associated with WMSD because these poor postures may result a low back and knee pain among workers (Salleh & Sukadarin, 2017). As being reported in previous study, the tea plantation workers have a high prevalence of low back pain as it is associated with awkward posture, required forces, lack of break time, frequent movement of body and manual handling in their work activities (Hadi, 2016)

2.4.2 Non-occupational risk factor

Apart from that, non-occupational factors also may lead to MSD. A research by Razak and colleagues (2014) have emphasized that having multiple risk factors such as workplace design, long working hours, age, BMI, level of education, Osteoarthritis, physical activity involvement and smoking may contribute to the MSD problem. It stated that 27.7% of the respondents were having degenerative joint disease or Osteoarthritis. The reported MSD among respondents was found to be significantly associated with the Osteoarthritis, having a history of previous injury and perception of exertion reporting for the past 12 months (Tamrin & Razak, 2014).

Age is also one of the non-occupational risk factors that lead to MSD. According to the study by Tamrin and Razak (2014), older workers had a lower MSD risk compared to younger workers as the older workers had less exposure to the hazard present in their work task as well as due to their working experience. Apart from that, the older workers are familiar with the work process and work area. However, the different level of risk represent for different age level will experiences pain at different body part. The participants who in the age of less than45 years old were significantly associated with reported low back pain meanwhile the reported pain in elbow, shoulder and hip were significantly reported among the participants in the age of 40 to 60 years old. (Osborne et al., 2012).

Based on previous study, the significant association was shown between smoking status and reported MSD in which, it was also noticeable among ex -smoker farmers. It was due to the pharmacological effect on their nerve and MSS which

originated from tobacco smoke (Tamrin & Razak2014). There was a significant association between smoking status and reported of regional pain particularly among ex-smokers This could be due to pharmacological effects of tobacco smoke toward their nerves and musculoskeletal system (Razak et al., 2014). Apart of that, a cross-sectional study by Shiri and colleagues (2010) had also depicted a similar finding in which current smoking status was associated with reported low back pain. This can be explained by the interaction between smokers and non-smokers during breaks and free time. .

Non-smokers have been exposed to second-hand smoke when they mingled around with other colleagues who were smokers. As being reported by the U.S. Department of Health and Human Services (USDHHS), an involuntary exposure to tobacco smoke have contributed to the wide range of health effects such as respiratory problems and cardiovascular disease (USDHHS, 2006). This same exposure can leave the same MSS effect on both smoker and non-smokers.

Many literatures show significant associations between education level and MSD, but there are a different and inconsistent relationships with lower level of educational worker and higher risk to get injuries including MSD .On the other hand, it was reported that higher level of education possesses higher risk of getting injuries including MSD (Tamrin& Razak, 2014). The finding was in line with the study conducted by Abdul Hadi, (2016), where respondents that received any formal education has a higher reported cased of back pain (75%)compared to the other respondents who did not received any education (56.9%).

Furthermore, individuals who are physically active will have a low risk of getting MSD because they have a good body fitness, strength and high muscle flexibility. A study performed by Vieira and colleagues (2008) concluded that there was a significant relationship between no-exercise and reported low back disorders. (Tamrin & Razak, 2014).

2.5 Ergonomic Risk Assessment

Pineapple plantation workers were exposed to various ergonomic risks which could contribute to develop the MSS. Ergonomic was one of the main hazards in pineapple plantation regarding on the safety and health issues. The highlighted risks were heavy lifting, highly repetitive motion, stooping, squatting, kneeling and bending. REBA method was developed by Hignett and McAtamney (2000) as a risk assessment method to provides an overall risk score for all the body parts which are trunks, neck, legs, shoulders, wrist and arms. The overall score and effect of hand coupling has taken into account the similar additional factors as (RULA) that developed by McAtamney and Corlett (1993). The postural MSD risk levels assessment had depicted a negligible, low, medium, high, and very high risk.

A video recording or picture of the respondents were taken while the workers performing their work task. In this REBA method, the postures was selected to be included in the assessment based on several characteristics which were; 1) most difficult work task posture and task based on interview and observation 2) perform certain posture for a long time period 3) highest force loads posture (Tamrin & Razak2014). Based on the previous study, it found that 24.4% of the respondents perceived high

exertion while performing the repetitive task. The repetitive trunk motion might affect the pattern of trunk muscle cavity as well as increased spine structural loading including the compression and shear force.

During harvesting phase, the workers suffer the postural stress as due to awkward posture, stooping in addition to forceful exertion and rapid work pace (Ng et al., 2013). A study conducted by Mohamad Salleh & Hani Sukadarin (2018), using Ovako Working Posture Assessment System (OWAS) analysis, they have identified postures of three activities that have been categorized in Action Category 3 which were planting (39.8%), harvesting (60.2%) and manual weeding (42.7%). Meanwhile, planting activity (17.5%) and manual weeding activity (27.2%) indicated as extremely harmful posture which fell under Action Category 4. Based on the risk assessment using a RULA technique, it found that all the tasks were posed a very high risk to the workers. As a result, it can contribute to injury and inflammation of muscle. tendons and other organs.

CHAPTER 3

METHODOLOGY

3.1 Study design

This was a cross-sectional study which aimed to determine the distribution of Musculoskeletal Symptoms (MSS), its risk factors and to conduct an ergonomic risk assessment among pineapple harvesters in Muar and Simpang Renggam, Johor.

3.2 Study location

This study was conducted at 10 pineapple plantations located in Muar and Simpang Renggam, Johor. These locations were selected because the areas were the largest pineapple plantation areas besides some of the workers were still using manual hand tool such as cleaver and rattan basket to perform their daily work tasks. The dependence on manual handling tool is very much associated with the type of pineapple cultivation and the type of soil in that area (Ya'acob, 2018). This area specifically cultivates pineapples that thrive well in peat soil. Figure 3.1 shows the map of state of Johor, Malaysia.

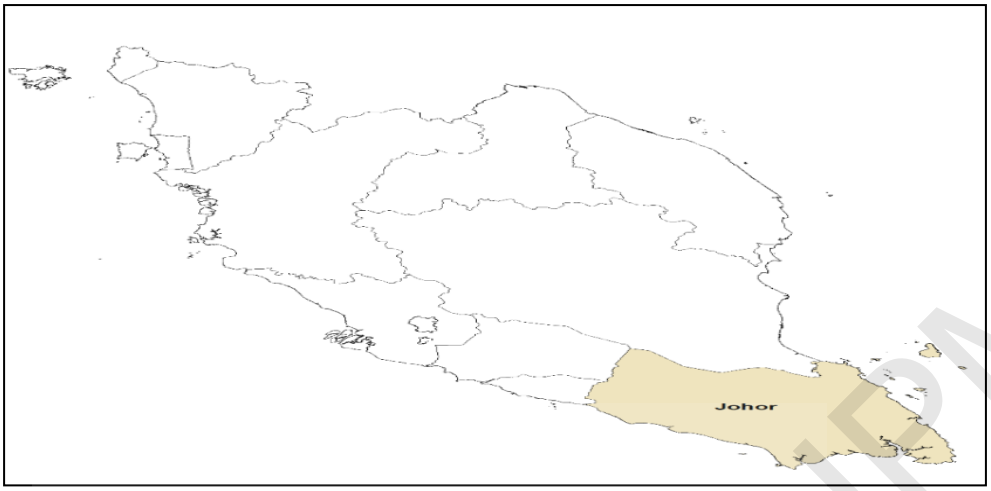


Figure 3.1: Map of Johor, Malaysia

3.3 Sampling

3.3.1 Sample population

The study population consisted of pineapple harvesting workers. The name list of the pineapple harvesting workers has be obtain from the management as a sampling frame for this study.

3.3.2 Sample unit

The pineapple harvesting workers were selected as a sampling unit respondent. The selection criteria for the sampling unit respondent were as below:

i) Inclusion criteria

1. Male workers
2. Age of 18 - 60 years old

3. Have been working at least 1 years and above as a pineapple haversting worker.
4. Full-time employment

ii) Exclusion criteria

1. Workers who had experienced an accident and injuries prior to working and were diagnosed with musculoskeletal disorder.
2. Workers who had performed one or more work tasks other than harvesting.
3. Workers who have been diagnosed with any systematic disease.

3.4 Sampling method

The study location was selected by using purposive sampling method because the pineapple harvesting activity are vigorously take placed and the fulfill criteria respondent was selected by using purposive sampling. All subject has been approached through Malaysian Pineapple Industry Board (MPIB) and with the help from wholesaler and gather together to obtained information regarding the study. Figure 3.2 shows the ten of location of pineapple plantations involved in this study.

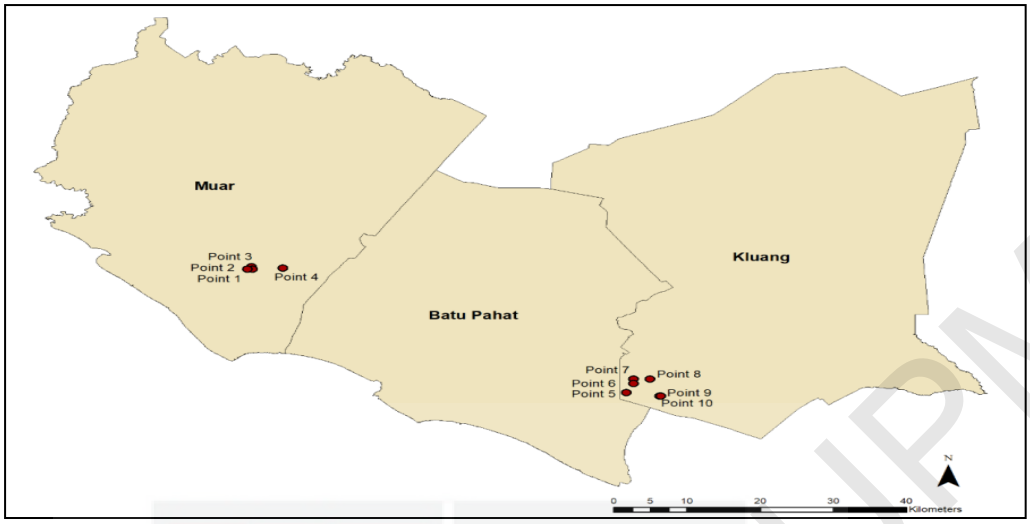


Figure 3.2: Map of selected point in Johor.

3.5 Sample size

a) To determine the sample size for objective (a) and (b) in the study, the formula from Kish L. (1965) was uses:

$$n = \frac{(Z_{1-\alpha})^2 \ P(1-P)}{d^2}$$

n = sample size

$Z_{1-\alpha}$ = statistic for level confidences = 1.96

P = 0.87 (Rani et al., 2016)

d = 0.1

Therefore, $n = \frac{(1.96)^2 \ 0.87(1-0.87)}{(0.1)^2}$

= 43

An additional 20% of a study population will be include to overcome the problem of low respond rate.

$$N = 43 + \left(\frac{20}{100} X\ 43\right)$$

= 52 respondents

b) To determine the sample size for objective (d) , the formula from Kish L. (1965) was used:

$$n = \frac{(Z_{1-\alpha})^2\ P(1-P)}{d^2}$$

n = sample size

$Z_{1-\alpha}$ = statistic for level confidences = 1.96

P = 0.034 (Rani et al., 2016)

d = 0.05

Therefore, the sample size is

$$\text{Therefore, } n = \frac{(1.96)^2\ 0.034(1-0.034)}{(0.05)^2}$$

= 50

An additional 20% of a study population will be include to overcome the problem of low respond rate.

$$N = 50 + \left(\frac{20}{100} X 50\right)$$

= 60 respondents

Thus, the total sample size is **60 respondents.**

3.6 Study instrument

In order to determine the prevalence of MSS, its risk factors and to assess the ergonomic risk factors, several instruments have been used as a research tool as following.

3.6.3 Standardize Cornell Musculoskeletal Discomfort Questionnaires

To conduct MSS assessment among the pineapples harvesting workers, a Standardize Cornell Musculoskeletal Questionnaires by has been used. This musculoskeletal assessment has been conducted for all type of risk factors in order to identify and validated the significant affected body parts. The symptoms assessed included neck, shoulder, upper back, upper arm, lower back, forearm, wrist, hip/buttock, thigh, knee, lower leg and foot.

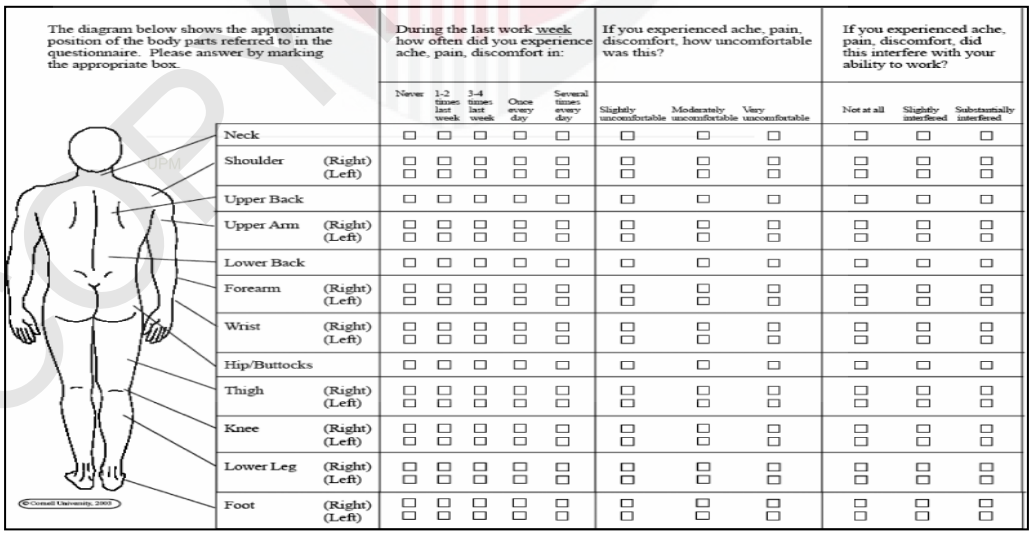


Figure 3.3: The Standardize Cornell Musculoskeletal Discomfort Questionnaire use to assess the MSS.

3.6.4 Structured Questionnaires

A structured questionnaire has been constructed to obtain an information from the workers. The questionnaires have been made up in two version language (Bahasa Melayu and English) and consist of 5 section.

Section A were asking about socio-demographic background of the workers which include age, gender, nationality, race, marital status, educational level, height, weight, BMI and family monthly income.

Section B were asking about social or lifestyle which include nicotine intake information and leisure time activity.

Section C were construct to obtain working information on previous and current job of the workers. This include work duration, working area and duration of employment.

Section D were asking about the worker's medical and health history. Information on current health status, treatment, medication, previous accident and injuries from workplace of the workers could be obtain.

The last part which is Section E, the Standardize Cornell Questionnaires were used to obtain information on MSS.

3.6.4 Ergonomic Risk Assessment (ERA)

To evaluate the whole-body postural risk factor associated with the harvesting work task, the Ergonomic Risk Assessment was conducted according to Ergonomic Risk Assessment at Workplace Guideline 2017 publish by DOSH. Video recording instrument is used to record the workers performing their task during the workplace visit.

For initial ERA, the initial ERA checklist was used to identify the risk factors present at the workplace. The work performed by the workers has been record from various perspective by using video recording and had been used as observation material and analysis in both level of ERA.

Risk factors	Total Score	Minimum requirement for advanced assessment	Result of Initial ERA	Any Pain or Discomfort due to risk factors as found in Musculoskeletal Assessment (refer Part 3.1) (Yes/No)	Need Advanced ERA? (Yes/No)
Awkward Postures	13	≥ 6		YES / NO	
Static and Sustained Work Posture	3	≥ 1		*If YES, please tick (√) which part of the body*	
Forceful Exertion	1	1		Neck	
Repetitive Motion	5	≥ 1		Shoulder	
Vibration	4	≥ 1		Upper back	
Lighting	1	1		Upper arm	
Temperature	1	1		Lower back	
Ventilation	1	1		Forearm	
Noise	2	≥ 1		Wrist	
				Hand	
				Hip/buttocks	
				Thigh	
				Knee	
				Lower leg	
				Feet	

Figure 3.4: Checklist use to determine the ergonomic risk factor.

For the advances ERA, a few tools have been used which include:

i. Rapid Entire Body Assessment (REBA) checklist

REBA was developed by Highnett and McAtamney as a means to assess entire body posture for risk associated with work task. The risk evaluation was done based on video recording during the workers performed their work task. The risk level was determined based on the calculation in REBA checklist. The obtain scores were used to determine the risk levels. The data obtained were entered and analysed by using Windows Excel spread sheet and REBA software developed by Cornell University Ergonomics Web (CUErgo) (2015).

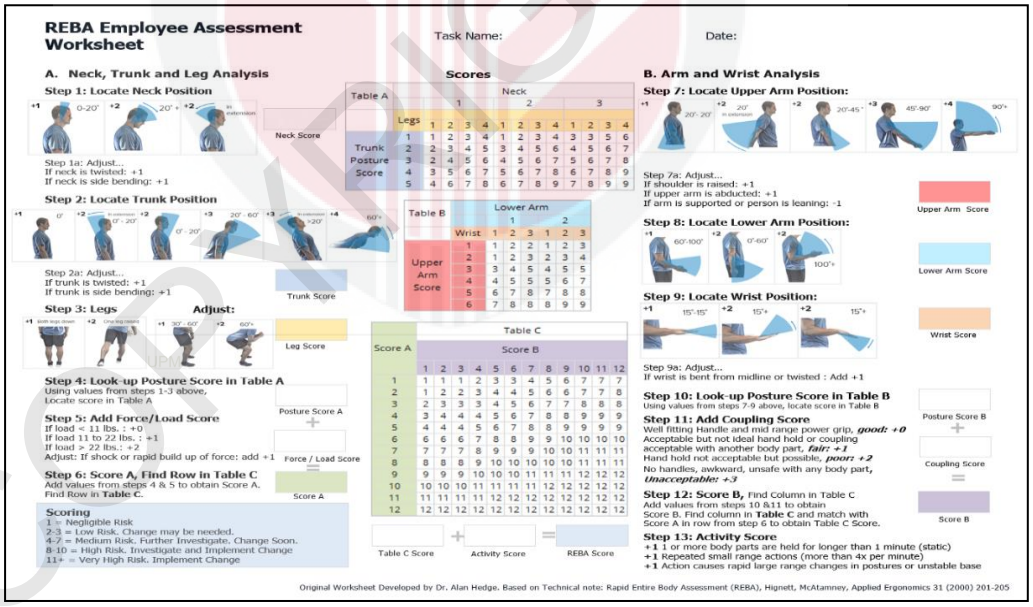
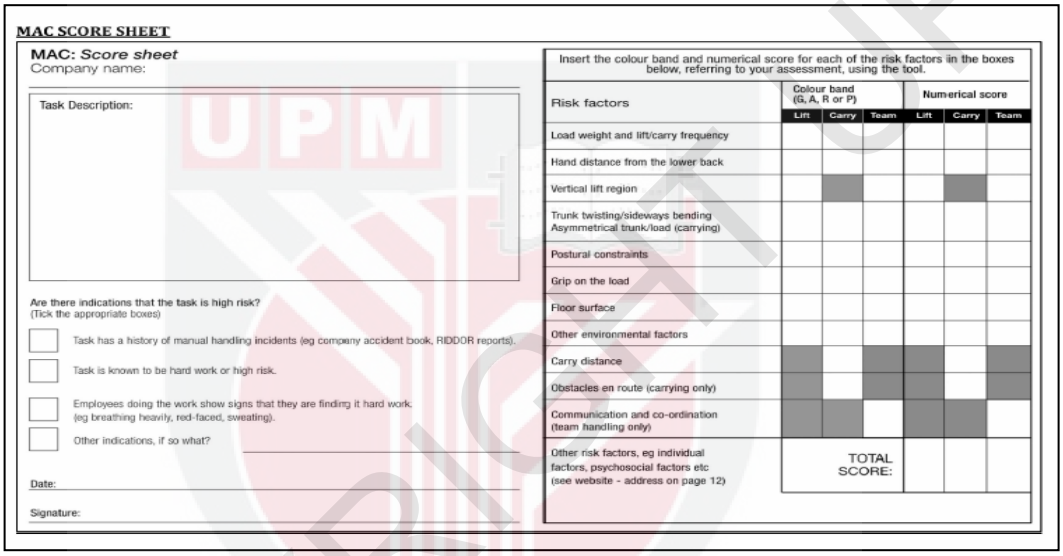


Figure 3.5: REBA checklist used for awkward posture assessment.

ii. Manual Handling Assessment (MAC) Tool

MAC tool was used to assess and evaluate the most common risk factors in lifting and lowering operation and the risk level was evaluate by using MAC checklist fully guided in DOSH guideline.



MAC SCORE SHEET

MAC: *Score sheet*
Company name:

Task Description:

Are there indications that the task is high risk?
(Tick the appropriate boxes)

- ☐ Task has a history of manual handling incidents (eg company accident book, RIDDOR reports).
- ☐ Task is known to be hard work or high risk.
- ☐ Employees doing the work show signs that they are finding it hard work. (eg breathing heavily, red-faced, sweating).
- ☐ Other indications, if so what?

Date:

Signature:

Insert the colour band and numerical score for each of the risk factors in the boxes below, referring to your assessment, using the tool.

Risk factors	Colour band (G, A, R or P)			Numerical score		
	Lift	Carry	Team	Lift	Carry	Team
Load weight and lift/carry frequency						
Hand distance from the lower back						
Vertical lift region						
Trunk twisting/sideways bending Asymmetrical trunk/load (carrying)						
Postural constraints						
Grip on the load						
Floor surface						
Other environmental factors						
Carry distance						
Obstacles en route (carrying only)						
Communication and co-ordination (team handling only)						
Other risk factors, eg individual factors, psychosocial factors etc (see website - address on page 12)	TOTAL SCORE:					

Figure 3.6: MAC score sheet use for forceful exertion.

iii. Assessment of Repetitive Task (ART) tool

ART tool was used to assess the common risk factors in task that involve repetitive movement of the upper limbs (arm and hands). This assessment was done based on observation and interview that focusing on both right and left hand of the workers. The assessment is split into four stages which is frequency and repetition of movements, force, awkward posture and additional factors to be considered.

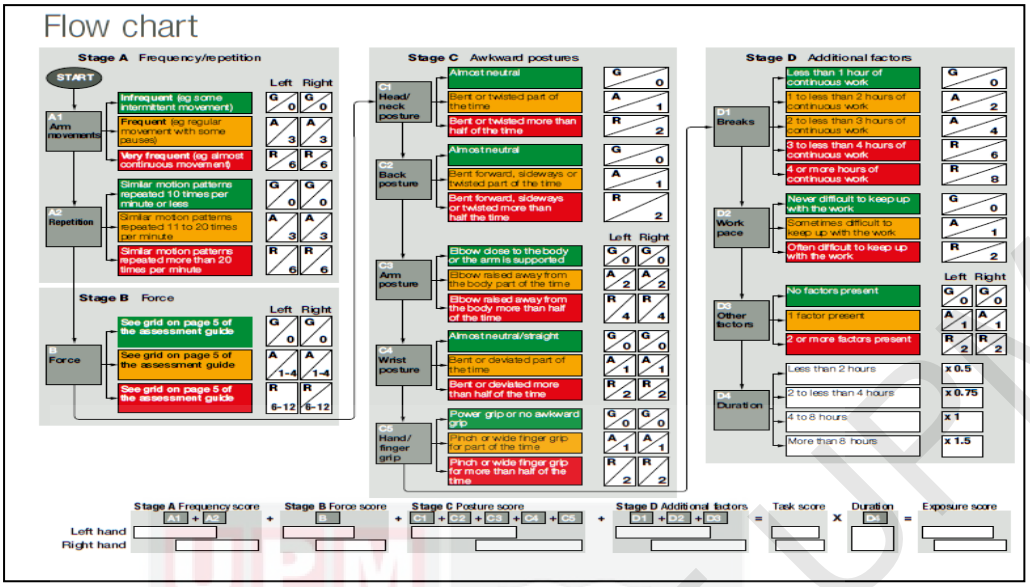


Figure 3.7: ART checklist used for repetitive motion assessment.

3.6.5 Seca body meter and Tanita weighting scale

The Seca body meter and the Tanita weighting scale were used to obtain the respondent height and weight of respondents, respectively. All this information were used to determine the respondents' BMI.

3.7 Validity

A pre-test was conducted prior to the actual data collection to validate the questionnaires. The questionnaires have been administered to 10% of the intended total number of sample size. The pineapple harvesting workers had been chosen to be the respondent of the study. The ambiguous terms have been identified during the pre-test and the questionnaires have been amended accordingly.

3.8 Reliability

The reliability of the questionnaire was tested by using the Cronbach Alpha test. The reliability of the questionnaires in this study is 0.977 which indicates an excellent level of internal consistency.

3.9 Quality Control

Back-to-back translation of questionnaire was performed as a quality control. The English version were translated to Malay version without changing the actual meaning of the question. The respondents were guided and supervised by the researcher to ensure there will be no misunderstood question and misleading answer while answering the question.

3.10 Data collection

The data was collected collection based on questionnaires has been conducted using face to face interview to obtain the personal information and MSS information as well as to ensure the privacy and confidentiality. Then, the ERA was been conducted through the video recording at a point of time the workers performing the job which later being used to analyses the ergonomic risk factor.

3.11 Study flowchart

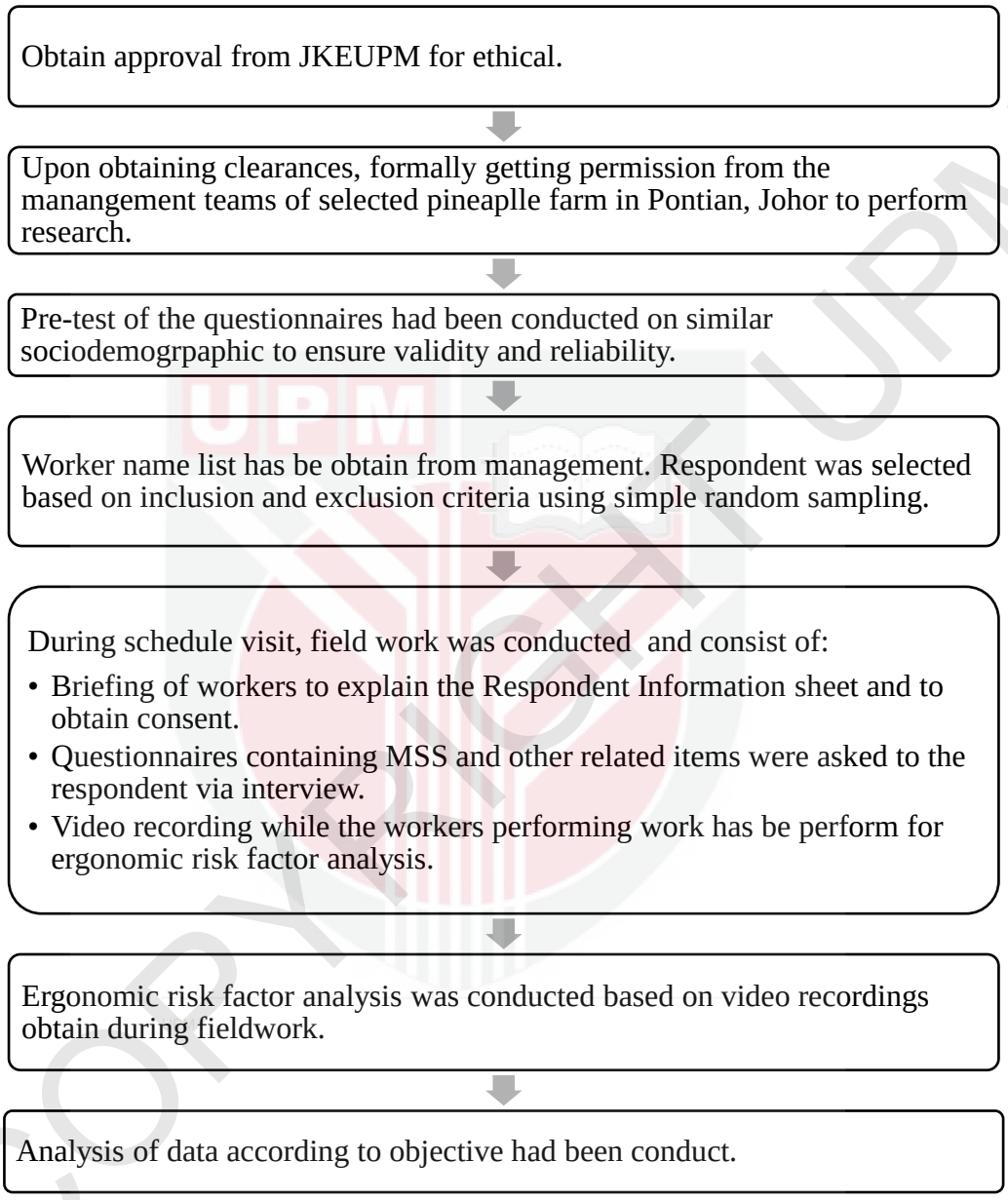


Figure 3.8: Flowchart of the study.

3.12 Statistical Analysis

All the statistical analysis was performed using the IBM SPSS Statistics 25 (SPSS Inc., Chicago, IL, USA). The descriptive analysis was performed in order to determine the sociodemographic distribution, Musculoskeletal Symptoms and to assess the ergonomic risk factor based on work process. Meanwhile, the chi-square analysis was performed for the purpose of determining the association between occupational and non-occupational risks with MSS among pineapple harvesting workers. Furthermore, the multiple logistic regression analysis was performed in order to determine the significant predictors of occupational and non-occupational risk factors that contribute to the reported MSS among pineapple harvesting workers.

Table 3.1: Data analysis for each specific objective.

Objectives	Data Analysis Method
To determine the sociodemographic distribution of the pineapple harvesting workers.	Descriptive Analysis
To determine the distribution of Musculoskeletal Symptom among the pineapple harvesting workers.	Descriptive Analysis
To assess the ergonomic risk factor based on work process among the harvesting pineapple workers.	Descriptive Analysis
To determine the association between occupational and non-occupational risk factors with MSS among pineapple harvesting workers.	Chi-Square test and Multiple Logistic Regression

CHAPTER 4

RESULT

4.1 Distribution of sociodemographic characteristics distribution of pineapple harvesting workers

The descriptive analysis for the sociodemographic characteristics of pineapple harvesting workers were depicted in Table 4.1. This study was conducted among male workers who were in the age of 18 to 60 years old with the total number of 60 workers. An average (SD) age of respondents was 37.13 (10.72) years old. This finding shows that the 25% (n = 15) of respondents were in the age of less than 30 years old while 75% (n = 45) of them were more than 30 years old.

About 16.7 % of them was Malaysian and the rest was non-Malaysian (83.3%). All the Malaysian respondents were Malay. Most of them (78.3%, n = 47) were married and more than half which was 56.7% (n = 34) received secondary educational level. Only 1.7% (n = 1) of the respondent attained tertiary educational level. The workers had an average BMI of 22.83 (4.0) which indicated that more than half (51.7%, n= 31) of them have a normal BMI followed by overweight (35%, n =21) and underweight

(13.3%, n = 8).The workers earned a median (IQR) of RM 2000 (500) income per month. The information on sociodemographic characteristics are presented in Table 4.1.

Table 4.1: Sociodemographic characteristics of respondents (N = 60)

Variable	N (%)	Mean ± SD	Median (IQR)
Age (years old)		37.13 ± 10.72	36 (14)
≤ 30	15 (25.0)		
>30	45 (75.0)		
Gender			
Male	60 (100)		
Female	0 (0)		
Nationality			
Malaysian	10 (16.7)		
Non-Malaysian	50 (83.3)		
Race			
Malay	10 (16.7)		
Chinese	0 (0)		
Indian	0 (0)		
Others	50 (83.3)		
Marital status			
Single	13 (21.7)		
Married	47 (78.3)		
Others	0 (0)		
Salary income (RM)		2088.30 ± 1385.58	2000 (500)
Education level			
Informal education	6 (10)		
Primary education	19 (31.7)		
Secondary education	34 (56.7)		
Tertiary education	1 (1.7)		
BMI		22.83 (4.0)	22.4 (6.33)
Underweight	8 (13.3)		
Normal	31 (51.7)		
Overweight	21 (35.0)		

N = frequency

SD = standard deviation

IQR = interquartile range

More than half of the workers (73.3%, n = 44) were smokers and most of them (58.3%, n = 35) smoked more than five cigarettes per day. Furthermore, there were few activities have been performed by respondents during their leisure time such as fishing (33.3%, n = 20), sport (11.7%, n = 7), farming (11.7%, n = 7), hunting (1.7%, n = 1) and surfing internet (1.7%, n = 1). More than half of them (61.7%, n = 37) have spent about less than four times per months on their hobby. The information on lifestyle are presented in Table 4.2.

Table 4.2: Lifestyle information (N = 60)

Variable	N (%)
Smoking status	
Yes	44 (73.3)
No	16 (26.7)
Number of cigarettes per day (n)	
≤ 5	9(15.0)
>5	35 (58.3)
Leisure activity	
Hunting	1 (1.7)
Fishing	20 (33.3)
Sports	7 (11.7)
Farming	7 (11.7)
Surfing Internet	1 (1.7)
Others	24 (40)
Leisure activity Frequency (per month)	
≥ 4 times	23 (38.3)
< 4 times	37 (61.7)

N = frequency

Majority of the workers had working experience from previous employment which was 66.7% (n =40) prior to the present work. The pineapple harvesting workers had work in pineapple plantation for an average 6.76 ± 8.10 years which most of them worked for up to 8 hours (61.7%) per day. Only 13.3% of the workers are doing other job after their working hours in harvesting pineapple. The information on work are presented in Table 4.3.

Table 4.3: Working information of respondents (N = 60)

Variable	N (%)	Mean ± SD	Median (IQR)
Previous Employment			
Yes	40 (66.7)		
No	20 (33.3)		
Year of working (year)		6.76 ±8.10	4 (9)
< 5	35 (58.3)		
5 – 10	12 (20)		
> 10	13 (21.7)		
Working status as a harvester			
Full-time	60 (100)		
Half Time	0 (0)		
Shift	0 (0)		
Full-time duration			
< 5 hours	1 (1.7)		
5 to 7 hours	22 (36.7)		
8 hours	37(61.6)		
Did other part-time job			
Yes	8 (13.3)		
No	52(86.7)		

N = frequency

SD = standard deviation

IQR = interquartile range

4.2 Distribution of Musculoskeletal Symptom (MSS)

The overall distribution of reported MSS among pineapple harvesting workers was 76.7% (n = 46). The most affected body parts as reported by the workers were shoulder accounted for 63.3% followed by lower back (46.7%) and foot (53.3%). The other body parts that were least reported by the workers neck (21.7%), upper back (25.0%), right upper arm (28.3%), left upper arm (31.7%), right forearm (28.3%), left forearm (26.7%), right wrist (25.0%), left wrist (21.7%), hip/ buttocks (30.0%), thigh (18.3%), knee (30.0%) and lower leg (35.0%). The information on distribution of reported MSS are presented in Table 4.4 and Figure 4.1.

Table 4.4: Distribution of MSS among pineapple harvesting workers (N = 60)

Variable		Frequency (N)	Percent (%)
Overall MSS		46	76.7
Neck		13	21.7
Shoulder		38	63.3
Upper back		15	25.0
Upper Arm			
	Right	17	28.3
	Left	19	31.7
Lower back		28	46.7
Forearm			
	Right	17	28.3
	Left	16	26.7
Wrist		15	25
	Right	15	25.0
	Left	13	21.7
Hip / Buttocks		18	30.0

Thigh	11	18.3
Knee	18	30.0
Lower leg	21	35.0
Foot	32	53.3

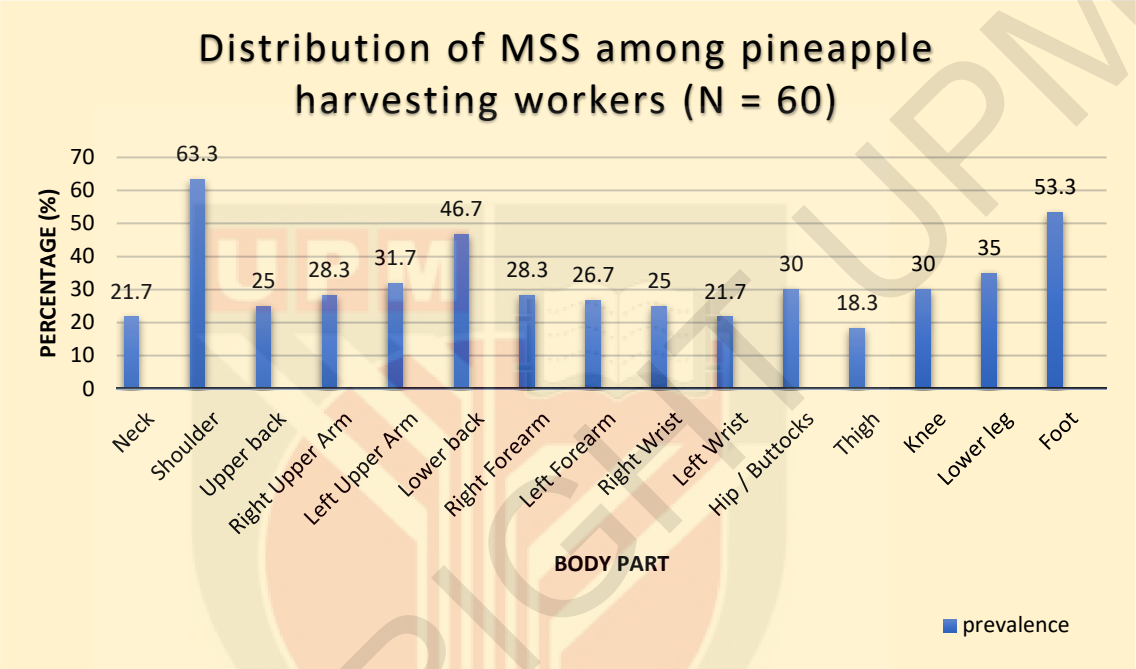


Figure 4.1: Distribution of MSS among pineapple harvesting workers (N = 60)

4.3 Ergonomic Risk Assessment (ERA)

Ergonomic risk assessment was conducted among 14 workers in which two workers were selected to represent each of study point locations.

At first, the Initial ERA have been conducted to identify the risk factors that present in the pineapple harvesting work tasks. According to table 4.5, it shows that several risk factors namely awkward posture, forceful exertion, repetitive motion and temperature required the advances ERA as the total score have exceeded the minimum requirement for advanced assessment.

Table 4.5: Initial Ergonomic Risk Assessment. (N= 14)

<table>
<tr><th>Risk Factor</th><th>Total Score</th><th>Minimum requirement for advanced assessment</th><th>Result of Initial ERA</th><th>Any Pain or Discomfort due to risk factors as found in Musculoskeletal Assessment (Yes / No)</th><th>Need Advances ERA? (Yes / No)</th></tr>
<tr><td>Awkward Postures</td><td>13</td><td>≥ 6</td><td>6</td><td rowspan="10">YES / NO
If YES, please tick (/) which part of the body
<table><tr><td>Neck</td><td>/</td></tr><tr><td>Shoulder</td><td>/</td></tr><tr><td>Upper back</td><td>/</td></tr><tr><td>Upper arm</td><td>/</td></tr><tr><td>Lower back</td><td>/</td></tr><tr><td>Forearm</td><td>/</td></tr><tr><td>Wrist</td><td>/</td></tr><tr><td>Hand</td><td></td></tr><tr><td>Hip / buttock</td><td>/</td></tr><tr><td>Thigh</td><td>/</td></tr><tr><td>Knee</td><td>/</td></tr><tr><td>Lower leg</td><td>/</td></tr><tr><td>Feet</td><td>/</td></tr></table></td><td>Yes</td></tr>
<tr><td>Static and Sustained Work Posture</td><td>3</td><td>≥ 1</td><td>0</td><td>No</td></tr>
<tr><td>Forceful Exertion</td><td>1</td><td>1</td><td>1</td><td>Yes</td></tr>
<tr><td>Repetitive Motion</td><td>5</td><td>≥ 1</td><td>3</td><td>Yes</td></tr>
<tr><td>Vibration</td><td>4</td><td>≥ 1</td><td>0</td><td>No</td></tr>
<tr><td>Lighting</td><td>1</td><td>1</td><td>0</td><td>No</td></tr>
<tr><td>Temperature</td><td>1</td><td>1</td><td>1</td><td>Yes</td></tr>
<tr><td>Ventilation</td><td>1</td><td>1</td><td>0</td><td>No</td></tr>
<tr><td>Noise</td><td>2</td><td>≥ 1</td><td>0</td><td>No</td></tr>
</table>

Evaluation of body postural risk was conducted on two specific work tasks which were loading and unloading. Based on the output of initial observation and workers' interview session, both tasks were seemed as the most difficult postures and work tasks to be performed. The workers required to sustain the postures for the long period of time during the pineapple loading process and the high force load occurred along the work process until the unloading of the pineapples. Based on the rapid entire body assessment (REBA) for awkward posture that had been conducted among 14 workers, the result shows that the loading work task were fell under high risk (8-10)

categories meanwhile the unloading work task are fall into very high risk (> 10) categories. The result of the postural body risk among the workers is shown in the Table 4.6. Figure 4.2 and 4.3 depict the example of working postures during the loading and unloading processes with REBA score, respectively.

Table 4.6: Rapid Entire Body Assessment (REBA) for awkward posture (N = 14)

Awkward Posture	REBA Score			
	Loading		Unloading	
	Frequency (N)	**Percent (%)**	**Frequency (N)**	**Percent (%)**
1 (Negligible Risk)				
2-3 (Low Risk)				
4-7 (Medium Risk)				
8-10 (Hight Risk)	14	100		
>11 (Very High Risk)			14	100

Figure 4.2: An example of working posture during the loading process with REBA score of high risk.

Figure 5: An example of working posture during unloading work process with REBA score very high risk

MAC assessment for forceful exertion was done particularly on lifting process during pineapple loading. Based on the table 4.7, it shows that the score was fell under "5 -12" which indicated that action was required in the near future. The result of the forceful exertion among the workers is shown in the Table 4.7.

Table 4.7: Manual-handling Assessment Charts (MAC) assessment for forceful exertion (N=14)

Forceful Exertion	MAC Score	
	Frequency (N)	**Percent (%)**
0-4 (No Action Required)		
5-12 (Action Required in the near future)	14	100
13-20 (Action Required Soon)		
21-31 (Action Required Immediately)		

ART assessment for repetitive movement was conducted among the workers as the work process has involved both right and left-hand during loading of pineapple. Based on table 4.8, the exposure score for both left and right hand were fell into high exposure level and further investigation was required immediately in order to reduce the risk.

Table 4.8: Assessment of Repetitive Tasks (ART) assessment for repetitive motion (N = 14)

Repetitive motion	ART score			
	Right Arm		Left Arm	
	Frequency (N)	Percent (%)	Frequency (N)	Percent (%)
0 -11 (Low) 12 -21(Medium) ≥ 22 (High)	14	100	14	100

4.4 Association between occupational and non-occupational risk factor with MSS

The top three most reported MSS namely shoulder, lower back pain and feet (as shown in figure 4.1) were included in the bivariate analysis. The chi-square test was performed in order to determine the association of several occupational risk factors and non-occupation risk factors with the occurrence of these top three most reported MSS among respondents. The non-occupational risk factors were age, BMI, educational level, smoking status, number of cigarettes per day, leisure activity and frequency of leisure activity. Meanwhile, occupational risk factors were the previous employment, full time duration, years of working and did other part time job.

The association between reported MSS with non- occupational and occupational risk factors are presented in Table 4.9. The finding shows that there was no significant association between non - occupational risk factors such as age, BMI, educational level, smoking status, number of cigarettes per day, leisure activity and frequency of leisure activity with any of reported MSS among respondents ($p > 0.05$).

In addition, several occupational risk factors such as previous employment, years of working and doing part- time jobs were found to have a significant association with the few reported MSS. This study reveals that years of working were significantly associated with reported shoulder pain ($X^2 = 8.040$, $p = 0.018$). Meanwhile, the previous employment and doing part time job were shown to be significantly associated with the reported lower back pain ($X^2 = 9.676$, $p < 0.01$) and ($p < 0.05$), respectively.

Table 4.9: Association between occupational and non-occupational risk factors and three highest reported Musculoskeletal Symptoms (MSS) (N = 60)

Variable	Shoulder					Lower Back					Feet				
	Yes	No	N (%)	X^2	p-value	Yes	No	N (%)	X^2	p-value	Yes	No	N (%)	X^2	p-value
	n (%)	n (%)				n (%)	n (%)				n (%)	n (%)			
Non occupational factors															
Age (years old)															
≤30	8 (13.3)	7 (11.7)	15 (25.0)	0.861	0.353	8 (13.3)	7 (11.7)	15 (25.0)	0.357	0.550	6 (10.0)	9 (15.0)	15 (25.0)	1.429	0.232
>30	30 (50.0)	15 (25.0)	45 (75.0)			20 (33.3)	25 (41.7)	45 (75.0)			26 (43.3)	19 (31.7)	45 (75.0)		
BMI															
Underweight	7 (11.7)	1 (1.7)	8 (13.3)	4.438	0.109	3 (5.0)	5 (8.3)	8 (13.3)	0.577	0.749	4 (6.7)	4 (6.7)	8 (13.3)	0.195	0.907
Normal	16 (26.7)	15 (25.0)	31 (51.7)			14 (23.3)	17 (28.3)	31 (51.7)			16 (26.7)	15 (25.0)	31 (51.7)		
Overweight	15 (25.0)	6 (10.0)	21 (35.0)			11 (18.3)	10 (16.7)	21 (35.0)			12 (20.0)	9 (15.0)	21 (35.0)		
Education level															
Informal education	5 (8.3)	1 (1.7)	6 (10.0)	2.354	0.502	3 (5.0)	3 (5.0)	6 (10.0)	1.595	0.661	3 (5.0)	3 (5.0)	6 (10.0)	2.569	0.463
Primary education	11 (18.3)	8 (13.3)	19 (31.7)			8 (13.3)	11 (18.3)	19 (31.7)			12 (20.0)	7 (11.7)	19 (31.7)		
Secondary education	21 (35.0)	13 (21.7)	34 (56.7)			17 (28.3)	17 (28.3)	34 (56.7)			16 (26.7)	18 (30.0)	34 (56.7)		
Tertiary education	1 (1.7)	0 (0.0)	1 (1.7)			0 (0.0)	1 (1.7)	1 (1.7)			1 (1.7)	0 (0.0)	1 (1.7)		
Smoking status															
Yes	10 (16.7)	6 (10.0)	16 (26.7)	0.007	0.936	19 (31.7)	25 (41.7)	44 (73.7)	0.805	0.370	25 (41.7)	19 (31.7)	44 (73.3)	0.805	0.370
No	28 (46.7)	16 (26.7)	44 (73.3)			9 (15.0)	7 (11.7)	16 (26.7)			7 (11.7)	9 (15.0)	16 (26.7)		

Number of cigarettes per day (n)															
≤ 5	5 (11.4)	4 (9.1)	9 (20.5)	x	0.702	3 (6.8)	6 (24.0)	9 (20.5)	x	0.710	4 (16.0)	5 (11.4)	9 (20.5)	x	0.467
> 5	23 (52.3)	12 (27.3)	35 (79.5)			16 (36.4)	19 (43.2)	35 (79.5)			21 (47.7)	14 (31.8)	35 (79.5)		
Leisure activity															
Hunting	1 (1.7)	0 (0.0)	1 (1.7)	4.750	0.447	0 (0.0)	1 (1.7)	1 (1.7)	4.178	0.524	1 (1.7)	0 (0.0)	1 (1.7)	10.070	0.073
Fishing	14 (23.3)	6 (10.0)	20 (33.3)			11 (18.3)	9 (15.0)	20 (33.3)			14 (23.3)	6 (10.0)	20 (33.3)		
Sports	4 (6.7)	3 (5.0)	7 (11.7)			2 (3.3)	5 (15.0)	7 (11.7)			1 (1.7)	6 (10.0)	7 (11.7)		
Farming	3 (5.0)	4 (6.7)	7 (11.7)			3 (5.0)	4 (6.7)	7 (11.7)			3 (5.0)	4 (6.7)	7 (11.7)		
Surfing Internet	0 (0.0)	1 (1.7)	1 (1.7)			0 (0.0)	1 (1.7)	1 (1.7)			0 (0.0)	1 (1.7)	1 (1.7)		
Others	16 (26.7)	8 (13.3)	24 (40.0)			12 (20.0)	12 (20.0)	24 (40.0)			13 (21.7)	11 (18.3)	24 (40.0)		
Leisure activity Frequency (per month)															
≥ 4 times	13 (21.7)	10 (16.7)	23 (38.3)	0.745	0.388	10 (16.7)	13 (21.7)	23 (38.3)	0.152	0.696	11 (18.3)	12 (20.0)	37 (61.7)	0.455	0.500
< 4 times	25 (41.7)	12 (20.0)	37 (61.7)			18 (30.0)	19 (31.7)	37 (61.7)			21 (35.0)	16 (26.7)	23 (38.3)		
Occupational factors															
Previous Employment															
Yes	24 (40.0)	16 (26.7)	40 (66.7)	0.574	0.449	13 (21.7)	27 (45.0)	40 (66.7)	9.676	0.002 *	22 (36.7)	18 (30.0)	40 (66.7)	0.134	0.714

No	14 (23.3)	6 (10.0)	20 (33.3)			15 (25.0)	5 (8.3)	20 (33.3)			10 (16.7)	10 (16.7)	20 (33.3)		
Full-time duration															
< 5 hours	1 (1.7)	0 (0.0)	1 (1.7)	0.936	0.626	0 (0.0)	1 (1.7)	1 (1.7)	1.878	0.391	0 (0.0)	1 (1.7)	1 (1.7)	2.804	0.246
5 to 7 hours	14 (23.3)	8 (13.3)	22 (36.7)			9 (15.0)	13 (21.7)	22 (36.7)			14 (23.3)	8 (13.3)	22 (36.7)		
8 hours	23 (28.3)	14 (23.3)	37 (61.7)			19 (31.7)	18 (30.0)	37 (61.7)			18 (30.0)	19 (31.7)	37 (61.7)		
Year of working (year)															
< 5 years	18 (30.0)	17 (28.3)	35(58.3)	8.040	0.018 *	15 (25.0)	20 (33.3)	35 (58.3)	0.527	0.768	17 (28.3)	18 (30.0)	35 (58.3)	1.693	0.429
5 – 10 years	8 (13.3)	4 (6.7)	12(20)			6 (10.0)	6 (10.0)	12 (20.0)			6 (10.0)	6 (10.0)	12 (20.0)		
> 10 years	12 (20.0)	1 (1.7)	13(21.7)			7 (11.7)	6 (10.0)	13 (21.7)			9 (15.0)	4 (6.7)	13 (21.7)		
Did other part-time job															
Yes	5 (8.3)	3 (5.0)	8 (13.3)	x	1.000	0 (0.0)	8 (13.3)	8 (13.3)	x	0.005 *	3 (5.0)	5 (8.3)	8 (13.3)	x	0.454
No	33 (55.0)	19 (31.7)	52 (86.7)			28 (46.7)	24 (40.0)	52 (86.7)			29 (48.3)	23 (38.3)	52 (86.7)		

N = frequency

** significant at p value <0.05*

** x indicates for Fisher Exact Test*

Based on Table 10, three of the risk factors for both shoulder and lower back which namely previous employment, years of working and did other part time job were found to be significantly associated with MSS reporting in the past 7 days. These significant risk factors were further analysed by using multiple logistic regression which adjusted for age, BMI and smoking.as presented in Table 11. Other risk factors also such as leisure activity frequency were also being included in this analysis. The result shows that pineapple harvesting workers without previous employment were 0.046 (95% CI 0.005 to 0.391) less likely to experiences lower back pain compared to who have previous employment ($p < 0.05$).

For reporting of shoulder pain, the model explained between 23% (Cox and Snell R Square) and 31% (Nagelkerke R Square) of variances in reported the symptom and correctly classified 63.24% of cases. Meanwhile, for reporting of lower back pain, the model explained between 35% (Cox and Snell R Square) and 46% (Nagelkerke R Square) of variances in reported the symptom and correctly classified 57.43% of cases.

Table 4.10: Logistic regression on risk factors associated with reported MSS among pineapple harvester workers (N = 60)

Variable	Shoulder				Lower Back			
	Odd ratio (OR)	95% Confidence Interval		p-value	Odd ratio (OR)	95% Confidence Interval		p-value
		Lower	Upper			Lower	Upper	
Occupational factors								
Previous Employment (Yes[b])								
No	0.705	0.116	4.295	0.705	0.046	0.005	0.391	0.005*
Year of working (year) (< 5 years[b])								
5 – 10 years	1.416	0.271	7.408	0.680	1.606	0.217	11.861	0.642
> 10 years	7.861	0.722	85.634	0.091	0.188	0.019	1.843	0.151
Did other part-time job (No [b])								
Yes	0.242	0.025	2.291	0.216	0.000	0.000	-	0.999
Non-occupational factors								
Smoking status (No[b])								
Yes	1.908	0.381	9.556	0.432	2.611	0.491	13.881	0.260
Leisure activity Frequency (per month) (< 4 times[b])								
≥ 4 times	0.738	0.190	2.846	0.660	2.068	0.491	8.711	0.322
BMI (Underweight [b])								
Normal	6.436	0467	88.795	0.164	0.732	0.076	7.010	0.787
Overweight	0.297	0.062	1.433	0.130	5.192	0.385	70.032	0.215
Age (years old) (≤30[b])								
>30	2.087	0.444	17.760	0.273	4.183	0.508	34.471	0.184
Classification rate		63.244 (68.2/86.8)				57.430 (68.2/86.8)		
Cox & Snell R Square Nagelkerke R square		0.229 - 0.313				0.346 - 0.462		

**significant at p<0.05*

[b] *reference*

CHAPTER 5

DISCUSSION

5.1 Distribution of MSS

Previous studies have reported that MSS were commonly experienced among agricultural workers. Evidences have shown that farmers were exposed to musculoskeletal problems which occurred due to the physical demands on the body, awkward posture, prolong standing and kneeling, stooping, bending, twisting, heavy load lifting and repetitive muscle activity (Naeini et al., 2014). All these postures will result in fatigue, illness, accident and contributed to various MSS.

In this current study, the distribution of MSS for the past 7 days was 76.7% as reported by the workers. This finding was in line with the previous study. According to the study conducted by Razak and collegues (2014), the prevalence reported by the workers was 71.7% and a study conducted by Widyanti (2018) among Indonesian farmers has found that the prevalence of reported MSS was 76.1%. Another study conducted by Jain and collegues (2018) among manual harvesting farmers in India showed that 76.4% of the respondent had experiences MSS.

However, the prevalence of reported MSS in this current study was slightly lower compared to the previous studies [Rani et al., 2016 (87%), Ng et al., 2014 (86%), and Thetkatheuk et al. (2018) (80%)]. Based on the pineapple harvesting work tasks, the workers were exposed to a combination of adverse ergonomics work conditions. The distribution was considered higher because workers experienced a postural stress due to awkward posture and stooping in addition to forceful exertion and a rapid work pace (Ng et. al., 2014) as well as equipment that was not ergonomically designed to lessen the impact (Kirkhorn et al., 2010).

In terms of the body parts, the highest prevalence of MSS was reported at shoulder (63.3%, n = 38) followed by foot (53.3%, n = 32) and lower back (46.7%, n= 28). Similar to other study by Rani et. al. (2016), the most affected body part were lower back and feet. A study conducted by Widyanti (2018) stated that shoulder and lower back were the most commonly affected body parts with highest reported prevalence accounted for 76.1% and 74.9% respectively. Another study reported that shoulder (19.2%) (Razak et al., 2014), lower back (52.9%) and leg (14.8%) (Meksawi et al., 2012) were the highest reported MSD among respondents. Heavy workload carries by the worker that are linked to harvesting tasks have been shown to increase a hazardous on the lumbar area which contribute to the reporting of MSS at the shoulder and feet (Mezlan et al., 2017). From a study by McMillan and colleagues (2015), lower back symptoms were significant outcome of biomechanical tasks, whereas different MSD were significant for each of another task.

The occurrence of three significant MSS reported among pineapple harvesting workers were may be due to strenuous work task arise from heavy lifting, repetitive work task and awkward posture. This is because the workers required to carry a full load of basket with approximately 50kg and up to 70 kg of pineapple with modified basket at their back with poor design of strap that connecting the basket to the body during the loading work process and also required the workers to walk on the unstable base of the peat soil while harvesting and through their way to the unloading area.

Apart from that from the interview with the worker, they also had experience sprained leg especially during the raining season as the base of the peat soil become more unstable and difficult to walk with the load carried at their back. The workers will carry cumulatively up to 500 – 600 kg per day which exceeded the safe limit and ideal lifting load of 23kg or 51 lbs as suggested by NIOSH (Mezlan et al., 2017). Figure 5.1 shows the different between with and without modification.

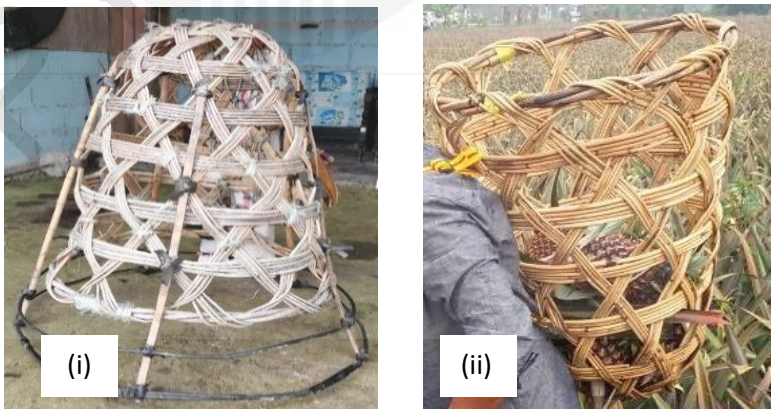


Figure 5.1: Rattan basket with (i) and without (ii) modification

According to a study by Salleh and Sukadirin (2019), the most critical postures that associated with harvesting were trunk (bend forward) and legs (squatting, stooping and standing one leg bend). Postural problem was the most critical as pineapple plantation workers were exposed to musculoskeletal problems such as lower back due to awkward and extreme posture. The condition got worsened during the process of unloading the pineapple onto the ground where workers tend to bend their body excessively (Rani et al., 2016).

Detail observation had shown that there was different prevalence between both right and left of upper arm, forearm and wrist. This was because the harvesting work tasks have involved the repetitive movement of both hands of workers. The result showed that left upper arm had higher prevalence (31.7%) compared to right upper arm (28.3%). It might be due to the used of left hand to hold the pineapple during cutting while the arms were fully outstretched above or at their head level to throw the pineapple into the basket that had been carried at their back (Mezlan et al., 2017). As mentioned by Ng and colleagues (2014), hand and arm had become the most potentially affected body areas during harvesting task due to the nature of the job requirement.

Apart from that, the right forearm and wrist have shown higher prevalence with 28.3 % and 25% respectively as reported by the workers compared to the left side. This was due to excessive forces applied by the workers during the cutting process. They used their right hand to hold with powerful grip without awkwardly grip a long cutting knife known as machete. Particularly, pain in the hand and arms were the most

commonly reported symptoms in association with production agriculture (Ng et al., 2014)

5.2 Ergonomic Risk Assessment

Ergonomic risk factor was one of the main hazards that present at the workplace. Based on the table 4.5, it showed that the awkward posture, forceful exertion, repetitive motion and extreme temperature were the most significant risk factors in the pineapple harvesting work process. This finding was in line with the previous study by Fathallah (2010) and Widyanti (2018) where the literature has shown three main priority risk factors in agriculture sector which included lifting and carrying heavy workload (over 50lbs), sustained or repeated full body bending (stoop) and very highly repetitive hand work (cutting).

5.2.1 Rapid Entire Body Assessment (REBA) for awkward posture

REBA was conducted among the pineapple harvesting workers as awkward posture was found in almost all the working process performed by the workers. This assessment was performed in order to evaluate the work process involved both upper and lower parts of the musculoskeletal systems and MSS risk associated with the job task. Based on the result, it showed that the loading and unloading work task were fell into high risk (8 -10) and very high risk (>10) categories, respectively. The work tasks that categorised in high postural risk required an immediate investigation and

implementation of changes. However, the changes on the work tasks must be immediately implemented for the work task that categorised as “very high postural risk”.

This result was in line with a study by Rani and colleagues (2016) where the harvesting work task were fell into high risk and very high risk postural. This was because the work nature of the pineapple harvesting required them to work in awkward posture in most of their working hours. Besides that, this result was also parallel with a study by Masri and Deros (2017), where the REBA analysis indicated that the posture among the tea pluckers were high risk and required immediate change on their work tasks. This finding was also supported by the previous study (Razak et al., 2014) where most of the workers in palm oil mill were subjected to very high risk and very high risk due to working in extreme and awkward posture.

Using a different method of assessment namely OWAS, a study by Salleh and Sukadarin (2017) had reported a similar finding where the harvesting work task was also categorised in Action Category 3 which indicated for distinctly harmful posture. Based on OWAS postural analysis result, about 60.2% of workers were adopted stoop posture during harvesting activity as the plantation crop height was 1.5 meter from the ground. The stooping posture was commonly emphasized in biomechanical research that related to high spinal compression forces occurred during the posture, that might be the considerable epidemiological evidences linked to low back disorder (Ng et al., 2013). On the other hand, the postural analysis of previous studies which used REBA method have indicated that the working posture of farm categorised as high risk and

dangerous were required an immediate attention from the employer as it might be potentially lead to MSS problem (Ojha & Kwatra, 2014; Omran et al., 2015).

During the loading process, the workers need to bend their neck and trunk to more than 20^{o} as the pineapple plant were growth lower on the ground as well as to prevent the fruits from getting and falling out from the basket. Therefore, the work activities in pineapple plantation required workers to stoop for a prolonged time (Salleh & Sukadarin, 2017). To unload the fruits from the basket onto the ground (collection area), the workers were required to bend forward at an angle of more than 60^{o} (compare to the safe limit of 45^{o}) to drawn out the fruits from the basket as the design of the basket did not allow other options to workers (Mezlan et al., 2017). Another study by Tamrin and colleagus (2014) have stated that the workers in pineapple sectors required to bend awkwardly with the use of force almost all the time to fulfil the job task.

5.2.2 MAC Assessment for Forceful Exertion

MAC assessment for forceful exertion was performed among the workers which focused on lifting activity during loading process of the pineapple. The current study finding indicated that the manual handling activities had fell into "5 – 12" category in which further action were required in the near future. Performing forceful exertions required an application of considerable contraction forces by the muscle, which caused them to experienced fatigue rapidly, overuse of muscle and may result in muscle strain,

soreness, irritate tendons, joins and disc which lead to inflammation, fluid build-up and constriction of blood vessel and nerves (Masri & Deros, 2017)

This result was parallel to a study by Razak and colleagues (2014) where 24.4% of the respondents perceived high exertion while performing their respective task. It involved the workers to repeatedly lift a total of approximately 3 kg of pineapple with torso upright and upper arm that fully outstretched or away from body to transfer the pineapple into the basket on their back. Their hand will be at or above their head level in a motion of throwing the pineapple backwards. There was no torso twisting or sideway bending was observed among the workers. High frequency of weight lifting (lifting any object more than 8kg per time) was a co-factor causing low back pain which increased intradiscal pressure that can induce annular tears and internal disc disruption, thus resulting a lumbar disc injury (Meksawi et al., 2012).

Furthermore, there were no postural constrains were observed during the work process as the wide walkway area enable for them to move freely without disruption. The grip on the load was good in which the long knife was well-designed and fit for the work activities, while the loose part in the pineapple' structure had enabled for a comfortable grip by the workers. During the observation, the floor surface was in dry, poor condition, worn and uneven. The similar observation was reported by Rani and colleagues (2016) where the workers exerted higher forces on the feet and ankle due to walking with heavy load and soft peat soil. It was not a stable based for the workers to perform their work on the peat soil. Therefore, it requires the employers'

engagement to implement preventive measures in order to reduce the possible health hazards due to natural condition of workplace.

Lastly, this study was showed that there was an environmental factor identified at their workplace which included an extreme temperature. The workers might work in open area with exposure direct to sunlight by which the Malaysian temperature can reach up to about 37^{o}C (Tamrin et al., 2014). This excessive heat in work environment have resulted working fatigue and weakness (Thetkathuek et al., 2018).

5.2.3 ART assessment for repetitive motion

The repetitive work was defined as the work cycle that needs to be completed for less than 30 seconds per cycle. Repetitive movements were known to be hazardous among workers especially during awkward postures when the work involved too often, long duration and quick movement on the same joints and muscle groups (Tamrin & Razak, 2014). Based on the result, the exposure level to the repetitive motion was categorised into high exposure in which the score for both right and left hand was more than 22.

The exposure was considered high for each hand because the harvesting work tasks have repeatedly involved both their right and left hand. One hand was used to hold the machete while the other hand will grip the pineapple. According to a study by Masri and Deros (2017), if there were no pauses between motions or pauses were

too short, the muscle was unable to recover back to the rested condition. Thus, the effect of forces on the muscle would be accumulated and lead to muscle fatigue and strained.

Prior to the loading process of pineapples, the loading task required frequent and continuous movement of arm throughout the process until the basket was full with the fruits. The similar motion pattern of the arm and hand were repeated approximately 15 times per minute. As being reported by the workers, they only took about 3 to 5 minutes to complete one cycle for basket to being full.

The hand they use to hold the machete has a higher level of risk as the hand will used a very strong force which are near to the maximum level that the worker can applied in order to cut the fruits from its stalk. However, only a moderate force has been applied to workers' hand that being used to grip the crop. During a repetitive work task performed within prolonged duration, a similar group of muscle were triggered which forced the tissue to go beyond its internal tolerance (Mezlan et al., 2017).

In terms of awkward posture in repetitive motion, the workers' head or neck has been in bending position for more than half of the working hours. The condition was worsened when the workers have to be in an awkward posture for more than 4 hours as they tend to bend their back forward for more than 20^{o}. In addition, the cutting and transferring process of pineapples into the basket required workers to bend their wrist. Apart from that, the grips are different between hands as a hand that grip a machete is powerful grip without grip awkwardly while the hand that grip the pineapple fruits is wide finger grip for more than half of the time. This is support by study from Mazlan

et al. (2017) worker will generally work for 4 to 5 hours in a day and unsafe working practices occur daily (six days in week).

In this assessment, other additional factors had been considered. Based on the observation, the workers have performed the task continuously without a break for less than one hour. The task was continuously performed till the intended weight of harvested pineapples or clients demand was achieved. The workers were suggested to have a break at least for 10 to 20 minutes in between their working hours (Rani et al., 2016). Based on the interview with the workers about difficulties in performing their work tasks, most of the workers agreed that they were able to keep up with their work. It was due to sufficient training received from the employer and experience from the previous employment.

In addition, few factors had been identified that present in the work task such as the tools being used. For example, the machete used to cut cause discomfort to hand or finger as it required the workers to grip the machete powerfully while wearing gloves that can lead to sweating on their hand and the task required fine precise movement of the hand or fingers in order to ensure they could prevent from getting injuries resulting from mistake in machete movement as well as they are exposed to an extreme temperature.

Pineapple harvesting was considered as strenuous work task because it required workers to perform the repetitive movement up to 8 hours per day. The work routine

had started early in the morning from 7am to 12 pm. After having one-hour break, the workers will continue their work until 3 pm.

Despite of all other factors, the psychosocial factor should also be considered. Through a discussion with workers, there was psychosocial factor had been identified in their workplace such as excessive work demand as the workers were required to work harder in order to meet that demand. According to a study by Ng and colleagues (2014), the harvesters concurrently might be affected by different cultural, organizational, psychosocial, and individual risk factors. For example, the foreign labours might face a home sickness as well as health, socioeconomic well-being and family problems. Besides, apart from job demands, psychosocial work-related exposure was possibly more strongly associated with qualities of organizations (work process and practices, organizational structure and culture) and general trends of the labour markets. (Kausto et al., 2011).

5.3 Association between risk factors and three highest reported body part

The association between occupational and non-occupational risk factors with three highest reported MSS for the past 7 days namely shoulder, feet and lower back were determined by using chi-square test. As shown in table 4.10, it showed that non occupational risk factors did not significant associated with the reported MSS. This result was in line with the previous study by Rani and colleagues (2016). The possible

reasons are because most of the workers have a normal BMI besides, they only perform an easy type of leisure activity per months (< 4 times).

However, the occupational risk factors such as previous employment and doing part time job were significantly associated with reported lower back pain meanwhile the years of working was significantly associated with reported shoulder pain ($p < 0.05$) among respondents. This result was in line with the finding of previous study in which working and resting duration were significantly proportional to the prevalence of shoulder disorder (Ng et al., 2015). These three risk factors were further analysed in the logistic regression adjusted for age (Rani et al., 2016), BMI and smoking (Razak et al., 2014). Based on Table 4.10, it indicates that only reported lower back pain demonstrates a significant association without the previous employment.

5.3.1 Association of previous employment with Lower Back Pain

This current study depicts that workers without previous employment were less likely to experiences lower back pain compared to a worker with previous employment. This was parallel with a study by Paul et al. (2019) by which long duration of involvement in farming activities were associated with higher prevalence of MSD. This is because from the interview with workers, most of them had been also working in agricultural field before such as in paddy farming, fruits farming, rubber plantation and oil palm plantation with an experience of more than 1 year and up to 30 years and also in other type of activities such lorry driver and cloth warehouse.

Once pain in a particular body part had developed, it was bound to remain over a long time and become chronic. This make it worst as the work process and posture that they performed and sustained at their previous workplace are similar with the current workplace which required them to bending and stooping. Another study by Ozturk & Esin (2011) indicates that an increase in prevalence of MSS were associate with the number of years of employment. The worker has been working for a long time at the previous workplace with more difficult work load than the current job where it has been the causes of the workers having symptoms of body pain.

CHAPTER 6

CONCLUSION

As a conclusion, the prevalence of MSS reported among the pineapple harvesting workers in this study was 76.7%. The top three of affected body parts that mostly reported by the respondents were shoulder (63.3%), foot (53.3%) and lower back (45.7%). The finding of Ergonomic Risk Assessment (ERA) showed that most of the workers were exposed to awkward posture, forceful exertion, repetitive motion and extreme temperature. The workers were exposed to high risk and very high body postural risk during their loading and unloading work process, respectively. Meanwhile, most of the workers perceived low exertion by which action were required in the near future. A high exposure to repetitive movement for both their right and left hand were experienced by the workers while performing the pineapple harvesting work task. This study found that workers without previous employment factor and are less likely to report MSS at lower back.

The pineapple harvesting work tasks have exposed the workers to a combination of excessive forces, repetitive work and awkward posture throughout the process of performing their work activities. All these activities required an improvement and attention from the workers and employer in order to remove the occupational hazards, reduce the risk of MSS, work-related accidents, illnesses and

injuries. Therefore, the working and living conditions of the workers can be improved that can contribute to the increase of the productivity. This study suggested that a well ergonomic intervention should be implemented in pineapple farming sector as it offers a simple solution that can be easily implemented and relatively inexpensive, and self-fabricated. However, it requires the workers' participation in developing ergonomic intervention in pineapple farming sector that is very important in providing the crucial feedback on efficiency and comfort issues that may affect worker acceptances.

First of all, appropriate training programmes such as training, courses and experts' consultancy are necessary to be established in order to reduce the reported MSS and exposure to the related risk factors. Adequate and effective training should be provided to the pineapple harvesting workers; therefore, the work tasks can be performed in the safe manners. For example, short ergonomic work training can provide information to the workers on what is the proper body posture while lifting the load that can assist them to reduce the risk of back injuries. Besides that, limiting risk factors through administrative control such as providing safe work procedure, stretching programs, job rotation, reduction of load carriage, duration of work, intermittent rest time and alternation work task as well as improving work organization can help to restrict the risk exposure. However, this effort needs to sustain trough shift in safety culture and positive attitude by employers. Managers or employers also play an important role at this stage since they are in a position to assess the likely cost, logistical consideration and productivity impact of any intervention

In addition, ergonomic intervention also is an effective and preventive measures especially if these ergonomic considerations involve tool design. Since the pineapple harvesting workers were still using rattan basket and long knife which required them to perform an excessive load lifting, repetitive cutting and extremely awkward bending, an appropriate design of tool is needed in order to reduce the exposure to the existing risk factors. Ergonomic design in traditional tools might be considered as an effective and preliminary step to promote a safe work culture in farming-related work tasks and activities. Apart of practising a proper body posture while performing work task, the ergonomic-designed tools is also significant in preventing some sort of musculoskeletal symptoms among farmers. In order to achieve the successful development of tools, workers involvement is required because their opinion and interpretation is needed as most agricultural worker were a primary role in identification, refinement and conformity on tools that they will used.

Last but not least, since the workers were exposed to extreme temperature for a longer period due to a nature of pineapple plantation, this study suggests that the workers should be encourage to drink adequate amount of water at frequent interval in order to avoid from dehydration. Besides, the workers might wear cool cotton clothing such as shady hat, shirt with collar, long trouser and long sleeves to allow air circulation and evaporation of sweat and heat rush.

The strength of this study is the ergonomic risk assessment is conducted according to Guideline on Ergonomic Risk Assessments at Workplace 2017 publish by DOSH and fully guided by trainers and ergonomic practitioners. There are several

limitations of this study. Firstly, the finding was only limited to a pineapple harvesting work task of the present pineapple plantation. This result cannot be generalized to other work task and pineapple plantation in Malaysia. Although pain is the most commonly reported musculoskeletal strain symptom, its use also problematic due to its subjective. Secondly, the there was a language barrier also was the one aspect that could interfere during the data collection stage since majority of the respondents were from Bangladesh and Indonesian. However, this was minimised by providing translator from the senior's worker who able to communicate in Bahasa Melayu.

No gender comparison could be made since this work sector was dominantly involved male workers. Furthermore, a recall bias might occur as several questions required workers to report past occurrences of symptoms and working experience. In addition, the analysis of ERA relied solely on the observer assessment based on the recorded video of workers performing the tasks, Therefore, it might be different interpretation of assessment that can contribute to bias. Further study is suggested with larger sample size and reviewing respondents' record in order to improve validity of the result

Gantt Chart

No	Activities	2019				2020					
		Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
1.	Finalize title and submit FYP registration form to coordinator										
2.	Preparation of questionnaires and documentations for the submission to Ethics Review Board in Universiti Putra										
3.	Submit research proposal to ethics committee										
4.	Proposal Presentation										
5.	Request permission to perform research from the management teams of selected pineapple farms in Pontian, Johor upon ethics approval obtained										
6.	Pre-test of questionnaires to a similar sociodemographic characteristic.										
7.	Preparation of research instrument for ergonomic risk assessment including computer software										
8.	Selection of harvesting workers in the pineapple plantation farms										
9.	Conduct phase 1 of study: questionnaire interviews, ergonomic risk assessment										
10.	Conduct phase 2 of study: Analysis of ergonomic risk factors										
11.	Analyse results according to objective										
12.	Thesis writing										
13.	Viva										
14.	Thesis review										
15.	Thesis submission										

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Appendix 1:

Ethical Clearance

Appendix 2:

Application Form

LAMPIRAN 1

Pengurus,

Peninsula Plantations Sdn Bhd,

Simpang Renggam Pineapple Estate,

K.b. 107, 86200 Simpang Renggam

Johor

LAMPIRAN 2

Butir – butir pelajar dan Projek Ilmiah Tahun Akhir yang akan dijalankan adalah seperti di bawah:

1. **Nama Pelajar** : Nur Zainnatul Ashyikin Binti Zainin
   - i. No matrik / Kad Pengenalan : 188109 / 960720 – 11 – 5702
   - ii. Emel : nurzainnatulashyikin@gmail.com
   - iii. No Tel : 019 – 9855702
   - iv. Tajuk Kajian : Distribution of Musculoskeletal Symptoms (MSS), Its Risk Factors and Ergonomic Risk Assessment of Pineapple Harvesting Workers at Pontian, Johor
   - v. Tempoh Penyelidikan : 20 September 2019 – 21 Jun 2020
   - vi. Bahan / Alatan kajian : Borang soal selidik dan rakaman video selama 15 – 20 minit

2. **Nama Pelajar** : Fauziatul Syuhada Binti Mansor
   - i. No matrik / Kad Pengenalan : 188419 / 970609 – 08 - 5866
   - ii. Emel : fauziatul.syuhada@gmail.com
   - iii. No Tel : 011-12517423
   - iv. Tajuk Kajian : The Assessment of Anthropometric Measurement And Development of Pineapple Harvesting Basket for Pineapple Harvesting Workers at Pineapple Plantation in Pontian, Johor
   - v. Tempoh Penyelidikan : 20 September 2019 – 21 Jun 2020
   - vi. Bahan / Alatan kajian : Borang soal selidik

Appendix 3:

Information Consent Form

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

FORM 2.4: RESPONDENT'S INFORMATION SHEET AND INFORMED CONSENT FORM

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

1. **STUDY TITLE :**

   Distribution of Musculoskeletal Symptoms (MSS), Its Risk factors and Ergonomic Risk Assessment of Pineapple Haversting Workers at Selected Areas in Johor.

2. **INTRODUCTION:**

   Agricultural or farming work is known as challenging occupation in which workers were suffer from various work and health related problem. Farmers face various problem in the following working condition such as bringing and lifting heavy loads, repetitive motion, excessive force, prolonged sitting and standing posture, working with the flexed back area and experiences of vibration from automobiles and mechanical hand tools. The purpose of this study is to determine the Musculoskeletal Symptoms (MSS), identify its risk factor and to conduct the ergonomic risk assessment among the pineapple harvesting workers. The study also helps to increase understanding and knowledge on MSS and ergonomic risk factor among pineapple farmers.

3. **WHAT WILL YOU HAVE TO DO?**

   a) You are required to answer all the questions in the questionnaire's booklet. Please answer the questions in the space provided.

   b) You are required to demonstrates your work process as the researcher will record and use it as observation material and analysis for the study.

   You can choose either to answer the questionnaires only and not to be recorded or vice versa. You have the right to withdraw from this research at any time without giving any reason whatsoever.

4. **WHO SHOULD NOT PARTICIPATE IN THE STUDY?**

   Pregnant woman workers and workers who already diagnosed of chronic diseases such as rhematism arthritis.

5. **WHAT WILL BE THE BENEFITS OF THE STUDY:**

   (a) TO YOU AS THE SUBJECT?

   The study will determine the musculoskeletal symptom and identify the postural

risk factor among the farmers. It can help to identify and eliminate those risk factor as well as improve your health status and quality of life.

(b) TO THE INVESTIGATOR?

It help investigator to determined the prevalences of Musculoskeletal Symptom and its risk factor among the pineaple haversting workers.

6. WHAT ARE THE POSSIBLE RISKS?

No compensation will be provided because the study will not cause any harm and risk to you.

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

All the information you are giving to us in this study will be kept strictly confidential, will not be made available for publics and only be used in this study. Besides, your identity also remains confidential in the event the study result is publish.

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

If you have any question, please do not hesitate to contact the following personnel

Nur Zainnatul Ashyikin Binti Zainin
Department of Environmental and Occupational Sciences
Faculty of Medicines and Health Sciences,
43400 UPM Serdang.
Contact no: 0199855702

Professor Madya Dr. Emilia Zainal Abidin
Department of Environmental and Occupational Health
Faculty of Medicine and Health Sciences
Universiti Putra Malaysia
Contact no: 03 – 97692643

*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 ……..…… (Respondent)

Date :……..

Signature ……..…….
(Witness)

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)

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

BORANG 2.4: PENERANGAN DAN PERSETUJUAN RESPONDEN

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

1. TAJUK KAJIAN

Taburan Gejala Gangguan Otot Rangka, Faktor – faktor Risiko Berkaitan dan Penilaian Risiko Ergonomik dalam kalangan Pekerja Menuai Nanas di Kawasan Terpilih di Johor.

2. PENGENALAN

Kerja pertanian dan penanaman dikenali sebagai pekerjaan yang mencabar di mana pekerja akan terdedah dan mengalami pelbagai masalah kerja dan kesihatan yang berkaitan. Para petani menghadapi pelbagai masalah di dalam keadaan kerja yang berikut seperti membawa dan mengangkat beban yang berat, gerakan yang berulang, daya berlebihan, postur duduk dan berdiri dalam tempoh yang lama, bekerja dalam keadaan membongkok dan terdedah kepada getaran daripada alat tangan mekanikal. Tujuan kajian ini adalah untuk menilai taburan gejala gangguan otot rangka, mengenalpasti faktor risiko dan menjalankan penilaian risiko ergonomik dalam kalangan pekerja menuai nanas. Kajian ini juga membantu meningkatkan kefahaman dan pengetahuan terhadap gejala gangguan otot rangka dan faktor risiko ergonomic dalam kalangan pekerja di ladang nanas.

3. APAKAH YANG PERLU ANDA LAKUKAN?

a) Anda dikehendaki untuk menjawab semua soalan yang terdapat di dalam buku soal selidik. Sila tandakan pada ruangan yang telah disediakan.

b) Anda dikehendaki untuk mendemostrasikan proses kerja anda di mana penyelidik akan merekod dan menggunakannya sebagai bahan pemerhatian dan analisis untuk kajian ini.

Anda boleh memilih untuk menjawab soal selidik sahaja dan tidak dirakam atau sebaliknya. Anda mempunyai hak untuk menarik diri dari penyelidikan ini pada bila-bila masa tanpa memberi apa-apa sebab.

4. SIAPA YANG TIDAK BOLEH MENYERTAI KAJIAN INI?

Pekerja wanita yang hamil dan pekerja yang telah menerima rawatan penyakit kronik seperti rheumarism arthritis.

5. APAKAH FAEDAH MENYERTAI KAJIAN INI?

a) KEPADA ANDA SEBAGAI PESERTA?

Kajian ini akan menilai taburan gejala gangguan otot rangka dan mengenalpasti faktor risiko ergonomik dalam kalangan pekerja. Kajian ini membantu mengenal pasti dan membasmi faktor risiko terlibat pada masa yang sama meningkatkan status kesihatan dan kualiti hidup pekerja.

b) **KEPADA PENYELIDIK?**

Kajian ini membantu penyelidik untuk mengenal pasti taburan gejala gangguan otot rangka dan faktor – faktor risiko yang terlibat dalam kalangan pekerja menuai nanas.

6. ADAKAH IA BERISIKO?

Kajian ini tidak menyebabkan sebarang bahaya dan risiko kepada responden. Oleh itu, tiada pampasan yang disediakan.

7. ADAKAH MAKLUMAT DAN IDENTITI SAYA KEKAL RAHSIA?

Semua maklumat yang diberikan di dalam kajian ini akan kekal rahsia, tidak akan dapat dilihat dan digunakan oleh orang awam dan hanya digunakan di dalam kajian ini. Selain itu, identiti responden juga adalah kekal terpelihara setelah hasil kajian diterbitkan.

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

Sekiranya anda mempunyai sebarang pertanyaan, sila hubungi kakitangan berikut

Nur Zainnatul Ashyikin Binti Zainin
Jabatan Persekitaran dan Pekerjaan
Fakulti Perubatan dan Sains Kesihatan
43400 Upm Serdang.
No telefon: 019-9855702

Professor Madya Dr. Emilia Zainal Abidin
Jabatan Persekitaran dan Pekerjaan
Fakulti Perubatan dan Sains Kesihatan
43400 Upm Serdang.
No telefon: 03 - 97692643

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

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.

I setuju/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*)

Appendix 4:

Questionnaires Booklet

RESPONDENT ID | | | | | |

QUESTIONNAIRE BOOKLET

Distribution of Musculoskeletal Symptoms (MSS), Its risk factors and Ergonomic Risk Assessment of Pineapple Harvesting Workers at Selected Area in Johor

Date : | | | | | | |

Please kindly be informed that you have been selected to participate in this study. All response will be treated as confidential. No one beyond the study team will have access to your details. Any summary of results will be presented in anonymous format so that no one will be able to recognize you from the results.

There are 5 sections to this questionnaire and it should take about 5 to 10 minutes to complete the questionnaire.

Your cooperation is highly appreciated.

Instruction: Please answer the questions below by ticking in the boxes or writing in the spaces provided.

SECTION A: SOCIO-DEMOGRAPHIC BACKGROUND

Age : _____ years old

Gender: ☐ Male ☐ Female

Nationality: ☐ Malaysian ☐ Non-Malaysian
Please state: _____

Race: ☐ Malay ☐ Chinese
☐ India ☐ Others
Please state: _____

Marital Status: ☐ Single ☐ Married ☐ Divorced

No. of children: _____

Education: ☐ No formal education ☐ Primary education
☐ Secondary education ☐ Tertiary education

Family Monthly Income: RM_____

Total Family members: _____

	First reading	Second reading	Third reading
***Weight (kg)**			
***Height (cm)**			

***To be filled by researcher**

SECTION B: SOCIAL / LIFESYLE INFORMATION

a) Nicotine usage

1. Do you smoke?

☐ Yes ☐ No ☐ Ex-smoker

2. If **Yes,** no. of cigarettes smoked in a single day?

☐ 2 sticks or less ☐ 3–5 sticks ☐ 6–9 sticks

☐ 10 sticks or more

b) Hobby / Leisure time activity

1. What is your hobby during leisure time?

☐ Hunting ☐ Fishing ☐ Sports

☐ Gardening ☐ Browsing Internet ☐ Others

Please state: _____

2. Do you do that hobby regularly? (**Regularly** is more than 4 times a month)

☐ Yes ☐ No

SECTION C: WORKING INFORMATION

a) Previous job information

1. Have your worked anywhere else before?

☐ Yes ☐ No

2. If **Yes**, please state below:

Type of work (specific)	Working hours (hour)	Working period (years)

*please state 2 longest job (**if any**)

b) Current job information

1. How long have you been working in this plantation as a harvester?

   Date of first day at work: _____

2. Have you work at different task in this plantation?

   ☐ Yes ☐ No

3. If **Yes**, please state the work task: _____

4. Do you need to go to a training to become a harvester?

   ☐ Yes ☐ No

5. Specify your working period.

   ☐ Full-time Total no. of working hours: _____

   ☐ Part-time Total no. of working hours: _____

   ☐ Shift-work Total no. of working hours: _____

6. Do you do any other work outside of working hours?

   ☐ Yes ☐ No

7. If **Yes**, please state the job that you have done.

   _____

SECTION D: MEDICAL HISTORY INFORMATION

a) General health information

1. Have you ever had any injuries or accidents throughout your life?

☐ Yes ☐ No

2. If **Yes**, please state the type of injuries or accidents.

_____

3. What treatment had been taken?

☐ Treatment from doctor

☐ Traditional massage

☐ Traditional medicine

☐ Others, please state: _____

b) Health related to work information

1. Have you ever had any injuries or accidents while working as a harvester?

☐ Yes ☐ No

2. If **Yes**, please write type of injuries or accident.

_____

3. Does the injury relate to pineapple harvesting?

_____

4. Have you ever received a diagnosis related to the disease?

☐ Yes ☐ No

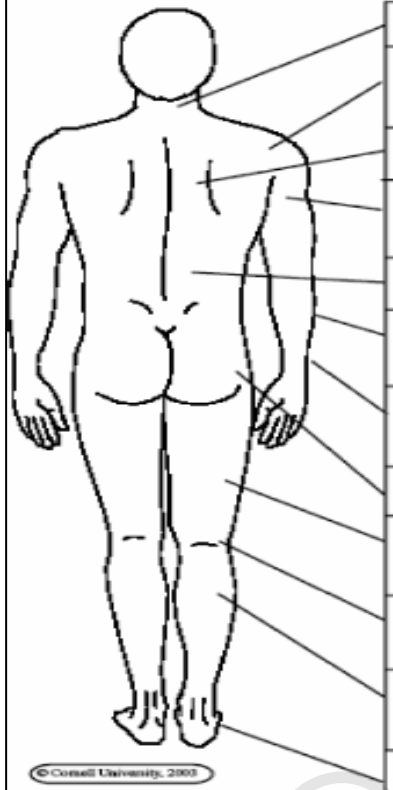
SECTION E: MUSCULOSKELTAL SYMPTOMS

5. Have you experienced any discomfort or pain in the body over the last 7 days?

☐ Yes ☐ No

If **Yes**, please indicate the part of the body that caused you discomfort or pain during the **last 7 days** in the picture below. Your answer can be **more than one body part**.

The diagram below shows the approximate position of the body parts referred to in the questionnaire. Please answer by marking the appropriate box.



		During the last work week how often did you experience ache, pain, discomfort in:					If you experienced ache, pain, discomfort, how uncomfortable was this?			If you experienced ache, pain, discomfort, did this interfere with your ability to work?		
		Never	1-2 times last week	3-4 times last week	Once every day	Several times every day	Slightly uncomfortable	Moderately uncomfortable	Very uncomfortable	Not at all	Slightly interfered	Substantially interfered
Neck		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Shoulder	(Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	(Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Upper Back		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Upper Arm	(Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	(Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lower Back		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Forearm	(Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	(Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Wrist	(Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	(Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Hip/Buttocks		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Thigh	(Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	(Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Knee	(Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	(Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lower Leg	(Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	(Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Foot	(Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	(Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

RESPONDEN ID | | | | | |

BOOKLET SOALAN

Taburan Gejala Gangguan Otot Rangka, Faktor Risiko Berkaitan dan Penilaian Risiko Ergonomik ke atas Pekerja Menuai Nanas di Kawasan Terpilih di Johor

Tarikh: | | | | | | | |

Sukacita dimaklumkan bahawa anda telah terpilih untuk mengambil bahagian dalam kajian in. Segala tindak balas akan dianggap sebagai sulit . Tiada sesiapa di luar pasukan kajian akan mempunyai akses kepada maklumat anda. Sebarang ringkasan hasil akan dipaparkan dalam format tanpa nama supaya tidak ada yang dapat mengenali anda dari hasilnya.

Terdapat 5 bahagian untuk soal selidik ini dan hanya perlu mengambil kira 5 hingga 10 minit untuk menyelesaikan soal selidik.

Kerjasama anda amat dihargai.

Arahan: Sila jawab soalan di bawah dengan menandakan kotak atau menulis di ruang yang disediakan.

BAHAGIAN A: LATAR BELAKANG SOCIO-DEMOGRAPHIC

Umur : _____ tahun

Jantina: ☐ Lelaki ☐ Perempuan

Kewarganegaraan: ☐ Warganegara ☐ Bukan Warganegara

Sila nyatakan: _____

Bangsa: ☐ Melayu ☐ Cina

☐ India ☐ Lain-lain

Sila nyatakan: _____

Status perkahwinan: ☐ Bujang ☐ Berkahwin ☐ Bercerai

Jumlah bilangan anak: _____

Pendidikan: ☐ Tiada Pendidikan formal ☐ Sekolah rendah

☐ Sekolah menengah ☐ Pendidikan tinggi

Jumlah Penadapatan Keluarga: RM_____

Jumlah Tanggunggan: _____

	Bacaan Pertama	Bacaan Kedua	Bacaan Ketiga
***Berat (kg)**			
***Tinggi (cm)**			

***Untuk diisi oleh penyelidik**

BAHAGIAN B: SOCIAL / LIFESYLE INFORMATION

c) Penggunaan nikotin

3. Adakah anda merokok?

☐ Ya ☐ Tidak ☐ Telah berhenti

4. Jika **Ya,** berapakah bilangan batang rokok?

☐ 2 batang atau kurang ☐ 3–5 batang ☐ 6–9 batang

☐ 10 batang atau lebih

d) Aktiviti masa lapang

3. Apakah hobi anda masa lapang?

☐ Memburu ☐ Memancing ☐ Bersukan

☐ Berkebun ☐ Melayari Internet ☐ Lain-lain
Sila Nyatakan:

4. Adakah anda melakukan hobi tersebut secara kerap? (**Kerap** ialah lebih 4 kali sebulan)

☐ Ya ☐ Tidak

BAHAGIAN C: MAKLUMAT PEKERJAAN

c) Maklumat pekerjaan terdahulu

3. Pernahkah anda bekerja di tempat lain sebelum ini?

☐ Ya ☐ Tidak

4. Jika **Ya**, sila nyatakan di bawah:

Jenis Pekerjaan	**Waktu bekerja (jam)**	**Tempoh bekerja (tahun)**

*sila nyatakan 2 pekerjaan yang paling lama (**jika ada**)

d) Maklumat pekerjaan sekarang

8. Berapa lamakah tempoh pekerjaan anda sebagai penuai?

   Tarikh mula bekerja: _____

9. Adakah anda pernah bekerja di bahagian lain di lading ini?

   ☐ Ya ☐ Tidak

10. Jika **Ya**, sila nyatakan bahagian tersebut:

    _____

11. Adakah anda perlu menghadiri latihan untuk menjadi penuai?

    ☐ Ya ☐ Tidak

12. Nyatakan tempoh bekerja anda.

    ☐ Sepenuh masa Jumlah waktu bekerja: _____

    ☐ Separuh masa Jumlah waktu bekerja: _____

    ☐ Bekerja shift Jumlah waktu bekerja: _____

13. Adakah anda melakukan pekerjaan lain di luar waktu berkerja?

    ☐ Ya ☐ Tidak

14. Jika **Ya**, sila nyatakan pekerjaan lain yang anda lakukan.

    _____

BAHAGIAN D: MAKLUMAT SEJARAH KESIHATAN

c) Maklumat kesihatan umum

4. Adakah anda pernah mengalami sebarang kecederaan atau kemalangan sepanjang hidup?

☐ Ya ☐ Tidak

5. Jika **Ya** sila nyatakan jenis kecederaan atau kemalangan tersebut..

_____

6. Apakah rawatan yang diambil?

☐ Mendapatkan rawatan daripada doktor

☐ Berurut seara tradisional

☐ Mengambil ubat-ubatan tradisonal

☐ Lain- lain, sila nyatakan_____

d) Maklumat kesihatan berkaitan pekerjaan.

6. Adakah anda pernah mengalami sebarang kecederaan atau kemalangan semasa bekerja??

☐ Ya ☐ Tidak

7. Jika **Ya**, sila nyatakan jenis kecederaan atau kemalangan tersebut.

_____

8. Adakah kecederaan itu berkait dengan penuaian nanas?

_____

9. Adakah anda pernah menerima diagnos berkaitan dengan penyakit musculoskeletal?

☐ Ya ☐ Tidak

BAHAGIAN E: SIMPTOM MUSKULOSKELTAL

1. Adakah anda pernah mengalami ketidakselesaan atau sakit di bahagian tubuh badan dalam tempoh 7 hari yang lepas?

   ☐ Ya ☐ Tidak

2. Sekiranya **Ya**, sila tandakan bahagian tubuh badan yang menyebabkan anda berasa tidak selesa atau sakit dalam tempoh **7 hari yang lepas** pada gambar di bawah. Jawapan anda **boleh melebihi satu bahagian tubuh badan**.

Gambarajah di bawah menunjukkan kedudukan bahagian badan seperti dirujuk dalam soalan. Sila jawab dengan menandakan kotak yang bersesuaian.

	Sepanjang minggu bekerja yang lepas, berapa kerapkah anda mengalami kesakitan atau ketidak selesaan di:					Jika anda mengalami kesakitan atau ketidak selesaan, bagaimanakah tahapnya?			Jika anda mengalami kesakitan atau ketidak selesaan, adakah ia mengganggu kebolehan anda untuk bekerja?		
	Tidak pernah	1-2 kali lepas	3-4 kali lepas	Sekali setiap hari	Beberapa kali setiap hari	Sedikit kurang menyenangkan	Agak tidak menyenangkan	Sangat tidak menyenangkan	Tidak sama sekali	Sedikit mengganggu	Sangat mengganggu
Leher	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Bahu (kanan)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Bahu (kiri)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Belakang atas	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lengan (kanan)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lengan (kiri)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Belakang bawah	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lengan bawah (kanan)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lengan bawah (kiri)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Pergelangan tangan (kanan)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Pergelangan tangan (kiri)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Pinggul/Punggung	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Peha (kanan)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Peha (kiri)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lutut (kanan)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lutut (kiri)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Betis (kanan)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Betis (kiri)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Kaki (kanan)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Kaki (kiri)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Appendix 5:

Initial Ergonomic Risk Assessment Checklist

Initial Ergonomic Risk Assessment Checklist

i) Awkward Posture

Table 3.1: Checklist for awkward posture

Body Part	Physical Risk Factor	Maximum Exposure Duration (Continuously or cumulative)	Please Tick (/)	
			Yes	No
Shoulders	Working with hand above the head OR the elbow above the shoulder	More than 2 hours per day	/	
	Working with shoulder raised	More than 2 hours per day	/	
	Work repetitively by rising the hand above the head OR the elbow above the shoulder more than once per minute	More than 2 hours per day	/	
Head	Working with head bent downwards more than 45 degrees	More than 2 hours per day	/	
	Working with head bent backwards	More than 2 hours per day		/
	Working with head bent sideways	More than 2 hours per day		/
Back	Working with back bent forward more than 30 degrees OR bent sideways	More than 2 hours per day	/	
	Working with body twisted	More than 2 hours per day		/
Hand / Elbow / Wrist	Working with wrist flexion OR extension OR radial deviation more than 15 degrees	More than 2 hours per day	/	
	Working with arm abducted sideways	More than 4 hours per day		/
	Working with arm extended forward more than 45 degrees OR arm extended backward more than 20 degrees	More than 2 hours per day	/	
Leg / Knee	Work in squat position	More than 2 hours per day		/
	Work in kneeling position	More than 2 hours per day		/
Sub Total (Number of tick(s))			7	6

The total score for awkward posture is **13**. **YES** score of **6** and above will initiate an advances assessment.

ii) Static and Sustained Work Posture

Table 3.2: Checklist for Static and Sustained Work Posture

Body Part	Physical Risk Factor	Maximum Exposure Duration	Please Tick (/)	
			Yes	No
Trunk / Head / Neck / Arm / Wrist	Work in static awkward position as in Table 3.1	Duration as per Table 3.1		/
Leg / Knee	Work in a standing position with minimal leg movement	More than 2 hours continuously		/
	Work in seated position with minimal movement	More than 30 minutes continuously		/
Sub Total (Number of tick(s))			0	3

The total score for Static and Sustained Work Posture is **3**. **YES** score of **1** and above will initiate an advances assessment.

iii) Forceful Exertion

Table 3.3: Checklist for Forceful Exertion

Activity (Where applicable)	Recommended weight limit	Exceed Limit?	
		Yes	No
Lifting and lowering only; or	Based on figure 3.1 and table 3.3		/
Repetitive lifting and lowering; or	Based on figure 3.1 and table 3.4	/	
Twisted body posture while lifting and lowering; or	Based on figure 3.1 and table 3.5		/
Repetitive lifting and lowering with twisted body posture; or	Based on figure 3.1 and table 3.4 and Table 3.5		/
Pushing and pulling; or	Based on table 3.6		/
Handling in seated position; or	Based on table 3.2		/
Carrying	Based on table 3.7		/
Sub Total (Number of tick(s))		1	6

Forceful exertion in any of the manual handling activities in Table 3.8 with **YES**. Score of **1** requires an advances assessment.

***Remarks:**

Average Weight of 1 pineapple: 3 kg

RWL = 5kg X 50%

= 2.5 kg

The average weight of pineapple (3kg) is exceed the RWL.

iv) Repetitive Motion

Table 3.4: Checklist for Repetitive Motion

Body Part	**Physical Risk Factor**	**Maximum Exposure Duration**	**Please Tick (/)**	
			Yes	**No**
Neck, shoulders, elbows, wrists, hand, knee	Work involving repetitive sequences of movement more than twice per minute	More than 3 hours on a "normal" workday OR More than 1 hour continuously without a break	/	
	Work involving intensive use of the fingers, hand or wrist or work involving intensive data entry (key-in)		/	
	Work involving repetitive shoulder / arm movement with some pauses OR continuous shoulder / arm movement		/	
	Work using the heel / base of palm as a "hammer" more than once per minute	More than 2 hours per day		/
	Work using the knee as a "hammer" more than once per minute.	More than 2 hours per day		/
		Sub Total (Number of tick(s))	3	2

The total score for repetition is **5. YES** score of **1** and above will initiate an advanced assessment.

v) Hands -Arm and Whole-Body Vibration

Table 3.5: Checklist for Hands -Arm and Whole-Body Vibration

Body Part	Physical Risk Factor	Maximum Exposure Duration	Please Tick (/)	
			Yes	No
Hand – Arm (segmental vibration)	Work using power tools (ie: battery powered / electrical pneumatic / hydraulic) without PPE*	More than 50 minutes in an hour		/
	Work using power tools (ie: battery powered / electrical pneumatic / hydraulic) with PPE*	More than 5 hours in 8 hours shift work		/
Whole body vibration	Work involving exposure to whole body vibration	More than 5 hours in 8-hour shift work		/
	Work involving exposure to whole body vibration combined employee complaint of excessive body shaking	More than 3 hours in 8 hours shift work		/
		Sub Total (Number of tick(s))	0	4

***PPE related with protection to vibration**

The total score for vibration is **4. YES** score of **1** and above will initiate an advanced assessment.

vi) Lighting

Table 3.6: Checklist for Lighting

Physical Risk Factor	Please tick (/)	
	Yes	No
Inadequate lighting		/

Any evidence of inadequate lighting in the workplace (YES, score = 1) requires an advanced assessment.

vii) Temperature

Table 3.6: Checklist for Temperature

Physical Risk Factor	**Please tick (/)**	
	Yes	**No**
Extreme temperature (hot / cold)	/	

Any evidence of extreme temperature in the workplace (YES, score = 1) requires an advanced assessment.

viii) Ventilation

Table 3.6: Checklist for Ventilation

Physical Risk Factor	**Please tick (/)**	
	Yes	**No**
Inadequate air ventilation		/

Any evidence of inadequate ventilation in the workplace (YES, score = 1) requires an advanced assessment.

ix) Noise

Table 3.6: Checklist for Ventilation

Environmental Risk Factor	**Physical Risk Factor**	**Please Tick (/)**	
		Yes	**No**
Noise	Noise exposure above Permissible Exposure Limit (PEL) (based on previous reports or measurement)		/
	Exposed to annoying or excessive noise during working hours		/

The total score for noise is **2**. **YES** score of **1** and above will initiate an advanced assessment.

Result of Initial Ergonomic Risk Assessment

<table>
<tr><th>Risk Factor</th><th>Total Score</th><th>Minimum requirement for advanced assessment</th><th>Result of Initial ERA</th><th>Any Pain or Discomfort due to risk factors as found in Musculoskeletal Assessment (Yes / No)</th><th>Need Advances ERA? (Yes / No)</th></tr>
<tr><td>Awkward Postures</td><td>13</td><td>≥ 6</td><td>6</td><td rowspan="10">YES / NO
If YES, please tick (/) which part of the body
<table><tr><td>Neck</td><td>/</td></tr><tr><td>Shoulder</td><td>/</td></tr><tr><td>Upper back</td><td>/</td></tr><tr><td>Upper arm</td><td>/</td></tr><tr><td>Lower back</td><td>/</td></tr><tr><td>Forearm</td><td>/</td></tr><tr><td>Wrist</td><td>/</td></tr><tr><td>Hand</td><td></td></tr><tr><td>Hip / buttock</td><td>/</td></tr><tr><td>Thigh</td><td>/</td></tr><tr><td>Knee</td><td>/</td></tr><tr><td>Lower leg</td><td>/</td></tr><tr><td>Feet</td><td>/</td></tr></table></td><td>Yes</td></tr>
<tr><td>Static and Sustained Work Posture</td><td>3</td><td>≥ 1</td><td>0</td><td>No</td></tr>
<tr><td>Forceful Exertion</td><td>1</td><td>1</td><td>1</td><td>Yes</td></tr>
<tr><td>Repetitive Motion</td><td>5</td><td>≥ 1</td><td>3</td><td>Yes</td></tr>
<tr><td>Vibration</td><td>4</td><td>≥ 1</td><td>0</td><td>No</td></tr>
<tr><td>Lighting</td><td>1</td><td>1</td><td>0</td><td>No</td></tr>
<tr><td>Temperature</td><td>1</td><td>1</td><td>1</td><td>Yes</td></tr>
<tr><td>Ventilation</td><td>1</td><td>1</td><td>0</td><td>No</td></tr>
<tr><td>Noise</td><td>2</td><td>≥ 1</td><td>0</td><td>No</td></tr>
</table>

Appendix 6:

REBA Employee Assessment Worksheet

ERGONOMICS PLUS

REBA Employee Assessment Worksheet

Task Name: Loading

Date: 8/3/2020

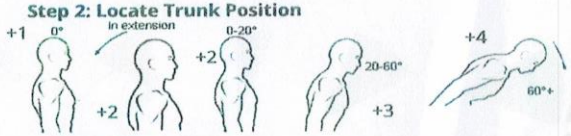
A. Neck, Trunk and Leg Analysis

Step 1: Locate Neck Position

+2 Neck Score

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

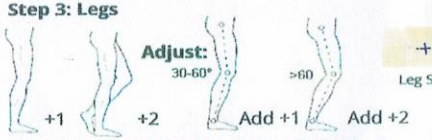
Step 2: Locate Trunk Position



+3 Trunk Score

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

Step 3: Legs



+1 Leg Score

Step 4: Look-up Posture Score in Table A

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

4 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

+3 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**.

7 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
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	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

Trunk Posture Score

Table B

Upper Arm Score	Lower Arm 1			2		
	Wrist 1	2	3	1	2	3
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

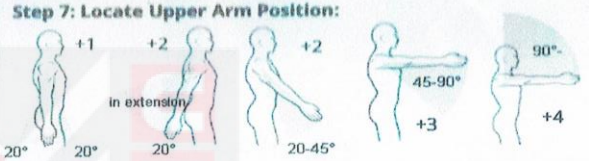
9 Table C Score

1 Activity Score

10 REBA Score

B. Arm and Wrist Analysis

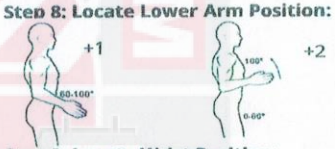
Step 7: Locate Upper Arm Position:



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

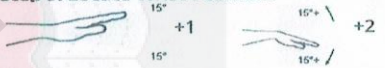
+4 Upper Arm Score

Step 8: Locate Lower Arm Position:



+2 Lower Arm Score

Step 9: Locate Wrist Position:



+3 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

7 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***

0 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.

7 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

ERGONOMICS PLUS

REBA Employee Assessment Worksheet

Task Name: unloading Date: 8/3/2020

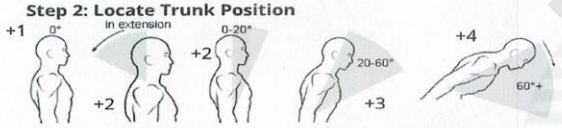
A. Neck, Trunk and Leg Analysis

Step 1: Locate Neck Position

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

+2 Neck Score

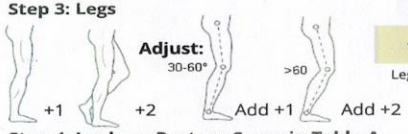
Step 2: Locate Trunk Position



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

+4 Trunk Score

Step 3: Legs



+3 Leg Score

Step 4: Look-up Posture Score in Table A

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

7 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

+2 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**.

9 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				Neck 2				Neck 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		Lower Arm 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

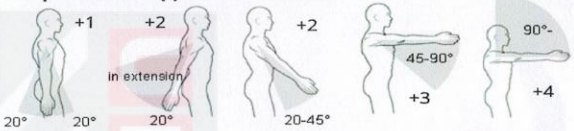
Table C

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

10 Table C Score + 1 Activity Score = 11 REBA Score

B. Arm and Wrist Analysis

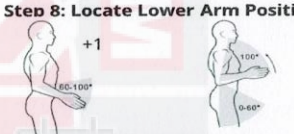
Step 7: Locate Upper Arm Position:



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

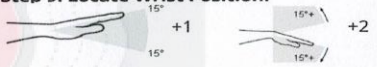
+1 Upper Arm Score

Step 8: Locate Lower Arm Position:



+1 Lower Arm Score

Step 9: Locate Wrist Position:



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

+1 Wrist Score

Step 10: Look-up Posture Score in Table B

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

1 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***

+ +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.

= 4 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

Original Worksheet Developed by Dr. Alan Hedge. Based on Technical note: Rapid Entire Body Assessment (REBA), Hignett, McAtamney, Applied Ergonomics 31 (2000) 201-205

Appendix 7:

MAC Assessment Score Sheet

MAC SCORE SHEET

MAC: *Score sheet*
Company name:

Task Description: Workers approximately lift a 3kg of pineapple with torso upright and upper arm that fully outstreched or away from body to transfer the pineapple fruits into the basket on their back.

Are there indications that the task is high risk?
(Tick the appropriate boxes)

- [ ] Task has a history of manual handling incidents (eg company accident book, RIDDOR reports).
- [/] Task is known to be hard work or high risk.
- [ ] Employees doing the work show signs that they are finding it hard work (eg breathing heavily, red-faced, sweating).
- [ ] Other indications, if so what? _____

Date: _____

Signature: _____

Insert the colour band and numerical score for each of the risk factors in the boxes below, referring to your assessment, using the tool.

Risk factors	Colour band (G, A, R or P)			Numerical score		
	Lift	Carry	Team	Lift	Carry	Team
Load weight and lift/carry frequency	G			0		
Hand distance from the lower back	R			6		
Vertical lift region	R			3		
Trunk twisting/sideways bending Asymmetrical trunk/load (carrying)	G			0		
Postural constraints	G			0		
Grip on the load	G			0		
Floor surface	A			1		
Other environmental factors	R			2		
Carry distance						
Obstacles en route (carrying only)						
Communication and co-ordination (team handling only)						
Other risk factors, eg individual factors, psychosocial factors etc (see website - address on page 12)			TOTAL SCORE:	12		

Appendix 8:

ART Assessment Score Sheet

Score sheet

Enter the colour band and numerical score for each risk factor in the table below.
Follow the instructions on page 10 to determine the task score and exposure score.

Risk factors	Left arm		Right arm	
	Colour	Score	Colour	Score
A1 Arm movements	R	6	R	6
A2 Repetition	A	3	A	3
B Force	A	4	R	12
C1 Head/neck posture	A	1	A	1
C2 Back posture	R	2	R	2
C3 Arm posture	R	4	R	4
C4 Wrist posture	R	2	R	2
C5 Hand/finger grip	R	2	G	0
D1 Breaks	R	8	R	8
D2 Work pace	G	0	G	0
D3 Other factors	R	2	R	2
Task score		34		40
D4 Duration multiplier		x 1		x 1
Exposure score		34		40
D5 Psychosocial factors Excessive work demand.				

Are there other indications that the task is high risk?

☐ The task or similar tasks have a history of ULDs (eg company accident book, RIDDOR reports, medically diagnosed cases of upper limb disorders).

☐ There are signs workers find the task difficult (eg wearing arm supports or bandages, reporting discomfort, aches or pains). Ask the workers if they have any of these symptoms.

☐ Other indications? If so, describe: