



UNIVERSITI PUTRA MALAYSIA

***THE ASSESSMENT OF ANTHROPOMETRIC MEASUREMENT AND
DEVELOPMENT OF HARVESTING BASKET FOR HARVESTER AT
SELECTED AREAS IN JOHOR***

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DEVELOPMENT OF HARVESTING BASKET FOR HARVESTER AT
SELECTED AREAS IN JOHOR**



BY

FAUZIATUL SYUHADA BINTI MANSOR

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

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ABSTRACT

THE ASSESSMENT OF ANTHROPOMETRIC MEASUREMENT AND DEVELOPMENT OF HARVESTING BASKET FOR HARVESTER AT SELECTED AREAS IN JOHOR

FAUZIATUL SYUHADA BITI MANSOR

Introduction: Pineapple harvesting has been associated with the highest ergonomic risk factors when compared to other work tasks in pineapple fields. A harvesting basket prototype have been previously designed however the testing was not carried out on actual pineapple harvesters. This study aimed to assess the anthropometric measurement and to measure the physiological workload, perceived exertion and discomfort related to the use of a rattan harvesting basket and a prototype basket. In addition, this study seeks to determine the perception of respondents to the use of the harvesting baskets and to finally develop a prototype for an ergonomic pineapple harvesting basket by incorporating the data collected. **Methodology:** This was a cross-sectional study conducted among pineapple harvesters in Johor. Data of 27 harvesters was collected using questionnaires that consisted of standard scales namely Borg Rating of Perceived Exertion (RPE) to assess perceived exertion and Borg CR-10 Scale to assess discomfort. The data collection process commenced with the administration of questionnaires and anthropometric measurements. Fitbit Fitness Smartwatch was used to determine heart rate variation which were then used to calculate energy expenditure as a measure of physiological workload. Perception of respondents to the use of basket was assessed using self-constructed questionnaire. The descriptive analysis was used to analyse the RPE, discomfort, and perceptions of respondents towards both basket and the comparison of heart rate and energy expenditure between both baskets were determined using the independent t-test. Results were then used to design a new harvesting basket. **Result:** This study found that there were no significant differences between physiological workload measured during the use of rattan basket and prototype basket. The heart rate and energy expenditure of respondents were as follows: rattan basket, Average Heart Rate (AHR) = 104.9 ± 14.8 bpm and Energy Expenditure (EE) = 7.9 ± 2.3 KJ-min; while prototype, AHR = 108.4 ± 14.7 bpm and EE = 8.5 ± 2.3 KJ-min (t -value = -0.8, p = 0.40). The average (standard deviation) RPE of the respondents were 8.76 ± 1.64 and waist had the highest Borg CR-10 scale (2.7 ± 2.6) followed by middle back (2.1 ± 2.6) and lower back (2.0 ± 2.7) respectively. Majority of the respondents satisfied their rattan basket (67%) and most of them said that the prototype basket did not fulfil their expectation. The design and development of the basket were then commenced, and a new prototype was designed by a third party. **Conclusion:** Pineapple harvesters needs to use ergonomic tools in performing their task to ensure the safety and health of the workers are well taken care of. The basket developed will reduce the risk factors of musculoskeletal disorder among harvester.

Keywords: Musculoskeletal Disorder (MSD), heart rate, energy expenditure, discomfort, ergonomic basket

ABSTRAK

PENILAIAN PENGUKURAN ANTHROPOMETRIK DAN PEMBINAAN BAKUL PENUAIAN UNTUK PENUAI DI KAWASAN TERPILIH DI JOHOR

FAUZIATUL SYUHADA BINTI MANSOR

Pengenalan: Penuaian nanas telah dikaitkan dengan faktor risiko tertinggi berbanding tugas yang lain di lading nanas. Prototaip bakul penuaian nanas telah dibina oleh pengkaji terdahulu tetapi percubaan tidak dilakukan oleh penuai nanas yang sebenar. Objektif kajian ini untuk menilai pengukuran anthropometric dan mengukur beban kerja fisiologi, tekanan yang dirasakan dan ketidak selesaan yang berkaitan dengan bakul rotan dan bakul prototaip. Tambahan pula, kajian ini juga mencari untuk menentukan persepsi responden tentang penggunaan bakul penuaian dan akhirnya membina prototaip yang baru untuk bakul penuaian ergonomik.

Metodologi: Kajian ini ialah kajian rentas yang dijalankan keatas penuai nanas di Johor. Data 27 orang responden telah dikutip menggunakan borang soal selidik yang terdiri daripada skala standard bernama Borg Rating of Perceived Exertion (RPE) untuk menguji tekanan yang dirasakan dan Borg CR-10 Scale untuk menguji ketidak selesaan. Fitbit Fitness Smartwatch telah digunakan untuk menentukan kadar denyutan jantung yang kemudiannya digunakan untuk mengira penggunaan tenaga. Persepsi responden terhadap penggunaan bakul dinilai menggunakan borang soal selidik yang dibina sendiri. Analisis deskriptif digunakan untuk menganalisis RPE, ketidakselesaan, dan persepsi responden terhadap kedua-dua bakul dan perbandingan kadar denyutan jantung dan tenaga antara kedua-dua bakul ditentukan menggunakan independent t-test. Hasilnya kemudian digunakan untuk mereka bakul penuaian baru.

Keputusan: Kajian ini mendapati bahawa tidak terdapat perbezaan yang signifikan antara beban kerja fisiologi yang diukur semasa penggunaan bakul rotan dan bakul prototaip. Kadar denyutan jantung dan penggunaan tenaga responden adalah seperti berikut: bakul rotan, Purata Denyutan Jantung (AHR) = 104.9 ± 14.8 bpm dan Penggunaan Tenaga (EE) = 7.9 ± 2.3 Kj-min; sementara prototaip, AHR = 108.4 ± 14.7 bpm dan EE = 8.5 ± 2.3 Kj-min (nilai-t = -0.8, p = 0.40). RPE rata-rata responden adalah 8.76 ± 1.64 dan pinggang mempunyai skala Borg CR-10 tertinggi (2.7 ± 2.6) diikuti dengan belakang badan tengah (2.1 ± 2.6) dan belakang badan bawah (2.0 ± 2.7). Sebilangan besar responden puas hati dengan bakul rotan mereka (67%) dan kebanyakan mereka mengatakan bahawa bakul prototaip tidak memenuhi harapan mereka. Reka bentuk dan pembinaan bakul kemudian dimulakan, dan prototaip baru dirancang oleh pihak ketiga. **Kesimpulan:** Penuai nanas perlu menggunakan alat ergonomik dalam melaksanakan tugas mereka untuk memastikan keselamatan dan kesihatan pekerja dijaga dengan baik. Bakul yang dibina akan mengurangkan faktor risiko gangguan muskuloskeletal di kalangan penuai.

Kata kunci: Muskuloskeletal Disorder (MSD), kadar denyutan jantung, penggunaan tenaga, ketidakselesaan, bakul penuaian yang ergonomik

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LIST OF ABBREVIATIONS

AHR	Average heart rate
EE	Energy expenditure
MSS	Musculoskeletal symptoms
MSD	Musculoskeletal disorder
NBOS	National Blue Ocean Strategy
GTP	Government Transformation Program
OWAS	Ovako Working Posture Analysis System
RULA	Rapid Upper Limb Assessment
RPE	Rating of perceive exertion

CHAPTER 1

INTRODUCTION

1.1 Background

According to World Health Organization (WHO, 2019), the major contributor of disability worldwide is musculoskeletal condition. Agriculture sectors are one of the sectors that had highest risk factors of musculoskeletal disorder. This is due to the physically strenuous work task in the agriculture sectors especially plantation that still use traditional ways in their work task. Based on Middlesworth (2019), musculoskeletal disorder is due to exposure to risk factor which can be divided into two categories, ergonomic risk factors and individual risk factors. Ergonomic risk factors consist of force repetition and posture while individual risk factors consist of poor work practices, poor fitness and poor health habits. Basher et al., (2015) reported that about half of the respondent of his study had experienced pain at least one or more times in different parts of the body during working in the plantation.

1.2 Pineapple Plantation

The demand of the pineapple production had been increased over time in

Malaysia. Malaysian pineapple was expected to increase in its export value from RM 155 million a year to RM 320 million by 2020 (Othman, 2017). Mezlan et al., (2017) had stated that working in the pineapple plantation will resulted to a lot of strain to the body due to its repetitive and heavy task such as panting, manual weeding and harvesting. The characteristics of the pineapple make it more difficult to handle because it grows low to the ground which lead to awkward and extreme postures. Salleh et al., (2019) had found in his study all work task at pineapple plantation which are planting, harvesting and manual weeding were categorized as distinctly harmful (Action Category 3) and extremely harmful (Action Category 4) based on Ovako Working Posture Analysis System (OWAS).

1.3 Rattan Harvesting Basket

Rattan harvesting basket had been used for a long time for pineapple harvesting. The usage of rattan harvesting basket will not become a problem as the weight of the harvesting basket from rattan is consider light. However, the problem comes. Based on study from Mezlan et al., (2017), the weight of the rattan basket was about 5 kg with cylindrical shape and raffia rope as the shoulder strap. Some harvester had modified their basket so more load can be filled into the basket which will increase the workload carried by the workers. The harvester needs to unload the pineapple by bending their body forward so that the fruit will fall out from the basket. This repetitive action will be resulted

to musculoskeletal symptoms. Furthermore, the raffia rope used is not adjustable and will give higher contact stress to the harvester's shoulder.

1.4 Problem Statement

It is proved that pineapple harvesting had the highest risk that contribute to musculoskeletal symptoms. Rani et al., (2016) found that harvesting had the highest risk factors compare to other work tasks after conducting the hazard identification and risk assessment of work task in pineapple plantation which resulted to low back pain and knee pain, excess fatigue shoulder pain and repetitive strain injuries. Development of modified basket for harvester was recommended to prevent the excessive bending to unloading the pineapple from the basket.

A study by Mezlan et al. (2017) had develop an improved harvesting basket that is believed will reduce MSS and discomfort of pineapple harvester. A latch had been added at the bottom of the improved harvesting basket and it can be open during the unloading process.

However, this improved harvesting basket was not tested by actual pineapple workers. Hence, the actual discomfort and physiological workload of the workers could not be determined by the test that had being carried out (Mezlan et al., 2017). In addition, the improved harvesting basket did not apply

any anthropometric measurement of the pineapple harvester to make sure the improved harvesting basket fit with the body of the workers. Rhie et al., (2017) stated that when the of anthropometric measurement is consider into a design specification, the incidences of MSDs will be reduced because the physical comfort of the user is improved

1.5 Study Justification

Multiple evidence has shown that harvesting task posed the highest risk of musculoskeletal symptoms than other work tasks. The ergonomic risk assessment among pineapple plantation workers conducted by Rani et al. (2016) have found that harvesting had the highest risk factors compared to other work tasks which resulted to low back pain, knee pain, excess fatigue shoulder pain and repetitive strain injuries. Development of modified basket for harvester was recommended to prevent the excessive bending during unloading of pineapple from the basket.

A study by Mezlan et al. (2017) had develop an improved harvesting basket that is believed to reduce musculoskeletal symptom (MSS) and discomfort of pineapple harvester. A latch had been added at the bottom of the improved harvesting basket and it can be opened during the unloading process.

However, this improved harvesting basket was not tested by actual pineapple workers. Hence, the actual discomfort and physiological workload of

the workers could not be assessed. by the tbasket simulation that had being carried out (Mezlan et al., 2017). In addition, the improved harvesting basket was developed without taking into account the anthropometric measurements of the pineapple harvesters. By considering the anthropometric measurement data in design specification, the reduction of MSDs incidence can be achieved as the physical comfort of the users is improved (Rhie et al., 2017).



1.6 Conceptual Framework

Harvesting is one of the main work tasks performed by the pineapple plantation workers. The workers exposed to variety of ergonomic risk factors such as high exertion force, prolonged stooping, heavy and awkward lifting which can contribute to musculoskeletal symptoms. The workers may experience the musculoskeletal symptoms such as discomfort and pain at several body parts include neck, shoulder, upper back, lower back, elbow, hip, knee, ankle and feet, if the risk factors are not controlled. A prototype of ergonomic pineapple harvesting basket had been developed by previous researcher in order to minimize the risk factors. This basket equipped with comfortable strap, backrest and an opening below the basket for unloading of fruits. An intervention of newly ergonomic basket is designed and developed based on the prototype with the consideration of workers' opinion and perception of the prototype. The prototype was tested by the harvester and the level of discomfort, heart rate, energy expenditure, perceived exertion and perception of workers were measured. The prolonged used of the ergonomic basket would reduce the prevalence of MSS among the harvesters. The independent variable of this study was the pineapple harvesting basket while heart rate, energy expenditure and the perception of the workers were the dependent variables due to different design of the pineapple harvesting basket.

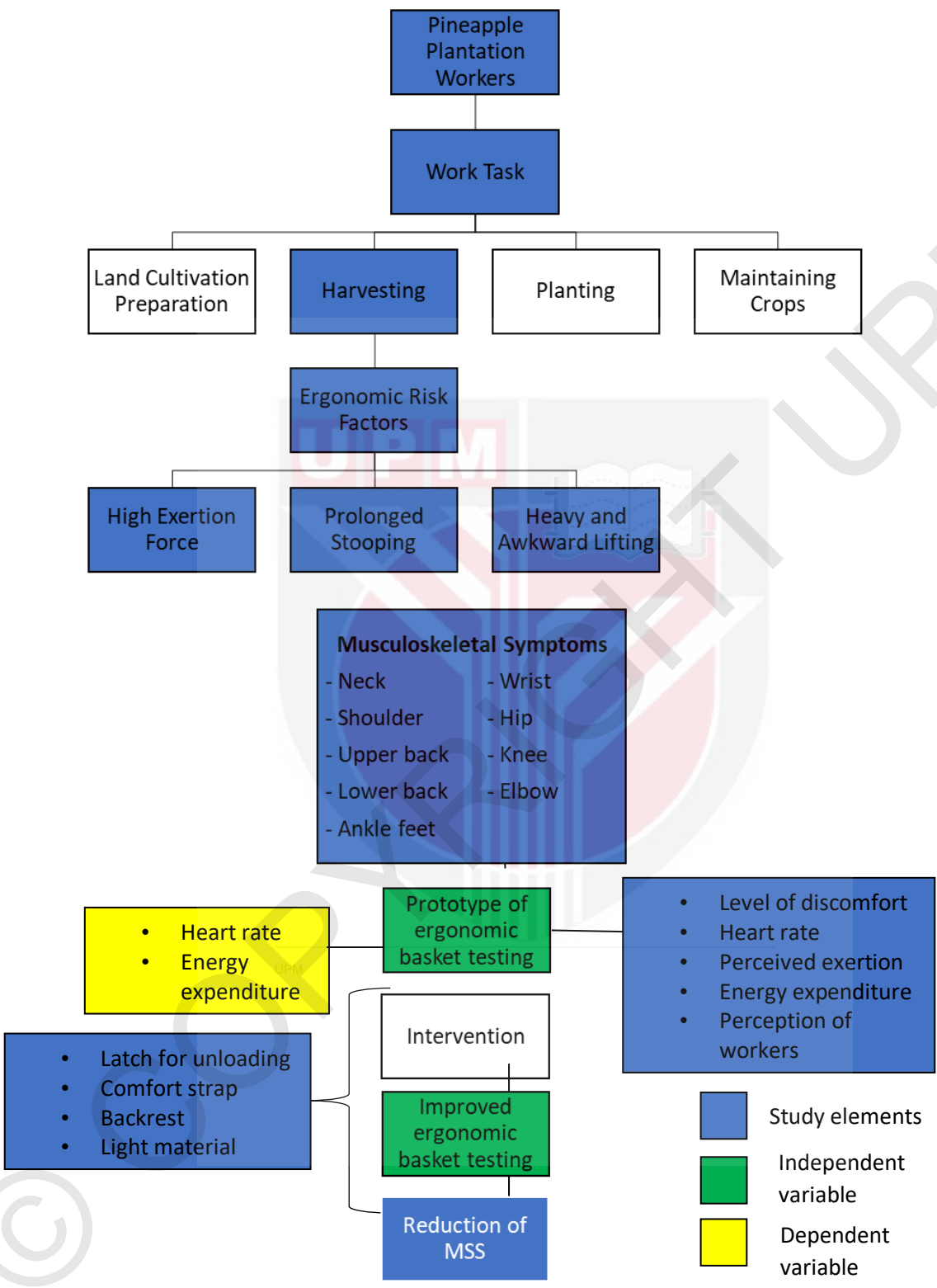


Figure 1.1: Conceptual Framework

1.7 Research Question

- i. What is the perception of the pineapple harvesters towards the old harvesting basket (the rattan basket) and the prototype of pineapple harvesting basket?
- ii. What is the difference between the old harvesting basket (the rattan basket) and prototype of pineapple harvesting basket in terms of heart rate and energy expenditure of harvesters?
- iii. What is the best design for an ergonomic pineapple harvesting basket?

1.8 Hypothesis

There are significant differences between the old harvesting basket (the rattan basket) and prototype of harvesting basket in terms of heart rate and energy expenditure of harvesters. There is also significant difference of the perception of the pineapple harvester towards the old harvesting basket (the rattan basket) and the prototype of pineapple harvesting basket. The application of anthropometric measurement of the pineapple harvester to the new design of ergonomic pineapple harvesting basket.

1.9 Objectives

1.9.1 General Objective

- i. To assess the anthropometric measurement, design and develop an ergonomic pineapple harvesting basket based on the prototype basket developed by previous researcher.

1.9.2 Specific Objective

- i. To test the prototype of pineapple harvesting basket on pineapple harvesters and measure their perceived exertion, heart rate, energy expenditure and discomfort.
- ii. To compare the old harvesting basket (the rattan basket) and prototype of pineapple harvesting basket in terms of heart rate and energy expenditure of harvesters.
- iii. To study the perception of the pineapple harvesters towards the old harvesting basket (the rattan basket) and the prototype of pineapple harvesting basket.
- iv. To apply anthropometric measurement of the pineapple harvesters to the new design of ergonomic pineapple harvesting basket.

CHAPTER 2

LITERATURE REVIEW

2.1 Pineapple Plantation Workers

Prime minister had introduced an approach for the pineapple plantation workers which is National Blue Ocean Strategy (NBOS) based on Government transformation Program (GTP) (reference). A new creative and innovative idea in providing comfort is the aim of the implementation of NBOS. A total of 16 acres areas is involved in the project for the cultivation of MD2 Pineapple (Mezlan et al., 2017).

2.2 Prevalence of MSS in Malaysia

The prevalence of musculoskeletal pain on different body parts have been reported among tea pluckers for the past 12 months (Masri et al., 2017) Wrist had the highest prevalence of MSS with 38.5% among the ten body parts followed by lower back (35%), neck (34.6%), knee (32.9%), upper back (26.9%), shoulder (24.8%), hip and feet (24.4%), elbow (22.2%) and ankle (18.4%). This high prevalence of musculoskeletal pain among workers were because of hazardous task performed by the workers which resulted to ergonomic risk factors such as pushing and lifting (Masri et al., 2017).

The prevalence of MSDs in research by Pal and Dhara, (2017) revealed that 93.25% of male and 92.26% of female among the workers suffered with lower back problem. This was followed by upper back problem (male: 63.8%; female: 65.16%), waist whereas male with 60.12% and female with 57.42%. The cause of this high prevalence is due to the predominant posture during working such as forward bending and squat sitting posture.

The research done by Hadi, (2016) shows that the prevalence of low back pain among tea leaf pluckers throughout their work in the plantation was 81.1% while 64.2% for the prevalence of low back pain in the past 12 months. The back pain was also categorized based on different part whereas lower back had the highest prevalence of back pain with 79.1 followed by middle back (67.4%) and upper back (66.3%).

Rani et al., (2017) reported that prevalence of MSS of the overall body parts was 87%. Lower back was the most affected body part (64.8%) while upper back had lowest prevalence of MSS (9.3%). The prevalence of MSS for other body parts were also reported which were feet/ankle (53.7%), knee (52.8%), shoulder (38%), wrist (20.4%), neck (13%) and hips/thigh (11.1%).

Nawi et al., (2016) almost all the oil palm workers had complaint of pain at their lower back. This study also shows the workers who work at loose fruit unit had highest pain experienced compared to other workers. The high pain experienced is due

to prolonged exposure of awkward postures during their working hours (Nawi et al., 2016)

A study by Ng et al., (2015) found that the prevalence of MSD for all body parts among palm oil harvester were consider high for the past 12 months (86%) while the prevalence for 7 days was 45%. Lower back had the highest prevalence for both 12 months (58%) and 7 days (28%) consistently followed by knee with 40% for 12 months and 15% for 7 days.

According to Pal et al., (2014) potato cultivators had high prevalence of MSDs especially which lower back (48%) and upper back (35) were the most affected areas among workers who aged more than 15 years old.

2.3 Ergonomic Risk Factors

Salleh et al., (2019) reported that pineapple plantation workers may harm and expose to musculoskeletal problems due to their awkward postures adapted to their work tasks. Manual handling had the highest risk task due to extreme posture which the workers need to bend and twisted their trunks while their arms were sometimes above shoulder height. Prolonged and repetitive awkward postures during planting activity was also considered high risk. The development of back pain, osteoarthritis, knee pain, and other extremity problems may occur due to stooping, kneeling and squatting (Salleh et al., 2019)

A research done by Salleh and Sukadarin, (2018) shows that the identified ergonomic risk factors in Malaysian pineapple plantation were prolonged exposure of squatting, standing, stooping and kneeling, deviation and twisting of wrist, heavy lifting, and highly repetitive motion on the lower limbs. The workers needed to constantly bend their trunk for more than 60° which may lead to low back disorders. Hip and knee arthritis might also occur due to the prolonged kneeling and squatting which more than three hours total per day. Besides, the harvester needs to carry heavy load during their working hours about 50 kg to 70 kg per session. This observation found that the main hazards in pineapple plantation were ergonomic risk factors which related to safety and health issue.

The occurrence of MSDs might be due to postural stress (Pal et al., 2014). This study shows that forward bending in harvesting had the highest score (40) of postural analysis by Quick Exposure Check method which fall under high risk level while squatting during plantation had lower score (32) but still fall under high risk level.

Based on a study by Ya'acob et al., (2017), the postural risk assessment namely Rapid Upper Limb Assessment (RULA) was performed in which 68.5% and 30% of participants had high and medium risk for MSS due to working postures, respectively. The work task of harvesting, and cultivation had the highest risk as 20% of those who performed these tasks scored the highest MSS risk.

2.4 Physiological Workload

A study done by Lucas et al., (2015) reported that the workers had above 50% of their maximum heart rate while working for over half of the workday. The physiological workload of cutting firewood activity was graded as “heavy” as the estimated average and peak energy expenditure was at 11.90 kJ/min and 13.3 kJ/min respectively (Borah, 2015).

Mohanty, (2016) stated that the workload rate for agriculture operation was categorized into three categories which were i) light when the working heart rate (WHR) was below 100 beats/min, ii) medium when WHR in the range of 100-125 beats/min and iii) heavy when WHR was more than 125 beats/min. The physiological workload is influenced by the posture while completing the task. This study found that the heart rate of workers was lower (97 beats/min) while plucking cobs in sitting posture compared to standing posture (109 beats/min) (Mohanty, 2016).

Based on research by Pal and Dhara (2017), the workers of potato cultivation have an average working heart rate of 105.33 beats/min in male and 109.97 beats/min in female. These workers had working at about 55% of their maximum heart rate in male and female respectively

2.5 Rating of Perceived Exertion

Borg 6-20 RPE (BORG-RPE) and Borg Category-Ratio-10 scale (BORG-CR10) are the scale used to measure exercise intensity (Arney et al., 2019). An individual's effort and exertion, fatigue and breathlessness while carried out physical work can be measured using BORG-RPE and it is highly relevant for safety practices and occupational health. Perceived exertion can be defined as how hard they felt their body is working and Borg scale can be used to rate it (Shariat et al., 2018). Borg's category ratio was constructed by Borg, (1982) where category ratio properties was applied in which questions such as "*How much stronger this intensity than that one?*" and "*How strong is this intensity?*" were asked

Aziz et al., (2019) had used Borg's CR-10 questionnaire for the respondent so that they can evaluate their discomfort level. Arising discomfort from certain body parts during the experimental session can be determined by using the rating. Other study Joshi et al., (2018) had used BORG-RPE to measure the effort involved in a certain work task whereas the scale is administered 30 minutes before the work end.

CHAPTER 3

METHODOLOGY

3.1 Study Design

This is a cross sectional study. This study aimed to develop an ergonomic harvesting basket based on the prototype basket designed by previous researcher. By taking into account on the anthropometric measurement data of the harvesters to replace the existing rattan basket used for harvesting. The development of the basket is aims to minimize the musculoskeletal symptoms by reducing the discomfort and contact stress to body parts of the harvester during harvesting.

3.2 Study Location

The anthropometric measurement and testing of prototype basket were carried out at selected areas in Johor. The development of the new improved was done by a hired party based on the design prepared. Figure 3.1 shows the location of the study.

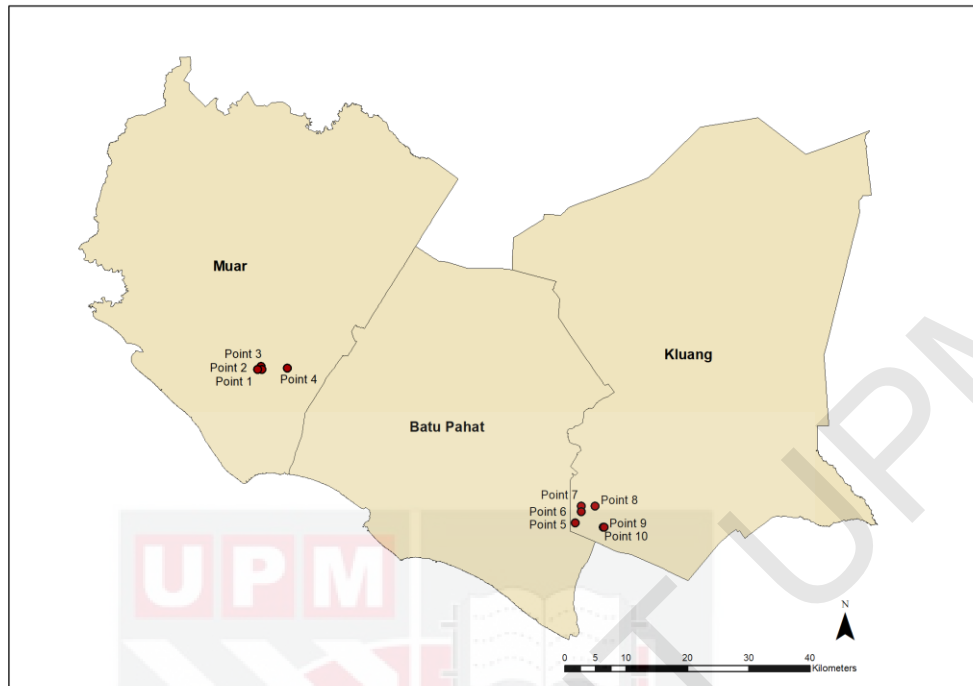


Figure 3.1: Maps of selected areas in Johor

3.3 Study Duration

The study was conducted from February 2020 until March 2020.

3.4 Sampling

3.4.1 Sampling Population

The sample population of this study are male harvester of pineapple plantation.

3.4.2 Sampling Unit

The respondents were selected based on the selection criteria:

Inclusion criteria:

1. Harvester who aged from 18 to 60 years old. The minimum retirement of workers are 60 years old based on the Minimum Retirement Age Act 2012.
2. Harvester that have work at least for six months to make sure harvester is their permanent job. Donovan and Ho, (2015) mentioned that the most common of probationary period is in the range three to six months.

Exclusion criteria:

1. Respondents that had been diagnosed with chronic disease such as heart disease because heart disease will be resulted to arrhythmia.
2. Respondents that had been diagnosed with musculoskeletal disorders (MSD) by medical doctors because it can influence the results of discomfort. According to Harris et al., (2011) the basket testing was conducted to study the discomfort level of workers with different types of baskets without affected by others factor.

3.4.3 Sampling Method

Purposive sampling was used as the sampling method for the study location and the respondents that fulfilled the criteria were chosen. This is because the location of the pineapple plantation in Johor was scattered and due to limited time as harvester has specific time to harvest their pineapple.

3.4.4 Sample Size

The total sample size for the study used the following formula:

$$\text{Formula } n = \frac{2\sigma^2 \left(Z_{1-\frac{\alpha}{2}} + Z_{1-\beta} \right)^2}{(\mu_1 - \mu_2)^2} \quad \dots\dots\dots \text{Equation 1}$$

Where:

σ = estimated standard deviation (assumed to be equal to each group)

μ_1 = mean of first population

$\mu_1 = 6$

μ_2 = mean of first population

$\mu_2 = 5$

$Z_{1-\frac{\alpha}{2}}$ = standard error associated with confidential interval

(Chosen 95% confidential interval = 1.96)

$Z_{1-\beta}$ = standard error associated with power

(Chosen 90% of power = 1.28)

$$n = \frac{2(1)^2(1.96+1.28)^2}{(6-5)^2}$$

n=21

n=21 + 20% dropout rate

The minimum number of adequate respondents was 25 respondents.

Mezlan, 2017 (Mean of overall distribution of energy expenditure using existing and improved basket

3.5 Study Instruments

3.5.1 Instruments

This study used the following instruments:

1. Self-developed questionnaire
2. Fitbit Fitness Smartwatch
3. Seca Weighing Scale
4. Measuring Tape

3.5.1.1 Questionnaire

A self-developed questionnaire was given to the respondents. The questionnaires were prepared in Malay and English version. Respondents may choose which version they preferred to answer. The questionnaire consisted of seven parts as following:

- i) Section A: Socio-demographic background information such as gender, age, nationality and race, anthropometric measurement data (filled by the researcher)
- ii) Section B: Medical history information.
- iii) Section C: Working information.
- iv) Section D: Perception of the harvester on rattan harvesting basket.
- v) Section E: rating of perceived exertion by the respondents when using the

prototype harvesting basket using Borg’s RPE scale.

vi)Section F: discomfort level of using prototype harvesting baskets (Borg’s CR-10 scale). The Borg’s CR-10 was shown in Figure 3.2.

Please identify discomfort levels for number 1 to 24 according to the scale given.

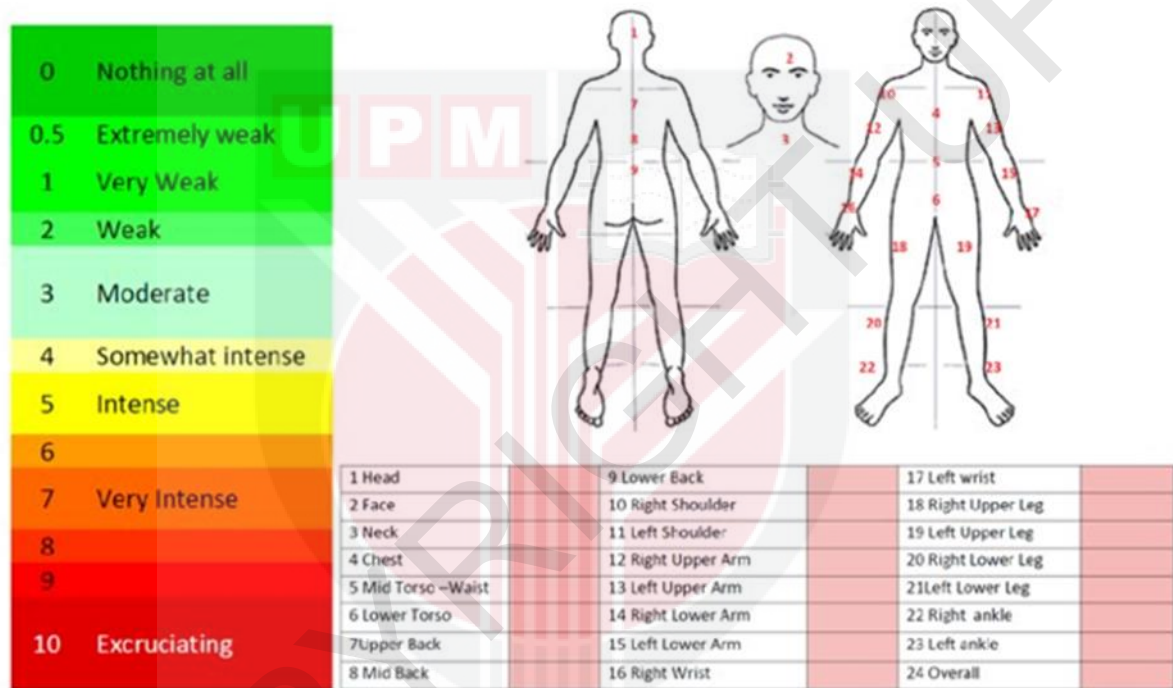


Figure 3.2: Borg’s CR-10 scale (Arrendondo, 2014)

3.5.1.2 Fitbit Fitness Smartwatch

The respondents were given to wear the Fitbit Fitness smartwatch prior the starting of the basket testing sessions for the old harvesting basket (the rattan basket) and prototype of pineapple harvesting basket. The heart rate of the respondents was

measured after the end basket testing using Fitbit Fitness Smartwatch. The heart rate of the respondents was measured after the end of basket session using Fitbit Fitness Smartwatch for both baskets.

3.6 Basket Testing

Questionnaire were distributed to collect the information of the respondents before starting the basket testing determine the criteria was fulfilled by the respondents. The anthropometric measurement of the respondents was taken for the intervention of improved harvesting basket. The respondents were given the Fitbit Fitness Smartwatch prior the starting of the basket testing sessions. The heart rate of the respondents was measured using the Fitbit Fitness Smartwatch while they were performing their work task using the old pineapple harvesting basket (rattan) and the measurement were recorded at the end of the basket testing session. Figure 3.3 show the old harvesting basket (rattan basket)



Figure 3.3: Old harvesting basket (rattan basket)

The prototype of pineapple harvesting basket were tested by the selected harvester at the field while the harvesters are completing their work task. Figure 3.4 show the prototype of pineapple harvesting basket. Upon completing basket testing session for prototype of pineapple harvesting basket, the workers had rated the intensity of the task from the scale 1 to 10 with 1 indicating minimal difficulty or intensity and 10 indicating maximum difficulty or intensity. This step had used Borg's RPE scale. Heart rate of the respondents were recorded after each round using the Fitbit Fitness Smartwatch.



Figure 3.4: Prototype of pineapple harvesting basket

After the respondents has completed the basket testing for prototype of pineapple harvesting basket, they completed the Borg CR – 10 scale to identify their discomforts level for 23 different body parts and overall, from the scale 0 to 10 with 0 indicating nothing at all and 10 indicating excruciating.

The pre-test questionnaire was conducted among male respondents the had the similar characteristics with the intended respondents of this study at Universiti Putra Malaysia. About 10% of the total sample size of the respondents of this study is taken for the pre-test.

3.7 Procedure of Data Collection

1. Ethical board committee of Universiti Putra Malaysia approval
2. The methodology was based on the objectives.
3. Following the basket testing sessions, for objective to design and develop an ergonomic pineapple harvesting basket, the harvesters' opinion and suggestion regarding the old harvesting basket (the rattan basket) and the prototype of pineapple harvesting basket after the basket testing were taken into account in designing and developing the new ergonomic pineapple harvesting basket.
4. In order to test the prototype of pineapple harvesting basket on pineapple harvester, field testing was conducted at selected areas in Johor. The heart rate was measured using Fitbit Fitness Smartwatch while the harvesters performing their work tasks and the measurement were recorded at the end of basket testing sessions.
5. To achieve the objective of comparing the harvesters' heart rate and energy expenditure while using two different baskets, the heart rates were recorded at the end of basket testing sessions. Then, the energy expenditure of both basket testing sessions were calculated using specific formula. The statistical analysis were performed in order to determine the significant difference of old pineapple harvesting basket (the rattan basket) and prototype of pineapple harvesting basket in terms of harvesters' heart rate measurement and energy expenditure while performing their work task.
6. In order to determine for objective to study the perception of the pineapple harvester towards the old harvesting basket (the rattan basket) and the prototype

of pineapple harvesting basket, respondents were required to answer few questions regarding their socio-demographic information, medical history information, perception on old harvesting basket, Borg's rating of perceived exertion, Borg CR-10 scale and perception of prototype of pineapple harvesting basket

7. In order to apply the anthropometric measurement of the pineapple harvester to the newly design of ergonomic pineapple harvesting basket, the body measurement of the respondents such as weight, height, shoulder length, neck to waist length and waist circumference were measured.
8. Data collected were entered to a statistical software and will be analysed according to the objectives.

3.8 Statistical Analysis

IBM SPSS (Statistical Package for the Social Sciences) version 25 was used to analyse the data obtained. The respondents' socio-demographic information perceived exertion, discomfort and perception of prototype harvesting basket had been analysed using descriptive analysis. Energy expenditure, heart rate and for both rattan and prototype harvesting basket were analysed using independent t-test/ Mann-Whitney U test.

*Energy expenditure (EE) was calculated from the average values of heart rate (AHR) using the formula by Bhattacharyya and Chakrabarti (2012) as below:

$$EE \text{ (Kj-min)} = 0.159 \times \text{AHR (beats per min)} - 8.72 \quad \text{————— Equation 2}$$

Table 3.1: Data Analysis Methods Based on Study Objectives

Objectives	Hypothesis	Data Analysis Methods
To test the prototype of pineapple harvesting basket on pineapple harvesters and measure their perceived exertion, energy expenditure, heart rate and discomfort.	-	Descriptive analysis
To compare the old harvesting basket (the rattan basket) and prototype of pineapple harvesting basket in terms of heart rate and energy expenditure of harvesters.	There is significant difference between the old harvesting basket (the rattan basket) and prototype harvesting basket in terms of heart rate and energy expenditure of harvesters.	Independent T-Test / Mann-Whitney U test
To study the perception of the pineapple harvester between the old harvesting basket (the rattan basket) and the prototype of pineapple harvesting basket.	There is significant difference of the perception of the pineapple harvester toward the old harvesting basket (the rattan basket) and the prototype of pineapple harvesting basket.	Descriptive analysis
To apply anthropometric measurement of the pineapple harvester to the new design of ergonomic pineapple harvesting basket.	-	-

3.9 Validity of Questionnaire

The questionnaire's validity contents were done in the pre-testing of the questionnaire. The questionnaires were distributed to 10% of the total sample size population among male respondent in UPM that have the similar characteristics with the intended respondents of this study. The identified ambiguous terms during the pre-test

were amended to improve the understanding of the respondents while answering the questionnaire.

3.10 Reliability

The questionnaire's reliability was tested using Cronbach's Alpha. The internal consistency in a statistic is measured using Cronbach's alpha and it was suitable to measure the internal consistency in scales where items had more than two response options (Adomsan & Prion, 2013). The Cronbach's alpha can range from 0 to 1. 0 is the value of α which means there is no relation but when 1 is the value of α , it means the perfect correlation. The value obtained was 0.78

3.11 Quality Control

This study's quality control was the reset of Fitbit Fitness Smartwatch before any measurement is taken and pre-test of the questionnaire was done before performing the basket testing.

CHAPTER 4:

RESULTS

4.1 Sociodemographic Information

A total of 27 pineapple harvesters were sampled which consisted of non-Malaysian men adults within a range of 20 to 57 years old (35.1 ± 9.3). Malaysian respondent was unable to be recruited into the study due to a limited number of Malaysian workers involved in pineapple harvesting task and all of them were in the age of more than 60 years old which ineligible for this study. There were 22% ($n = 6$) of the respondents were single while 78% ($n = 21$) of them were married. Majority of the respondents attained primary (48%, $n = 13$) and secondary educational level (48%, $n = 13$) and only 4% ($n=1$) of them had informal education. The information on sociodemographic background of the respondents was shown in Table 4.1

Table 4.1: Sociodemographic characteristics of respondents (N=27)

Sociodemographic		n	%	Mean±SD
Age (years)	<29	6	22	
	30-39	11	41	35.1 ± 9.3
	>40	10	37	
Nationality	Malaysian	0	0	
	Non-Malaysian	27	100	-
Marital status	Single	6	22	
	Married	21	78	-
	Others	0	0	
Education level	Informal education	1	4	
	Primary education	13	48	
	Secondary education	13	48	-
	Tertiary education	0	0	

4.2 Perceived exertion, heart rate, energy expenditure and discomfort level of respondents

Table 4.2 shows the average of BORG rating of perceived exertion of the respondents when using the prototype of pineapple harvesting basket. The average rating of perceived exertion by respondents was 8.76 (1.64). They had rated the intensity of performing the task from the scale 1 to 10; where 1 indicates a minimal difficulty or intensity and the maximum of intensity denotes by 10.

Table 4.2: BORG Rating of exertion of respondents while using the prototype of pineapple harvesting basket

Variable	Mean (SD)	Min	Max
BORG Rating of Exertion	8.76 (1.64)	6.0	10.0

Apart from that, the discomfort levels for all body parts reported among respondents while using the prototype of pineapple harvesting basket from the scale 0 to 10 with 0 indicating nothing at all and 10 indicating excruciating was shown in Figure 4.1. The result shows that waist had the highest average score with 2.70 (2.64) followed by middle back with 2.07 (2.56) and lower back with 1.96 (2.74) which indicates weak discomfort levels when using prototype of pineapple harvesting basket. The overall body parts had 3.30 (2.51) of average score. This means that overall body parts had moderate discomfort levels when using prototype of pineapple harvesting basket.

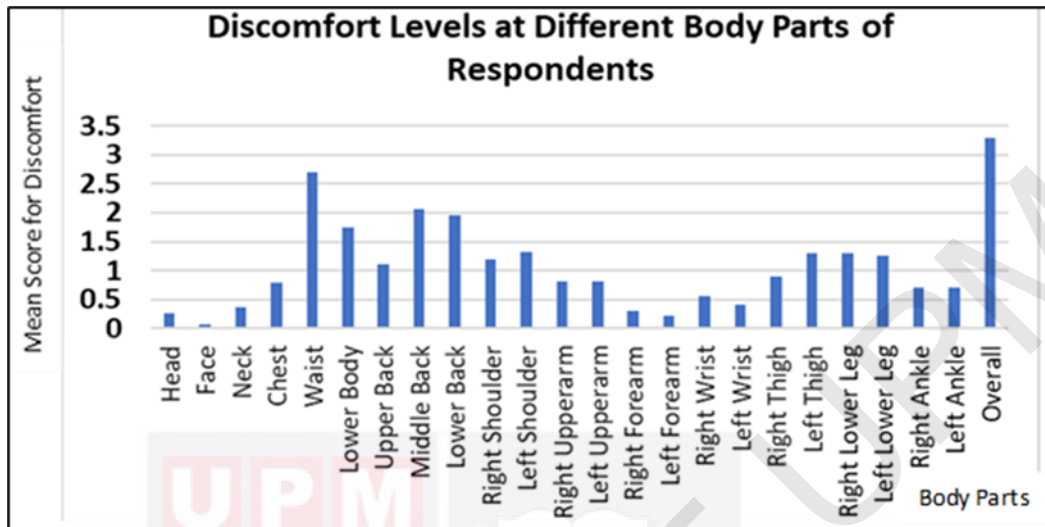


Figure 4.1: Discomfort levels of respondents while using prototype of pineapple harvesting basket. (n=27) *0 indicates nothing at all and 10 indicates excruciating

4.3 Mean difference between the rattan and prototype harvesting basket in terms of heart rate and energy expenditure.

Table 4.3 shows the mean of heart rate and energy expenditure of respondents while using old harvesting basket (rattan basket) and prototype of pineapple harvesting basket. The average heart rate of the respondents while using old harvesting basket (rattan basket) were 104.78 ± 14.76 beats per min and 108.39 ± 14.67 while using prototype of pineapple harvesting basket. Besides, the average energy expenditure of the respondents while using old harvesting basket (rattan basket) were 7.94 ± 2.34 Kj-min and 8.51 ± 2.33 Kj-min while using prototype of pineapple harvesting basket. The finding of independent t-test analysis shows that there were no significant differences between heart rate and energy expenditure of respondents for old harvesting basket (rattan basket) and prototype of pineapple harvesting basket ($p=0.41$).

Table 4.3: Distribution of heart rate and energy expenditure of respondents while using old harvesting basket (rattan basket) and prototype of pineapple harvesting basket. (n=23)

Variables	Mean (SD)		Mean difference (95% CI)	t-statistics (df)	p-value*
	Rattan basket	Prototype basket			
Heart Rate	104.78 (14.76)	108.39 (14.67)	-3.60 (-12.35, 5.13)	-0.83 (44)	0.41
Energy Expenditure	7.94 (2.34)	8.51 (2.33)	-0.56 (-1.96, 0.81)	-0.83 (44)	0.41

*Significant at $p > 0.05$ *Statistic test used was independent t-test

From the average values of heart rate (AHR), energy expenditure (EE) was calculated with the formula given by (Varghese et al., 1994; Bhattacharyya & Chakrabarti, 2012): Energy Expenditure (Kj-min) = $0.159 \times \text{Average Heart Rate (beats per min)} - 8.72$.

4.4 Perceptions of respondents towards rattan basket and prototype pineapple harvesting basket

4.4.1 Respondents' perception towards Rattan Harvesting Basket

The average duration of the harvester carrying the old harvesting basket (rattan basket) were 6.0 (1.0) hour per day and it took about an average of 5.0 (7.0) minutes for a basket to full which also depend on the distance of the harvesting point and unloading area. The maximum weight of load for a full rattan basket was 69.9 (16.5) kg and the average daily weight load carried by harvesters was 1685.2 (1548.9) kg. Table 4.4 shows the perception of the respondents towards the old harvesting basket (rattan basket).

As being reported by the respondents, every harvester will have their own rattan basket which was provided by their employer. The rattan basket will be modified by themselves to carry more load. Surprisingly, there were 7% (n=2) of respondents have used a similar rattan basket for more than 10 years. Only 11% (n=3) of respondents have used their rattan basket for five to nine years. While another 67% (n=18) and 15% (n=4) of them have used their rattan basket for at least one to four years and less than one year, respectively.

In addition, majority of the respondents (93%, n=25) had modified their rattan basket and only 7% (n =2) of them have retained the original specification of rattan basket. There was 52% of the respondents (n=14) perceived the rattan basket's weight was light and another 22% (n=6) and 26% (n=7) of them mentioned that the rattan basket was medium and heavy weight.

Focusing on the respondents' body postures while harvesting, majority of respondents (74%, n = 20) reported that the task required them to stooping and leaning forwards. Apart from that, the harvesting task also involved the harvesters' body to be in a leaning sideways posture as being mentioned by 22% (n = 6) of respondents. More than half of the respondents (70%, n =19) perceived the loading process of pineapple using the old harvesting basket (rattan basket) was quick and easy. The other 26% (n=7) of them considered the process was quick but painful and only 4% (n=1) stated that the process was time consuming and painful

Approximately, only 3% (n =1) of the respondents were very dissatisfied with the basket and 4% were dissatisfied. Meanwhile, 67% (n=18) of them were satisfied and 26% (n=7) were very satisfied with the basket. Furthermore, the respondents were also asked regarding their opinion on the additional features of basket that need to be installed for the purpose of improving its efficiency and comfortability. About 22% (n = 6) of the respondents had agreed that the basket should be equipped with the waist and chest belt. However, more than half of respondents (63%, n = 17; 74%, n = 20) agreed that an adjustable and padded strap are a compulsory feature that need to be installed to the basket.

Table 4.4: Perception of respondents towards the old harvesting basket (rattan basket) (n=27)

Perception		Frequency	Percentage (%)
Basket Provider	Employee	27	100
Own self		0	0
Duration of Basket Usage (Year)	<1	4	15
	1 - 4	18	67
	5 - 9	3	11
	>10	2	7
Basket Modification	Yes	25	93
	No	2	7
Load of Basket	Light	14	52
	Medium	6	22
	Heavy	7	26
Body Posture while harvesting			
a) Stooping	Yes	20	74
	No	7	26
b) Leaning Forward	Yes	20	74
	No	7	26
c) Leaning Sideways	Yes	6	22
	No	21	78

Efficiency during loading load			
	Quick & easy	19	70
	Quick but painful	7	26
	Time consuming but easy	0	0
	Time consuming and painful	1	4
Satisfaction level			
	Very dissatisfied	1	3
	Dissatisfied	1	4
	Satisfied	18	67
	Very Satisfied	7	26
Features needed for a basket			
a) Waist belt			
	Yes	6	22
	No	21	78
b) Chest belt			
	Yes	6	22
	No	21	78
c) Adjustable strap			
	Yes	17	63
	No	10	37
d) Padded strap			
	Yes	20	74
	No	7	26

4.4.2 Respondents' Perception towards Prototype of Pineapple Harvesting Basket

The average maximum load of the prototype of pineapple harvesting basket were 46.0 (15.1) kg and the time taken to full a basket was 5.0 (6.0) minutes. The perception of the respondents towards the prototype of pineapple harvesting basket is shown in Table 4.5.

Based on the result of the prototype of pineapple harvesting basket, 64% (n = 16) of the respondents disagreed that the prototype of pineapple harvesting basket had fulfil their expectation. 16% (n = 4) of the respondent were in the middle and 20% (n = 5) of them agree that the prototype of pineapple harvesting basket had fulfil their expectation.

In addition, majority of the respondents (84%, n = 21) disagreed that the prototype of pineapple harvesting basket had made harvesting task easier. While only 8% (n = 2) of them have deemed that the prototype basket will enhance the efficiency of their harvesting task.

In terms of comfortability of the prototype, about 80% (n = 20) of the respondents stated that the prototype was uncomfortable to be used during harvesting task. Only 8% (n =2) agreed that the prototype of pineapple harvesting basket was comfortable.

Furthermore, approximately 84% (n=21) of the respondents perceived that the usage of pineapple harvesting basket's prototype will not contribute to the increment of productivity. Meanwhile, only 4% (n =1) of the respondents agreed that the usage may benefits the productivity. Apart of that, only 15% (n = 4) of the respondents were willing to use the prototype of pineapple harvesting basket. However, 85% (n =23) of them still considering using the old rattan basket instead of the pineapple harvesting basket's prototype.

Table 4.5: Perception of respondent on prototype of pineapple harvesting basket (n=27)

Perception		Frequency	Percent (%)
Does fulfil expectation	Disagree	16	64
	Middle	4	16
	Agree	5	20
Does it make harvesting easier	Disagree	21	84
	Middle	2	8
	Agree	2	8
Does it feel comfortable	Disagree	20	80
	Middle	3	12
	Agree	2	8
Increase productivity	Disagree	21	84
	Middle	3	12
	Agree	1	4
Willing to use	Yes	4	15
	No	23	85

4.5 Anthropometric measurements of respondents and its application on new improved pineapple harvesting basket.

4.5.1 Anthropometric measurements of respondents

Table 4.6 shows the distribution of anthropometric measurement data of the respondents. The respondents had average weight and height of 60.0 (12.7) kg and 159.7 (18.7) cm, respectively. The average of shoulder length was 44.9 (3.1) cm. The average length from neck to waist was 52.0 (4.1) cm while the average waist circumference of the respondents was 85.8 (10.4) cm.

Table 4.6: Frequency distribution of anthropometric measurement of respondents (n=27)

Anthropometric measurement	Min	Max	Mean (SD)
Weight (kg)	25.0	79.0	60.0 (12.7)
Shoulder length (cm)	42.0	53.0	44.9 (3.1)
Neck to waist length (cm)	43.0	61.0	52.0 (4.1)
Height (cm)	72.0	175.0	159.7 (18.7)
Waist circumference (cm)	69.0	104.0	85.8 (10.4)

4.5.2 Application of anthropometric measurement data in the development of an ergonomic pineapple harvesting basket.

In the process of determining the product specifications of new-developed ergonomic pineapple harvesting basket, there were several aspects have been considered. It includes the average anthropometric measurement data of respondents and their perceptions and opinions on the old rattan basket and the prototype.

The new developed ergonomic pineapple harvesting basket was made with aluminium which was lighter than iron; material used for development of pineapple harvesting basket prototype. Majority of the respondents have commented on the weight of the prototype which was heavier than their old rattan basket. In addition, the new developed basket was also equipped with an opening at the bottom of the basket to prevent an excessive bending during unloading process of pineapple. Unlike the new developed basket, the opening section functioned for unloading process was placed at rear of the prototype which easily loosed when overloaded. Some features of the prototype of pineapple harvesting basket were maintained such as padded back and adjustable shoulder strap. The ergonomic pineapple harvesting basket also can be folded to ease the storage. Figure 4.2 shows the overall dimension of the ergonomic

pineapple harvesting basket with the measurement in millimetre (mm).

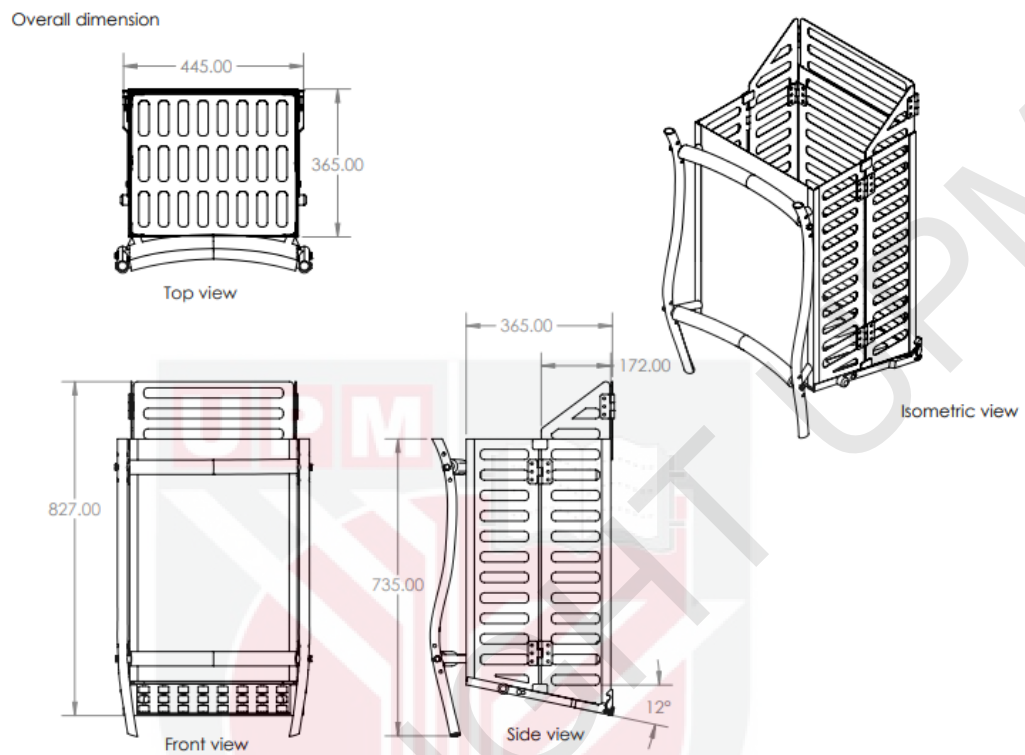


Figure 4.2: Overall dimension of the new developed ergonomic pineapple harvesting basket with measurement (mm)

CHAPTER 5

DISCUSSION

The primary aim of this study was to develop an ergonomic harvesting basket by considering the anthropometric measurement of harvesters as well as their opinions and perceptions on the previous developed prototype of harvesting basket. Generally, this study has able to obtain information on the rating of perceived exertion of the respondents (8.76 ± 1.64), the discomfort level of the respondents where waist had the highest Borg CR-10 scale (2.7 ± 2.6) followed by middle back (2.1 ± 2.6) and lower back (2.0 ± 2.7) respectively. The heart rate and energy expenditure of respondents were as follows: rattan basket, Average Heart Rate (AHR) = 104.9 ± 14.8 bpm and Energy Expenditure (EE) = 7.9 ± 2.3 Kj-min; while prototype, AHR = 108.4 ± 14.7 bpm and EE = 8.5 ± 2.3 Kj-min. This study found that there were no significant differences between physiological workload measured during the use of rattan basket and prototype basket (t-value=-0.8, p=0.40). Majority of the respondents satisfied their rattan basket (67%) and most of them said that the prototype basket did not fulfil their expectation. The design and development of the basket were then commenced, and a new prototype was designed by a third party.

5.1 Perceived exertion, heart rate, energy expenditure and discomfort level of respondents

Due to time constraint, only one round of basket testing session for both baskets had been done per respondents. Supposedly, the basket testing need to be done for more than one session so that the results of RPE and physiological workload can be compared

between session. A previous local study by Mezlan et al. (2017) found significant difference of average heart rate within five rounds of basket testing sessions. In this study, the mean rating of perceived exertion was 8.76 (1.64) which indicates the maximal intensity during harvesting. This was due to weight and shape of the prototype of pineapple harvesting basket. Even though the prototype of pineapple harvesting basket was designed as rectangular trapezoid to eliminate the contact stress at the back of harvesters, it had added strain on the respondents' back. The backward-widening shape of the prototype has resulted the force to pull backward. Hence, the respondents needed to withstand the force with their back. In addition, the weight of the prototype of pineapple harvesting basket was heavier than old harvesting basket (rattan basket) due to the materials used for the basket. The previous prototype of harvesting basket was developed using iron as a basket's material due to its properties; can be welded. Mezlan et al. (2017) stated that they had used to iron as the materials for the prototype of pineapple harvesting basket because of its characteristic which is can be welded. This is important as the prototype of pineapple harvesting need to be welded especially at the opening and the latch. Furthermore, based on the explanation of the respondents, basket that made of rattan will become lighter along with the time as the rattan will dried due to the heat and sun exposure. So, the longer the old harvesting basket (rattan basket) was used the lighter its weight.

Focusing on the most affected body parts, the waist (2.7 ± 2.6), middle back (2.1 ± 2.6), and lower (2.0 ± 2.7) back had highest average score for discomfort level. Even though these body parts had the highest average score, it scores still falls under the range of weak and moderate levels of discomfort. This finding was supported by Rani et al. (2016) in

which the lower back (65%) was also be the most reported musculoskeletal symptoms (MSS) among the pineapple plantations' workers. The study by Mezlan et al. (2017) had also reported the highest average score (0.94) of discomfort level for lower back as complained by the pineapple harvesters. This is because pineapple harvesters had carried heavy weight load (46.0 ± 15.1 kg) in addition with the weight of the prototype (5 kg) which had exceeded the permissible limit (23 kg) suggested by the National Institute Occupational Safety and Health (Kamarudin et al., 2014). Furthermore, the harvesters had to use their body mostly waist, middle and lower back to accommodate the weight of the load behind their back.

Even though the discomfort level of respondents' body parts falls within weak and moderate levels, many studies had reported that pineapple harvesting was a high-risk task (Rani et al., 2016; Salleh and Sukadirin, 2018). Previous hazard identification and risk assessment of work tasks performed among pineapple plantations' workers have revealed that the harvesting task had highest risk rating compared with other tasks involved. Several ergonomic risk factors namely high exertion force, highly repetitive hand motion, prolonged stooping, heavy and awkward lifting have been identified throughout the harvesting work process (Salleh and Sukadirin, 2018). These explained why the task had the highest risk rating among other work tasks in the pineapple plantation which will indirectly expose that particular group of workers to be at high risk to experience musculoskeletal symptoms (MSS). In order to overcome this issue, it is important for the harvesters to use an ergonomic-designed tool as one way to ensure the safety and health of the workers are well taken care of. Development of safe and trustworthy design can tackle the ergonomics risk factors in an occupational set up while performing any activities

(Bhattacharyya, 2009). A study by Bhattacharyya and Chakrabarti (2012) have mentioned the importance of focusing on working condition, design of the work accessories/machines and health of the workers in order to increase efficiency in work performances as well as providing better facilities for the workers. The ergonomic requirements should be achieved in designing a good work appliance or machine required (Bhattacharyya and Chakrabarti, 2012).

5.2 Mean difference between the rattan and prototype harvesting basket in terms of heart rate and energy expenditure

In order to estimate the energy expenditure of respondents while performing the harvesting task, the heart rate of workers was recorded during both basket testing sessions. The workers' average heart rate was slightly higher when they used the prototype of harvesting basket (108.4 ± 14.7 bpm) rather than using rattan basket (104.9 ± 14.8 bpm). The weight of the prototype which was heavier than a rattan basket may attribute to this finding. This was in line with a study finding by Hong et al. (2000) which revealed a significant increase of heart rate at the first five minutes of walking while carrying a load that was 20% of body weight. The heart rate of that particular group of respondents (119.60 bpm) was higher than those carrying a load that 10% of body weight (118.80 bpm). Apart of that, the previous study was also applied a similar concept of current study in which the physiological workloads of harvesting task were compared between both basket testing sessions using the rattan and the prototype of harvesting baskets (Borah and Khalita, 2016). Performing the pineapple harvesting task using the old harvesting basket (rattan basket) have falls under the range of light physiological workload (91-105 bpm)

while the used of the prototype of pineapple harvesting basket was considered as moderate-heavy workload. Thus, it shows that the weight of the harvesting basket may impact the respondents' physiological workload.

The average energy expenditure of the respondents while carrying the prototype of harvesting basket and rattan basket were 8.5 ± 2.3 Kj-min and 7.9 ± 2.3 Kj-min, respectively. Even though a slightly higher of energy expenditure was shown when the respondents using the prototype of harvesting basket (8.5 ± 2.3 Kj-min) compared to rattan basket, there was no significant difference was revealed. This was in line with other study finding (Borah and Khalita, 2016), in which, performing harvesting task using both baskets have been considered as moderately heavy physiological workload (7.6 – 10.0 Kj-min) (Borah & Khalita, 2106). Furthermore, the opening features cannot be used, so there were no differences in performing the harvesting and unloading tasks for both baskets.

5.3 Perception on Old Harvesting Basket (Rattan Basket) and Prototype of Pineapple Harvesting Basket

The perceptions of workers towards the rattan baskets and the prototype of harvesting basket were assessed. This study found that majority of the harvesters (93%, n= 25) had modified by extending their basket in order to increase the load. Therefore, the time spend to achieve the maximum daily load of pineapple (cumulative pineapple weight per day) can be shortening, thus, it will increase the productivity. However, the carrying weight load of the harvesters has already exceeded the permissible weight limit (23 kg) as suggested by the National Institute Occupational Safety and Health (Kamarudin et al.,

2014).

Apart of that, the respondents were also asked regarding their body postures while performing the harvesting task. More than half of respondents (74%) reported that their work task as a harvester required them to be in awkward posture including stooping. Thus, exposing them to be at risk of falling while carrying heavy weight load at the back using the rattan basket. In addition, the natural working environment at the pineapple plantation was also affect the physiological workload of harvesters. For example, the soil structure of peat soil made it harder for the harvesters to walk through a narrow pathway while performing the harvesting task. Therefore, more physiological workload was experienced by the harvesters due to uneven soil at pineapple plantation (Mezlan et al., 2017).

On the other hand, the respondents' satisfaction on their rattan harvesting basket was also being assessed. More than half of the respondents (67%, n =18) were satisfied with the rattan basket in terms of its weight. A light weight of rattan basket (without load) have made the harvesters' task became easier. On the other hand, the respondents have described their harvesting task using the rattan basket as a quick task but need to adhere with the pain. It occurred when they need to excessively bend their body forward with the heavy load behind their back during the pineapples' unloading process. For the purpose of development of new ergonomic harvesting basket, majority of the harvester (63%, n =17) agreed that the new developed basket should be equipped with an adjustable and padded strap features. Most of harvesters have used cotton sackcloth as the strap of their rattan harvesting basket. The narrow width strap will expose the harvesters to contact stress at their upper limbs and shoulder. Furthermore, the strap was not adjustable and did not fit

with the harvesters' body. A padded strap is needed as it can reduce the strain on shoulder during harvesting (Mezlan et al., 2017). The information on the respondents' perceptions towards the rattan basket were significant to be obtained in order to figure out the added aspect and features of the new developed prototype.

Focusing on the prototype of harvesting basket, the respondents perceived that the average maximum load of the prototype of pineapple harvesting basket was lesser than old harvesting basket (rattan basket). As the weight of the empty prototype of pineapple harvesting basket itself was much heavier than the rattan harvesting basket, therefore, less load can be filled in it compare to the rattan harvesting basket.

In assessing the satisfaction of respondents towards the prototype, more than half of the respondents (64%, n=16) said that the prototype of pineapple harvesting basket did not fulfil their expectation. One of the reasons was the short latch of the prototype. Primarily, the latch was created in order to facilitate and ease the unloading process of pineapple. However, after being tested by the respondents, it cannot sustain the heavy load, thus causing the pineapple to fell out of the basket while the harvesting process still in progress. As a result, it will indirectly affect the pineapples' quality as some of it might be bruised. Due to time constraint, most of the respondents did not pick up the fallen pineapples and causing the reduction of productivity. In order to overcome this situation, the opening part was tied and made it dysfunctional. Once the prototype's basket was full, the respondents needed to remove the prototype at first before the pineapples were unloaded manually. It was dangerous for the respondents to bend their body to unload the pineapples. All these have caused the time consuming to complete the unloading process

of pineapples. Hence, most of the respondents were not willing to use the prototype of pineapple harvesting basket as they were more comfortable to use their old harvesting basket (rattan basket).

5.4 Anthropometric measurements of respondents and its application on new improved pineapple harvesting basket.

In order to develop a new ergonomic harvesting basket, this study had considered the anthropometric measurement of the respondents as well as their perceptions and opinions on the previous prototype and the rattan harvesting basket. Several anthropometric measurements of respondents including the weight, shoulder length, neck to waist length, height and waist circumference were recorded. Then, these measurements were considered in the design specifications of new-ergonomic harvesting basket.

Other than that, few additional features of the prototype were also improved in the new-ergonomic harvesting basket. Previously, the opening part of the basket that designed to facilitate the unloading process of pineapple was place at the rear position of the prototype. However, during the basket testing session of the prototype, the unloading process of pineapple was not smooth as expected due to the position of the opening part. In addition, the cactus like leaves of pineapple made it easy to stick at the net of the prototype. Figure 5.1 shows the pineapple that stick at the net of the prototype of pineapple harvesting basket and other person need to help to unload the pineapples. Unlike the previous prototype of harvesting basket, the opening part for unloading process was designed at the bottom of the basket in order to overcome the dysfunctional issue of the

opening part of the previous harvesting basket's prototype.



Figure 5.1: Pineapple stick at the net of basket

Furthermore, the shape of the new-developed ergonomic pineapple basket was developed in a normal rectangular rather than rectangular trapezoid like the prototype of pineapple harvesting basket. That particular was chosen to reduce the force that pull backwards during harvesting. Even though cylindrical shape can also be considered, the opening for unloading cannot be placed at cylindrical design.

Some of the features from the prototype of pineapple harvesting basket were maintained such as padded back and adjustable strap as it will increase the comfortability and reduce the contact stress. These features were retained in the new-developed ergonomic basket as majority of respondents also agreed that the new-developed ergonomic harvesting basket should be equipped with adjustable, comfy of shoulder, waist and chest straps to support the heavy weight load at their back. Figure 5.2 shows the prototype of the new-developed ergonomic harvesting basket equipped with padded

shoulder and waist and adjustable and padded strap. The development of these features had considered their anthropometric measurements in terms of its design specifications. Considering the anthropometric measurements of workers in the development of new ergonomic work appliance would reduce the MSDs' incidences as the physical comfort of the users was improved (Rhie et al., 2017).



Figure 5.2: The prototype of new-developed ergonomic harvesting basket equipped with padded shoulder and waist and adjustable and padded strap.

CHAPTER 6

CONCLUSION AND RECOMMENDATION

As a conclusion, the pineapple harvesters should be provided with ergonomic-designed tools in performing their work task to ensure their safety and health were well taken care of. This study was able to develop an ergonomic harvesting basket in which the anthropometric measurements of pineapple harvesters and their suggestions on the previous developed prototype of harvesting baskets have been considered in the basket's development process.

However, further research is granted to measure the efficiency of the new developed ergonomic-harvesting basket in reducing the risk of musculoskeletal symptoms among pineapple harvesting workers. The basket testing of new-developed ergonomic-harvesting basket by the pineapple harvester workers will be an advantage as the actual physiological workload (heart rate and energy expenditure), perceived exertion, discomfort level, and opinions of the workers will be measured and considered for improvement.

This study has several limitations. The selection bias may occur due to the use of purposive sampling method. This is because the location of the pineapple plantation in Johor is scattered. In addition, only several plantations which undergoing the harvesting phase were included in the study. Furthermore, only one round was conducted due to limited time so the data collected cannot be compare for each round to get the accurate

rating of perceived exertion. Furthermore, the load carried by each of respondent was not constant so the results might be differed as the load carried was varied. The new ergonomic harvesting basket should be tested at the field in order to test the effectiveness and its applicability to be use at the pineapple plantation.



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APPENDIX 1: ETHICAL APPROVAL LETTER

**ETHICS COMMITTEE FOR RESEARCH INVOLVING HUMAN SUBJECTS
(JKEUPM)
UNIVERSITI PUTRA MALAYSIA**

Research title	: The Assessment of Anthropometric Measurement and Development of Pineapple Harvesting Basket for Pineapple Harvesting Workers at Pineapple Plantation in Pontian Johor.
Study Site	: Pineapple plantation, Pontian Johor.
JKEUPM Ref No.	: JKEUPM-2019-435
Researcher	: Fauziatul Syuhada Mansor
Supervisor	: Assoc. Prof. Dr. Emilia Zainal Abidin

Documents received and reviewed with reference to the above study:

1. Ethics Application Form, Version 1 dated 25/10/2019
2. Respondent Information Sheet & Consent (English), Version 2 dated 18/12/2019
3. Respondent Information Sheet & Consent (Malay), Version 2 dated 18/12/2019
4. Proposal (English), Version 1 dated 25/10/2019
5. Questionnaires/ Interviews (English), Version 1 dated 25/10/2019
6. Questionnaires/ Interviews (Malay), Version 1 dated 25/10/2019
7. Curriculum Vitae of:
 - a. Assoc. Prof. Dr. Emilia Zainal Abidin
 - b. Prof. Dr. Noor Hassim Ismail

The University Research Ethics Committee, Universiti Putra Malaysia (JKEUPM) operates in accordance to the ICH-GCP Guidelines.

Decision by JKEUPM:

- Approved
- Permission MUST BE OBTAINED** from the respective hospitals/ institutions before conducting the research
- Disapproved

Please note that the approval is **VALID UNTIL 15 JANUARY 2021**

Researchers should comply with the following:

- I. Complete a Study Final Report upon study completion (Form 3.2).
- II. Ethical approval is required in the case of amendments/ changes to the study documents/ study sites/ study team.



APPENDIX 2: PERMISSION LETTER FOR DATA COLLECTION

LAMPIRAN 1

Pegawai,
Lembaga Perindustrian Nanas Malaysia
Cawangan Johor – Muar
Kompleks Penghulu Mukim Ayer Hitam Batu 18
Ayer Hitam
84060 Muar
Johor

Pengurus,
Peninsula Plantations Sendiian Berhad
Batu 38, Kampung Sg. Linau
Ladang Nenas Simpang Renggam
86200, Simoang Renggam
Johor

APPENDIX 3: RESPONDENT'S INFORMATION SHEET AND CONSENT



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 :

The Assessment of Anthropometric Measurement and Development Of Harvesting Basket For Harvester At Selected Areas In Johor

2. INTRODUCTION:

Agriculture sectors are one of the sector that had the highest risk factors of musculoskeletal disorder and pineapple plantation is one of it. Pineapple harvesting had the highest risk factors compare to other work tasks such as prolonged stooping, high exertion force and heavy and awkward lifting. These risk factors may lead to musculoskeletal symptoms. This study is to develop an improved ergonomic harvesting basket based on the prototype of ergonomic harvesting developed by previous researcher to replace the existing basket used by the harvester to reduce the musculoskeletal symptoms.

3. WHAT WILL YOU HAVE TO DO?

You need to answer questionnaire that will be distributed to gather the information on personal background, medical history information, working information, perception on rattan harvesting basket and new harvesting basket, rating of perceived exertion and discomfortness when using new harvesting basket.

4. WHO SHOULD NOT PARTICIPATE IN THE STUDY?

The worker that already diagnosed of chronic disease such as heart disease and musculoskeletal disorder.

5. WHAT WILL BE THE BENEFITS OF THE STUDY:

(a) TO YOU AS THE SUBJECT?

Development of new harvesting basket will reduce the discomfortness of the workers while using the basket and the usage of the basket will indirectly reduce the musculoskeletal symptoms of the workers. The health of the workers will also be increased.

(b) TO THE INVESTIGATOR?

This study will help the investigator to determine the suitable design and material for the development of ergonomic basket. Investigator also will be able to understand how the process of designing and developing an ergonomic basket and learn how to do a plan management for this study.

6. WHAT ARE THE POSSIBLE RISKS?

There is no possible risk available in this study.

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

Yes, the information that you provided and your identity will remain confidential.

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

You may contact the researcher Fauziatul Syuhada binti Mansor at 011-12517423 or email at fauziatul.syuhada@gmail.com or supervisor of this study Prof. Madya Dr. Emilia binti Zainal Abidin at 03-89472643 or email at za_emilia@upm.edu.my if you have any queries.

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

9. CONSENT

I Identity Card No.
address.....

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

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

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

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

* delete where necessary

Signature Signature
(Respondent) (Witness)

Date : Name :
I/C No. :

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

Date Signature
(Researcher)



APPENDIX 4: PENERANGAN DAN PERSETUJUAN RESPONDEN



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

Penilaian Pengukuran Anthropometrik dan Pembinaan Bakul Penuaian untuk Penuai di Kawasan Terpilih di Johor

2. PENGENALAN

Sektor pertanian adalah salah satu sektor yang mempunyai faktor risiko tertinggi untuk gangguan muskuloskeletal dan pertanian nanas adalah salah satu daripadanya. Penuaian nanas mempunyai faktor risiko tertinggi berbanding dengan tugas kerja lain seperti bongkok berpanjangan, kekuatan tenaga yang tinggi dan mengangkat benda yang berat dan secara janggal. Faktor risiko ini boleh menyebabkan gejala muskuloskeletal. Kajian ini bertujuan untuk membangunkan bakul penuaian ergonomik yang lebih baik berdasarkan prototaip penuaian ergonomik yang dibangunkan oleh penyelidik terdahulu untuk menggantikan bakul sedia ada yang digunakan oleh penuai untuk mengurangkan gejala muskuloskeletal.

3. APAKAH YANG PERLU ANDA LAKUKAN?

Anda perlu menjawab soal selidik yang akan diedarkan untuk mengumpulkan maklumat mengenai latar belakang peribadi, maklumat sejarah perubatan, maklumat pekerjaan, persepsi tentang bakul penuaian rotan dan bakul penuaian baru, penerafan penampilan yang dirasakan dan ketidakselesaan apabila menggunakan bakul penuaian baru.

4. SIAPA YANG TIDAK BOLEH MENYERTA KAJIAN INI?

Pekerja yang telah didiagnoskan dengan penyakit kronik seperti penyakit jantung dan gangguan muskuloskeletal.

5. APAKAH FAEDAH MENYERTA KAJIAN INI?

a)KEPADA ANDA SEBAGAI PESERTA?

Pembangunan bakul penuaian baru akan mengurangkan ketidakselesaan pekerja ketika menggunakan bakul dan penggunaan bakul secara tidak langsung akan mengurangkan gejala muskuloskeletal pekerja. Keelhatan pekerja juga akan meningkat.

b) KEPADA PENYELIDIK?

Kajian ini akan membantu penylasaf menentukan reka bentuk dan bahan yang sesuai untuk pembangunan bakul ergonomik. Penylasaf juga akan dapat memahami bagaimana proses merekabentuk dan membangunkan bakul ergonomik dan belajar bagaimana untuk melakukan pengurusan pelan untuk kajian ini.

6. ADAKAH IA BERISIKO?

Tidak ada kemungkinan risiko dalam kajian ini.

7. ADAKAH MAKLUMAT DAN IDENTITI SAYA KEKAL RAHSIA?

Ya, maklumat dan identiti anda kekal rahsia.

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

Anda boleh hubungi penylidik iaitu Fauzlatul Syuhada binti Mansor di talian 011-12517423 atau emali di fauzlatul.syuhada@gmail.com atau penylla penylidikan ini Prof. Madya Dr. Emilia binti Zainal Abidin di talian 03-89472643 atau emali di za_emilia@uam.edu.my Jika terdapat sebarang pertanyaan.

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 Helatan 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 imej/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.

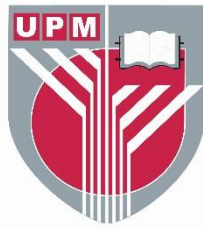
Tarikh Tandatangan
(Penyelidik)



APPENDIX 5: QUESTIONNAIRE

RESPONDENT ID

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UPM
UNIVERSITI PUTRA MALAYSIA
BERILMU BERBAKTI

QUESTIONNAIRE BOOKLET

**THE ASSESSMENT OF ANTHROPOMETRIC MEASUREMENT AND
DEVELOPMENT OF HARVESTING BASKET FOR HARVESTER AT SELECTED
AREAS 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 7 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 (7-12 years old)
 Secondary education (13–17 years old) Tertiary education (>18 years old)

*Weight: _____ kg *Shoulder: _____ cm *Neck to Waist: _____ cm

*Height: _____ cm *Waist Circumference: _____ cm

***To be filled by researcher**

SECTION B: 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 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: PERCEPTION ON RATTAN HARVESTING BASKET

1. Who provided your working tool (basket)?

2. How long you have used your basket? _____

Less than 1 year

1 – 4 years

5 – 9 years

More than 10 years

3. Have you made any modification on your basket? (For example, modified the height or the size of the basket to fill more load)

4. Please rate the weight of your basket without the load.

Light

Medium

Heavy

5. What is the key performance indicator (KPI) for harvester? Or what is the total weight of pineapple that you need to harvest in a day or how much acres need to be harvest in a day?

6. How long do you carry the basket in a day?
_____hours

7. How much the time taken to fully load the basket at a time?
_____hours / minutes

8. Do you know the maximum load of the basket?

9. Is the harvesting were done all year long?

All year-round

Seasonal

Four times a year

Two times a year

10. In your opinion, what is the maximum safe load of the harvesting basket?

11. When walking with your basket, do you assume any of the following postures?

(You can choose more than one)

- Stooping
 Leaning forward
 Leaning sideways
 None of the above

12. How efficient do you find the process of unloading your load using your basket?

- Quick and easy
 Quick but painful
 Time consuming but easy
 Time consuming and painful

13. What problems do you have when using your basket? And are there any ways you think this could be solved?

14. How satisfied are you with your basket?

- Very dissatisfied
- Dissatisfied
- Satisfied
- Very satisfied

15. Which features that you think is needed for a basket? (You can choose more than one)

- Waist belt
- Chest strap
- Adjustable shoulder straps
- Padded shoulder strap

SECTION E: BORG'S RATING OF PERCEIVED EXERTION (BORG'S RPE)

1. At the field, workers are asked the following questions.

a. Upon completion round 1 of one full basket of pineapple harvesting, how intense was the set of exercise? Please circle answer on a scale from 1-10, with 1 indicating minimal difficulty or intensity and 10 indicating maximal difficulty or intensity.

1	2	3	4	5	6	7	8	9	10
----------	----------	----------	----------	----------	----------	----------	----------	----------	-----------

b. Upon completion round 2 of one full basket of pineapple harvesting, how intense was the set of exercise? Please circle answer on a scale from 1-10, with 1 indicating minimal difficulty or intensity and 10 indicating maximal difficulty or intensity.

1	2	3	4	5	6	7	8	9	10
----------	----------	----------	----------	----------	----------	----------	----------	----------	-----------

c. Upon completion round 3 of one full basket of pineapple harvesting, how intense was the set of exercise? Please circle answer on a scale from 1-10, with 1 indicating minimal difficulty or intensity and 10 indicating maximal difficulty or intensity.

1	2	3	4	5	6	7	8	9	10
----------	----------	----------	----------	----------	----------	----------	----------	----------	-----------

d. Upon completion round 4 of one full basket of pineapple harvesting, how intense was the set of exercise? Please circle answer on a scale from 1-10, with 1 indicating minimal difficulty or intensity and 10 indicating maximal difficulty or intensity.

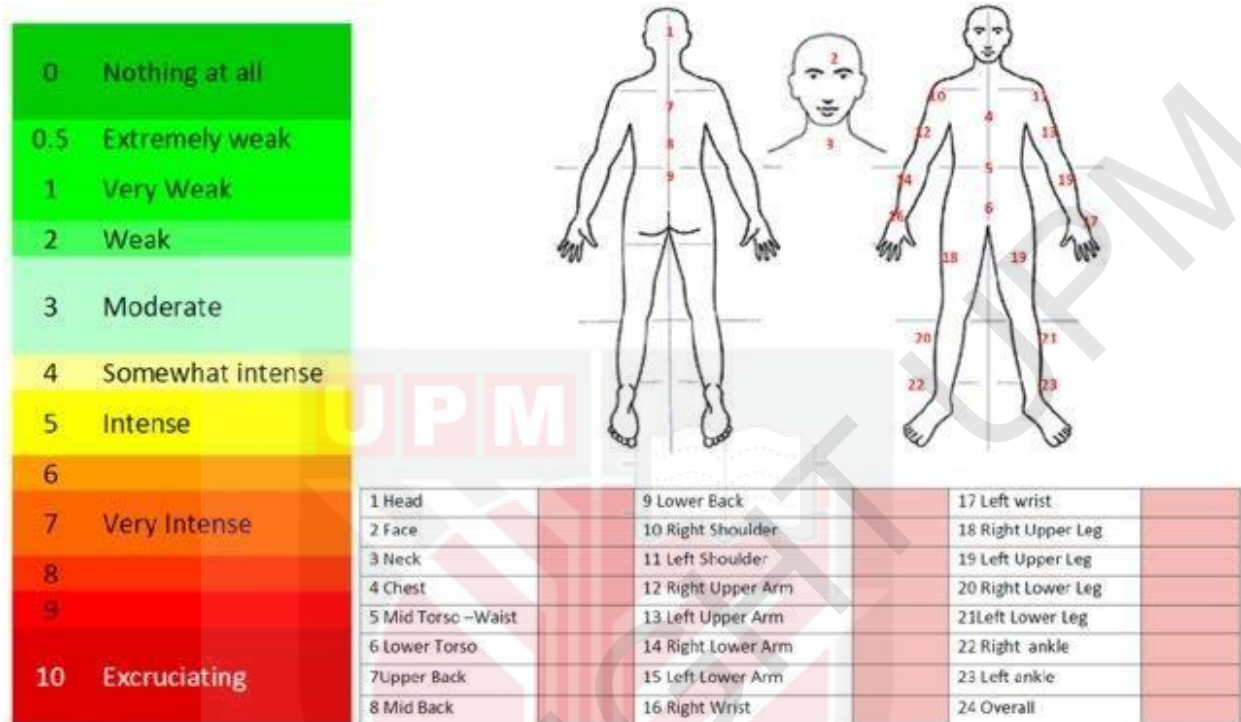
1	2	3	4	5	6	7	8	9	10
----------	----------	----------	----------	----------	----------	----------	----------	----------	-----------

e. Upon completion round 5 of one full basket of pineapple harvesting, how intense was the set of exercise? Please circle answer on a scale from 1-10, with 1 indicating minimal difficulty or intensity and 10 indicating maximal difficulty or intensity.

1	2	3	4	5	6	7	8	9	10
----------	----------	----------	----------	----------	----------	----------	----------	----------	-----------

SECTION F: BORG CR-10 SCALE

Please identify discomfort levels for number 1 to 24 according to the scale given.



SECTION G: PERCEPTION OF NEW HARVESTING BASKET

Pre-questionnaire on the newly designed pineapple harvesting basket.

1. In your opinion, what is the full load weight of pineapples that can be carried in the new pineapple harvesting basket?

2. In your experience, how long (time) do you need to load the new pineapple harvesting basket?

3. Aside from changing to machinery tool, what do you think the characteristics that a pineapple harvesting basket needs to have to make work easier?

4. Does our basket meet your expectations? Answer in scale 1 (Totally Disagree) to 10 (Totally Agree)

1	2	3	4	5	6	7	8	9	10
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5. Does our basket make the harvesting process easier? Answer in scale 1 (Totally Disagree) to 10 (Totally Agree)

1	2	3	4	5	6	7	8	9	10
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6. Do you feel comfortable using our basket? Answer in scale 1 (Disagree) to 10 (Totally Agree)

1	2	3	4	5	6	7	8	9	10
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7. Do you think the use of the new pineapple harvesting basket increases your work productivity? Answer in scale 1 (Disagree) to 10 (Totally Agree)

1	2	3	4	5	6	7	8	9	10
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8. What do you like the most about the new pineapple harvesting basket?

9. How can we improve the basket to meet your needs?

10. Are you willing to use the new basket if provided?

11. Are you willing to purchase the new harvesting basket to assist you with harvesting work? If Yes, at what price?

12. Do you have any other comments, questions or concerns regarding our basket?

Post questionnaire on the newly designed pineapple harvesting basket modified from initial design

1. The basket felt lighter compare to normal basket. Answer in scale (Totally Disagree) to 10 (Totally Agree)

1	2	3	4	5	6	7	8	9	10
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2. The work task became easier after using the basket. Answer in scale 1 (Totally Disagree) to 10 (Totally Agree)

1	2	3	4	5	6	7	8	9	10
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3. The time taken to loading and unloading the pineapple is reduced. Answer in scale 1 (Totally Disagree) to 10 (Totally Agree)

1	2	3	4	5	6	7	8	9	10
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4. I feel comfortable wearing the basket compare to normal basket. Answer in scale 1 (Totally Disagree) to 10 (Totally Agree)

1	2	3	4	5	6	7	8	9	10
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5. The basket can fill the same amount of load of the normal basket. Answer in scale 1 (Totally Disagree) to 10 (Totally Agree)

1	2	3	4	5	6	7	8	9	10
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6. I can wear the basket for a longer time compare to normal basket. Answer in scale 1 (Totally Disagree) to 10 (Totally Agree)

1	2	3	4	5	6	7	8	9	10
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7. The strap of the basket reduced the pain on the shoulder. Answer in scale 1 (Totally Disagree) to 10 (Totally Agree)

1	2	3	4	5	6	7	8	9	10
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8. The basket meets the needs of the harvester. Answer in scale 1 (Totally Disagree) to 10 (Totally Agree)

1	2	3	4	5	6	7	8	9	10
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9. I would likely to use the basket during harvesting. Answer in scale 1 (Totally Disagree) to 10 (Totally Agree)

1	2	3	4	5	6	7	8	9	10
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APPENDIX 6: BORANG SOAL SELIDIK



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BOOKLET SOALAN

**Penilaian Pengukuran Anthropometrik dan Pembinaan Bakul Penuaian
untuk Penuai di Kawasan Terpilih di Johor**Tarikh:

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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 7 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

1. Umur : _____ tahun
2. Jantina: Lelaki Perempuan
3. Kewarganegaraan: Warganegara Bukan Warganegara , Sila nyatakan: _____
4. Bangsa: Melayu Cina
 India Lain-lain , sila nyatakan: _____
5. Status perkahwinan: Bujang Berkahwin Bercerai
6. Jumlah bilangan anak: _____
7. Pendidikan: Tiada pendidikan formal Sekolah rendah (7-12 tahun)
 Sekolah menengah (13-17 tahun) Pendidikan tinggi (>18 tahun)
8. Jumlah pendapatan keluarga: RM _____
- *Berat: _____ kg *Bahu: _____ cm *Leher ke pinggang: _____ cm
- *Tinggi: _____ cm *Ukurlilit pinggang: _____ cm

***To be filled by researcher**

BAHAGIAN B: MAKLUMAT SEJARAH KESIHATAN

a) Maklumat kesihatan umum

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

Ya

Tidak

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

3. Apakah rawatan yang diambil?

Mendapatkan rawatan daripada doktor

Berurut seara tradisional

Mengambil ubat-ubatan tradisonal

Lain- lain, sila nyatakan _____

b) Maklumat kesihatan berkaitan pekerjaan.

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

Ya

Tidak

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

3. Adakah kecederaan itu berkait dengan penuaian nanas?

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

Ya

Tidak

BAHAGIAN C: MAKLUMAT PEKERJAAN

a) Maklumat pekerjaan terdahulu

1. Pernahkah anda bekerja di tempat lain sebelum ini?

Ya Tidak

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

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

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

b) Maklumat pekerjaan sekarang

1. Berapa lamakah tempoh pekerjaan anda sebagai penuai?

Tarikh mula bekerja: _____

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

Ya Tidak

3. Jika **Ya**, sila nyatakan bahagian tersebut: _____

4. Adakah anda perlu menghadiri latihan untuk menjadi penuai?

Ya Tidak

5. Nyatakan tempoh bekerja anda.

<input type="checkbox"/>	Sepenuh masa	Jumlah waktu bekerja: _____
<input type="checkbox"/>	Separuh masa	Jumlah waktu bekerja: _____
<input type="checkbox"/>	Bekerja shift	Jumlah waktu bekerja: _____

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

Ya Tidak

7. Jika Ya, sila nyatakan pekerjaan lain yang anda lakukan.

BAHAGIAN D: PERSEPSI BAKUL ROTAN PENUIAI

1. Siapakah yang menyediakan bakul kepada anda?

2. Berapa lamakah anda telah menggunakan bakul anda?

<input type="checkbox"/>	Kurang daripada setahun
<input type="checkbox"/>	1 – 4 tahun
<input type="checkbox"/>	5-9 tahun
<input type="checkbox"/>	Lebih daripada 10 tahun

3. Adakah anda pernah melakukan sebarang modifikasi ke atas bakul anda? (Sebagai contoh, modifikasi tinggi atau saiz bakul supaya boleh mengisi lebih banyak beban)

4. Sila kadarkan berat bakul anda tanpa beban

<input type="checkbox"/>	Light
<input type="checkbox"/>	Medium
<input type="checkbox"/>	Heavy

5. Apakah penunjuk prestasi utama (KPI) untuk penuai? Atau apakah jumlah berat nanas yang anda perlukan untuk menuai dalam sehari atau berapa ekar perlu dituai dalam sehari?

6. Berapa lama anda membawa bakul dalam sehari?

_____jam

7. Berapa banyakah masa yang diambil untuk memenuhkan bakul pada satu masa?

_____jam/minit

8. Adakah anda tahu beban maksimum bakul?

9. Adakah penuaian dijalankan sepanjang tahun?

- Sepanjang tahun
- Bermusim
- Empat tahun sekali
- Dua tahun sekali

10. Pada pendapat anda, apakah beban keselamatan maksima bakul penuaian?

11. Semasa berjalan dengan bakul anda, adakah anda menganggap sebarang postur berikut? (Anda boleh memilih lebih daripada satu)

- Membongkok
- Terdorong ke hadapan
- Terdorong ke kiri atau ke kanan
- Tiada satu pun di atas

12. Berapa cekapkah anda merasakan proses mengeluarkan beban menggunakan bakul anda?

- Cepat dan mudah
- Cepat tetapi menyakitkan
- Memakan masa tetapi mudah
- Memakan masa dan menyakitkan

13. Apakah masalah yang anda miliki semasa menggunakan bakul anda? Dan apakah ada cara anda fikir ini dapat diselesaikan?

14. Adakah anda berpuas hati dengan bakul anda?

- Sangat tidak berpuas hati
- Tidak berpuas hati
- Berpuas hati
- Sangat berpuas hati

15. Ciri-ciri yang manakah anda rasa diperlukan untuk sesebuah bakul? (Anda boleh memilih lebih daripada satu)

- Tali pinggang
- Tali di bahagian dada
- Tali bahu boleh laras
- Tali bahu berspan

BAHAGIAN G: BORG'S RATING OF PERCEIVED EXERTION (BORG'S RPE)

1. Di lapangan, pekerja diminta menjawab soalan berikut.

Apabila selesai pusingan 1 penuaian nanas penuh satu bakul, berapa sengitnya latihan itu? Sila bulatkan jawapan pada skala 1-10, dengan 1 menunjukkan kesukaran yang minimum atau 10 menunjukkan kesukaran maksimum.

1	2	3	4	5	6	7	8	9	10
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Apabila selesai pusingan 2 penuaian nanas penuh satu bakul, berapa sengitnya latihan itu? Sila bulatkan jawapan pada skala 1-10, dengan 1 menunjukkan kesukaran yang minimum atau 10 menunjukkan kesukaran maksimum.

1	2	3	4	5	6	7	8	9	10
----------	----------	----------	----------	----------	----------	----------	----------	----------	-----------

Apabila selesai pusingan 3 penuaian nanas penuh satu bakul, berapa sengitnya latihan itu? Sila bulatkan jawapan pada skala 1-10, dengan 1 menunjukkan kesukaran yang minimum atau 10 menunjukkan kesukaran maksimum.

1	2	3	4	5	6	7	8	9	10
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Apabila selesai pusingan 4 penuaian nanas penuh satu bakul, berapa sengitnya latihan itu? Sila bulatkan jawapan pada skala 1-10, dengan 1 menunjukkan kesukaran yang minimum atau 10 menunjukkan kesukaran maksimum.

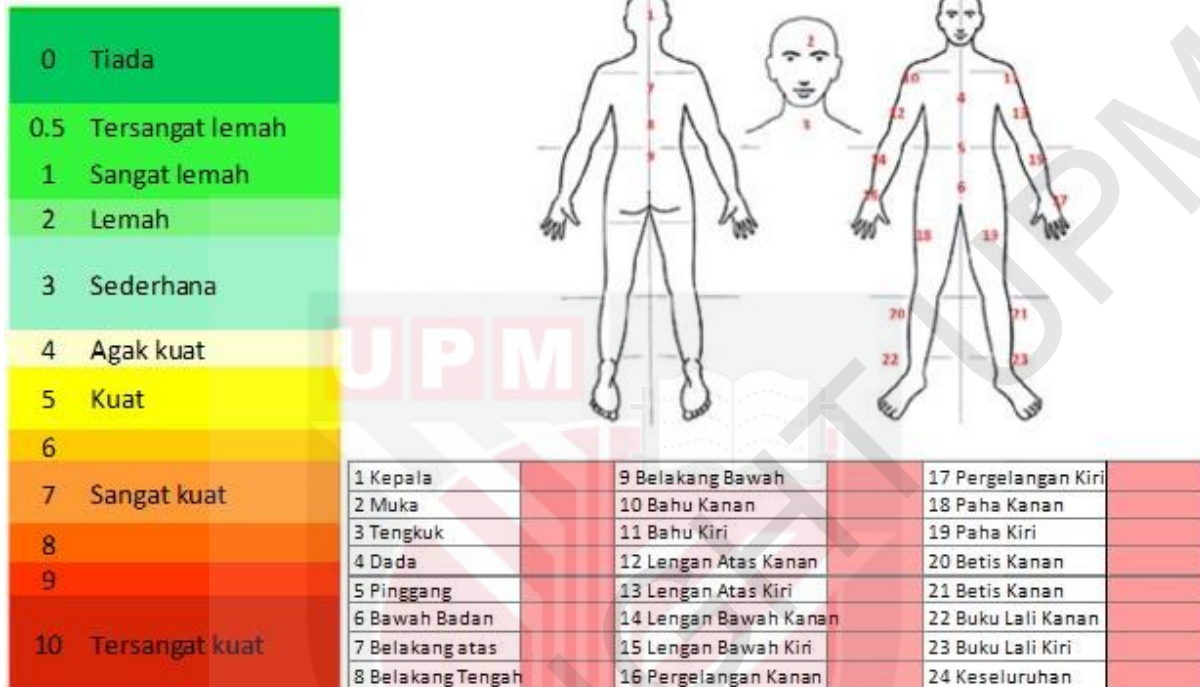
1	2	3	4	5	6	7	8	9	10
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Apabila selesai pusingan 5 penuaian nanas penuh satu bakul, berapa sengitnya latihan itu? Sila bulatkan jawapan pada skala 1-10, dengan 1 menunjukkan kesukaran yang minimum atau 10 menunjukkan kesukaran maksimum.

1	2	3	4	5	6	7	8	9	10
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BAHAGIAN H: BORG CR-10 SCALE

Sila nyatakan tahap ketidakselesaan untuk nombor 1 hingga 24 mengikut skala yang diberikan.



BAHAGIAN I: PERCEPTION OF HARVESTING BASKET

Pra-soal selidik mengenai bakul penuaian nanas yang baru direka bentuk.

1. Pada pendapat anda, apakah berat beban penuh nanas yang boleh dibawa dalam bakul penuaian nanas baru?

2. Dalam pengalaman anda, berapa lama (masa) yang anda perlukan untuk memuatkan bakul penuaian nanas baru?

3. Selain daripada menukar kepada alat jentera, apa yang anda fikir ciri-ciri bakul nanas yang perlu untuk memudahkan kerja lebih mudah?

3. Adakah bakul kami memenuhi jangkaan anda?

Jawab dalam skala 1 (Tidak Setuju hingga 10 (Sangat Setuju)

1	2	3	4	5	6	7	8	9	10
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4. Adakah bakul kami membuat proses penuaian lebih mudah? Jawab dalam skala 1 (Tidak Setuju) hingga 10 (Sangat Setuju)

1	2	3	4	5	6	7	8	9	10
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5. Adakah anda berasa selesa menggunakan bakul kami? Jawab dalam skala 1 (Tidak Setuju) hingga 10 (Sangat Setuju)

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

6. Adakah anda berfikir penggunaan bakul nanas baru meningkatkan produktiviti kerja anda?

Jawab dalam skala 1 (Tidak Setuju) hingga 10 (Sangat Setuju)

1	2	3	4	5	6	7	8	9	10
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7. Apa yang paling anda sukai tentang bakul baru penuaian nanas?

8. Bagaimanakah kita dapat meningkatkan bakul kami untuk memenuhi keperluan anda?

9. Adakah anda ingin menggunakan bakul baru jika disediakan?

10. Adakah anda sanggup membeli bakul baru untuk membantu anda dengan kerja penuaian? Jika Ya, pada harga apa?

11. Adakah anda mempunyai sebarang komen, soalan atau kebimbangan lain mengenai bakul kami?

Post-questionnaire mengenai bakul penuaian nanas yang baru direka bentuk.

1. Bakul itu lebih ringan berbanding keranjang biasa. Jawab dalam skala 1 (Tidak Setuju) hingga 10 (Sangat Setuju)

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

2. Tugas kerja menjadi lebih mudah selepas menggunakan bakul kami. Jawab dalam skala 1 (Tidak Setuju) hingga 10 (Sangat Setuju)

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

3. Masa yang diambil untuk memuatkan dan memunggah nanas dikurangkan. Jawab dalam skala 1 (Tidak Setuju) hingga 10 (Sangat Setuju)

1	2	3	4	5	6	7	8	9	10
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4. Saya merasa selesa memakai bakul berbanding bakul biasa . Jawab dalam skala 1 (Tidak Setuju) hingga 10 (Sangat Setuju)

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

5. Bakul boleh mengisi jumlah beban yang sama dari bakul biasa. Jawab dalam skala 1 (Tidak Setuju) hingga 10 (Sangat Setuju)

1	2	3	4	5	6	7	8	9	10
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6. Saya boleh memakai bakul untuk masa yang lebih lama berbanding bakul biasa. Jawab dalam skala 1 (Tidak Setuju) hingga 10 (Sangat Setuju)

1	2	3	4	5	6	7	8	9	10
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7. Tali bakul mengurangkan kesakitan pada bahu. Jawab dalam skala 1 (Tidak Setuju) hingga 10 (Sangat Setuju)

1	2	3	4	5	6	7	8	9	10
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8. Bakul memenuhi keperluan penuai. Jawab dalam skala 1 (Tidak Setuju) hingga 10 (Sangat Setuju)

1	2	3	4	5	6	7	8	9	10
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9. Saya ingin menggunakan bakul ini semasa penuaian. Jawab dalam skala 1 (Tidak Setuju) hingga 10 (Sangat Setuju)

1	2	3	4	5	6	7	8	9	10
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