ERGONOMICS RISK ASSESSMENT IN MUSCULOSKELETAL DISORDERS AMONG AGRICULTURAL WORKERS IN SELANGOR AGRICULTURAL DEVELOPMENT CORPORATION, SG TENGI SELATAN, KUALA KUBU BAHRU, SELANGOR, MALAYSIA

ABSTRACT

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This cross-sectional study was conducted among 50 agricultural workers to determine the effects of the awkward posture on musculoskeletal disorders (MSDs). The selection of participants was chosen based on inclusion criteria and exclusion criteria. Standardized Nordic Musculoskeletal Questionnaire (SNMQ) was used to determine the prevalence of musculoskeletal disorders and Workplace Ergonomics Risk Assessment (WERA) was used to determine the prevalence of musculoskeletal disorders (MSDs) and identify the risk of musculoskeletal disorders among participants respectively. Descriptive statistics and multivariable analyses were used to characterize the data and identify factors associated with work-related musculoskeletal disorders. The most prevalent musculoskeletal disorders recorded were the neck (30%) followed by the shoulder (24%) and upper back (20%). There was a significant relationship between working posture (bending and twisting) and shoulder pain ($\chi 2=6.07$, $p=0.01$), upper back pain ($\chi 2=3.67$, $p=0.05$), and elbow pain ($\chi 2=6.29$,$p=0.01$). According to the WERA score, a majority (96%) of participants are classified under medium risk (28 to 44) of getting musculoskeletal disorders. An immediate investigation is required to solve this problem which required the importance of ergonomics intervention to improve working condition for this population

Keywords: agriculture, awkward posture, musculoskeletal disorders, WERA

LIST OF ABBREVIATIONS

ADC	Agriculture Development Corporation
BMI	Body Mass Index
DOSH	Department of Safety and Health
ERA	Ergonomics Risk Assessment
FFB	Fresh Fruit Bunches
ILO	International Labour Organization
MPOB	Malaysian Plantation Oil Berhad
MSD	Musculoskeletal Disorders
OMD	Occupational Muscular Skeletal Disorder
SD	Standard Deviation
SNMQ	Standardized Nordic Musculoskeletal Questionnaire
SPSS	Statistical Package Social Sciences Statistic
WERA	Workplace Ergonomics Risk Assessment
WMSD	Work-Related Musculoskeletal Disorders

1.0 INTRODUCTION

According to the International Labor Organization (ILO), an estimated 1.3 billion workers are engaged in agriculture production worldwide and around 160 million work-related musculoskeletal disorders (WMSDs) have a prominent role in terms of occupational health and also economics. The economic costs of musculoskeletal problems are immense, and this burden is predicted to extend within the future (Dianat et al., 2020). Furthermore, it had been stated that agriculture work has long been recognized together as the most hazardous occupation to human health both in developing and developed countries. Musculoskeletal symptoms are a genuine clarification of non-attendance of short-term and future illness, helpful restriction, work incapacity, and decreased quality of life, and have a real financial impact on both individuals and communities. (Martimo, 2010)

As stated by (Widyanti, 2018), MSDs among farmers might be due to the activities of the farmer that is being dominated by manual activities in every area of farming, starting from the plantation to the harvest. These activities are a combination of excessive force, repetitive work, and awkward postures of the farmer during performing their activities on the farm and make them more prone to develop MSDs.

The work nature of agriculture plantation included a process of harvesting, collection, and gathering of fresh fruit to a collection point, loading into the lorry and transported to the weighbridge as well as maintenance work (Mat et al., 2017).In a study conducted by (Ezrin Hani et al., 2016), many researchers have begun to highlight issues of ergonomics among harvester who develop to have MSDs especially back pain.

One of the main ergonomic risk factors that have been identified is an awkward posture. This suggests that poor working postures place unacceptable posture problems on the agriculture plantation workers and as a result, contributes to the development of musculoskeletal symptoms in a different part of body regions. For example, according to a study conducted by (Goswami et al., 2012), different post-harvesting tasks were performed by female workers under different working conditions and it was found that they are suffered from pain and musculoskeletal symptoms in different parts of the body as they are exposed to postural stress.

Agriculture is one of Malaysia's occupations, with 1.570.3 thousand people employed in agriculture registered in 2018 and 77.7 percent of males dominated the sector (1,220.6 thousand persons). Out of the total, the number of non-citizens employed was 4924 thousand people. Agricultural land use covers 23 percent of the total land area (approximately 34 million hectares) in Malaysia which is primarily used for industrial crops such as oil palm, rubber cocoa.

According to the Department of Occupational Safety and Health Malaysia, statistics of Occupational Poisoning and Diseases is gradually increasing in the number of cases reported in Malaysia until 2019. The statistics show Occupational Muscular - Skeletal Disorders (OMD) ranked the second-highest cases reported after Occupational Noise Related Hearing Disorders (HD). Statistics by DOSH show that although the number of accidents has declined over the years, the total numbers of accidents in the agriculture sectors were consistently the second highest after the manufacturing sector. This statement can be supported by recent trends in Malaysia which showed the increase in compensation costs from the year 2009 to 2014 caused by Musculoskeletal Disorder (MSD).

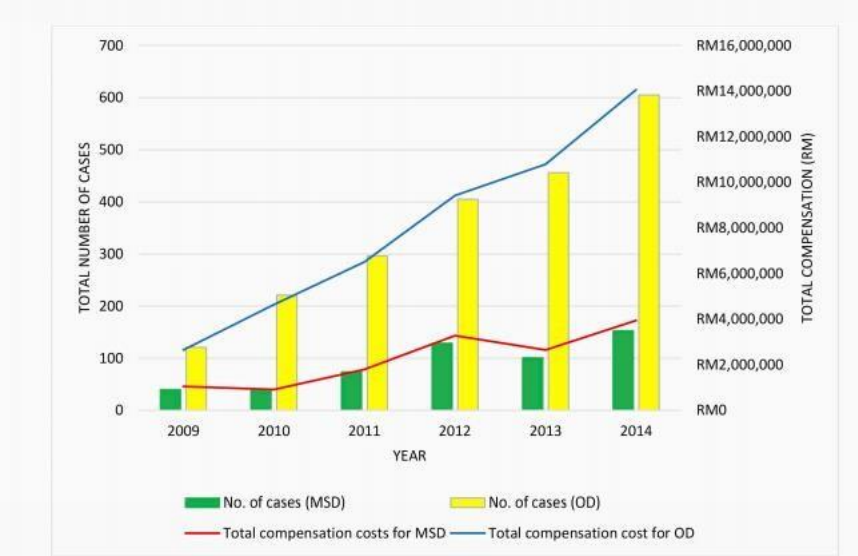

Figure I: Trend of recorded musculoskeletal disorders relative to occupational diseases cases and compensation reported for permanent disability from 2009-2014

Considering the importance of agriculture for Malaysia, research related to ergonomic in Malaysia agriculture is very limited. In taking the widely reported total numbers of accidents in agriculture sectors and work-related musculoskeletal symptoms and disorders which can influence agricultural productivity, there is a need to observe ergonomics conditions include posture in agriculture and the prevalence of musculoskeletal injuries among agriculture plantation workers.

2.0 METHODOLOGY

2.1 Study Design, Setting, and Sample.

This study was a cross-sectional study conducted among agriculture plantation workers who worked in Selangor Agricultural Development Corporation (ADC) in Sungai Tengi Selatan, Kuala Kubu Bharu, Selangor, Malaysia during harvesting stage, collection stage, unloading into the truck, and maintenance of crop-care stage. The workers were recruited by approaching the agriculture plantation manager to provide information about this study. All participants read and signed informed consent before the data collection. The total population in Sungai Tengi Selatan plantations is 50 workers who are categorized into two crops include oil palm and fruits such as coconut, jackfruit, mangosteen *rambutan,* and *pulasan.*

The sample size was calculated by using Krejcie and Morgan (1970) table. According to the table, with a total population size is 50 individuals, the sample representatives will be 44 individuals with a margin of error of 0.05. However, according to (Razak et al., 2014), the sample representatives can total up to 50 individuals by addition of 10% of the sample size to prevent a low response rate with an absence of the respondents. Thus, the total sample size in this study is 50 individuals which is the total population of Sungai Tengi Selatan plantation workers. The selection of respondents was conducted by using purposive sampling with inclusion and exclusion criteria. The inclusion criteria were full-time workers aged between 20 and 50 years who are using a chisel, metal poke, or hook and wheelbarrow for tasks. The exclusion criteria are part-timer, the complaint about any musculoskeletal diseases and

injury during past years, and any history of recent injury or accident or any other surgery in any part of the body

2.2 Study Instruments

In this study scheduled interviews, questionnaires, and non-participant observation were used. There are three instruments used in data collection.

2.2.1 Standardized Nordic Musculoskeletal Questionnaire (SNMQ)

For the convenience of the participants, the Malay translated questionnaire was used in this study. The questionnaire consisted of items on demographic and job characteristics as well as musculoskeletal symptoms (by using the standardized Nordic Musculoskeletal). This simple, general questionnaire, recognized/validated internationally, detects symptoms in the neck, back, shoulders, and extremities (De Barros & Alexandre, 2003). It presents 28 multiple-choice questions, sometimes negative, structured in two well-differentiated parts. The first part, the general one, refers to symptoms in 9 parts of the body (neck, shoulders, elbows, wrists/hands, upper back, lower back, hip/thighs, knees, and ankles/feet) during the last 12 months/7 days. The second part, the specific one, refers to symptoms in three parts of the body (neck, shoulders, and lower back) throughout the subject's working life/7 days beforehand. In both cases, complementary information (qualitative variables, sex, age, nationality) (López-Aragón et al., 2017)

2.2.2 Workplace Ergonomic Risk Assessment (WERA) form.

The WERA assessment form consists of six physical risk factors including posture, repetition, forceful, vibration, contact stress, and task duration, and it involves

the five main body regions which were the shoulder, wrist, back, neck, and leg. It has a scoring system and actions level that provides a guide to the level of risk and need for action to conduct a more detailed assessment. The steps in conducting WERA assessment include 1) Observe the task 2) Select the task or job for assessment 3) Score the task or job 4) Calculate the exposure scores 5) Consideration of action level .

- Low Level = a score of 18 to 27 indicates the task is accepted.
- Medium Level = a score 28 to 44 indicates the task is needed to further investigate and require change.
- High Level = a score of 45 to 54 indicates the task is not accepted and should change immediately

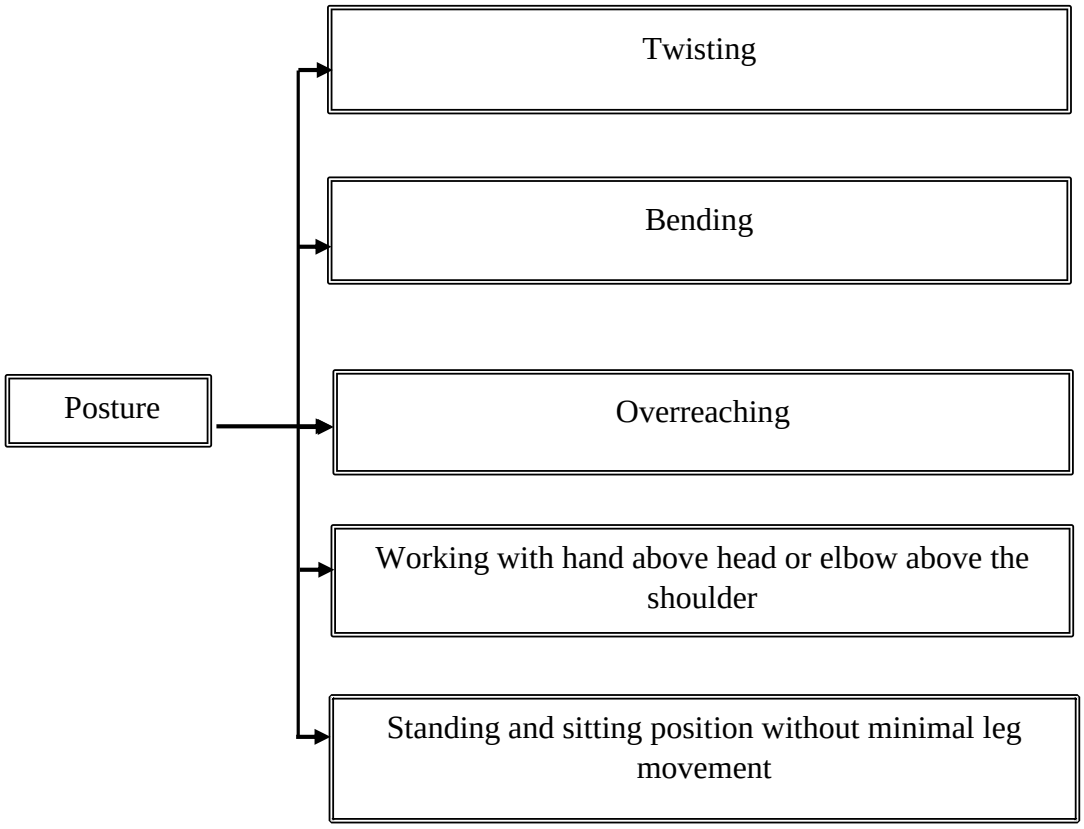

Figure II: Framework of posture ergonomics risk assessment applicable to this study.

Table I: The table below shows methodology steps in assessing awkward posture on musculoskeletal disorders on agriculture plantation workers started with data preparation, data collection, and data analysis phase.

Data preparation	1. Recruitment of 50 agriculture plantation workers based on inclusion criteria 2. Selection of job task of agriculture plantation workers which are categorized into two crops, oil palm plantations, and fruit farms 3. Job task for oil palm plantations and fruit farms • Harvester • Collector • Maintenance • Driver
Data collection	1. The ethics form and Malay version of the Standardized Nordic Questionnaire were distributed to participants 2. Video recorded workers bodies is taken at every stage of the job task 3. An initial checklist is ticked based on field observation and recorded video 4. Workplace Ergonomics Risk Assessment (WERA) is calculated and given the final score.
Data analysis	1. Data collected was inserted into Statistical Packages for the Social Science (SPSS) software for Windows version19 and analyzed.

2.3 Data Analysis

Data collected were analyzed through Statistical Packages for the Social Science (SPSS) software for Windows version19. Descriptive statistics such as mean, standard deviation, percentages, and frequencies were used to describe the study variables. The MSD among agriculture plantation workers majorly varied with the age and job task. All the data and information from the Nordic questionnaire survey were analyzed to evaluate the MSD problems based on working factors (posture, load, frequency, duration, and repetition), the risk of MSD problems, and distribution of worker factors (age, height, weight, and duration of the work). Chi-square test was applied on contingency tables for hypothesis testing to determine an association between the prevalence of musculoskeletal disorder and WERA score among oil palm plantation workers. Any variables with a p-value < 0.1 from the chi-square test were included in the multivariate logistic regression analysis. A p-value < 0.05 were considered as significant.

3.0 RESULT

3.1 Socio-demographic and work-related details.

The socio-demographic and job details of the studied agriculture plantation workers are presented in Table II. Forty-three men (86%) and seven women (14%) participated. Participants' ages ranged from 26 to 36 years (Mean ± SD: 32.1 ± 10.0) with around 50% of participants have no formal education and only 1% of workers being educated with tertiary education level. Most of participants were married (66%) and had a mean BMI of BMI of 23.2 kg/m^2 (SD = 3.5kg/m^2, range = 18.25 kg/m^2).The study participants included 20 (40%) agriculture plantations maintenance 14 (28%) harvester, 12 (24%) collector and 4 (8%) driver. The majority of them have been working as agricultural workers for 5-15 years (50%). Most of the participants worked in a team of more than 6 persons which are harvester, collector, and maintenance (92%), and the least team members are the driver (8%) as they are working alone. They worked exceed from average daily working hours (84%) which is more than 8 hours a day. It was favourable for respondents to select once of work breaks with (28.0%), where twice work breaks was the slightest.

Table II: Socio-demographic and work-related details of agricultural workers (n=50).

Variables	N	Percentage	Mean ± SD
Gender			
Male	43	86.0 %	
Female	7	14.0%	
Age			
18 – 25	17	34.0 %	
26 – 35	18	36.0 %	32.1 ± 10.0
36 – 43	6	12.0%	
> 44	9	18.0%	
BMI			
18.5 – 25, desirable	38	76.0%	23.2 ± 3.5
25 – 30, overweight	9	18.0%	
>30, obese	3	6.0%	
Marital status			
Single	17	34.0%	
Married	33	66.0%	
Educational level			
No formal education	25	50.0%	
Primary education	5	10.0%	
Secondary education	14	28.0%	
Tertiary education	1	2.0%	
Job task			
Harvester	14	28.0%	
Collector	12	24.0%	
Maintenance	20	40.0%	
Driver	4	8.0%	

Total work experience (years)			
< 5	18	36.0%	
5-15	24	48.0%	9.0 ± 7.0
>16	8	16.0%	
Daily working hours			
<8	8	16.0%	
≥ 8	42	84.0%	8.0 ± 1.0
Work breaks, n (%)			
Once	28	56.0%	
Twice	6	12.0%	
Thrice	16	32.0%	
Team member, n (%)			
1 person	4	8.0%	
6-10 person	34	68.0%	
>10 person	12	24.0%	

Note: SD = standard deviation

3.2 Prevalence of work-related musculoskeletal disorders among agricultural workers.

Figure III represents the prevalence of WMSDs in the various body parts of the agriculture plantation workers by different job tasks for the last 12 months. The most prevalent of WMSD symptoms are neck 15 (13%) followed by shoulder and upper back with 12 (24%) and 10 (20%) respectively. As can be seen from this table, there were a few MSD complaints which higher than others. For harvesters, elbow (62.5%) is the area's highest prevalence of WMSD symptoms, followed by shoulder and ankles/feet with (25%) and (50%) respectively. Meanwhile, the most prevalent of

WMSD symptoms for collectors is knee 5 (55.6%) followed by shoulder 3 (25.0%) and upper back 3 (30.0%).

3.3 Distribution of pain in different body regions according to demographic factors

Data of distribution of pain in different body regions according to age, BMI, job experience, job tasks, and daily working hours were presented in Table III. Among all nine body regions, the neck was most reported WMSD with the increase of age (34 ± 10.0), BMI (24.2 ± 3.9), total work experience (11.0 ± 7.0), job task (4.0 ± 2.0), and daily working hour (7.0 ± 1.0).

3.4 Association between demographic factors and the prevalence of WMSDs

The association between demographics factors and the prevalence of WMDSs is shown in Table IV. From the results of the association, it can be concluded there were significant differences between the prevalence of WMSD symptoms and demographic variables. The demographic factors were significant higher in age 45 ± 13.0 ($p=0.01$) BMI 23.6 ± 3.2 ($p<0.01$) and 23.6 ± 3.2 ($p<0.05$), total work experience 9.0 ± 0 ($p<0.05$), job ask 4.0 ± 1.0 ($p<0.01$), 2.0 ± 1.0 ($p<0.05$) and daily working hour 7.0 ± 1.0 ($p<0.05$)

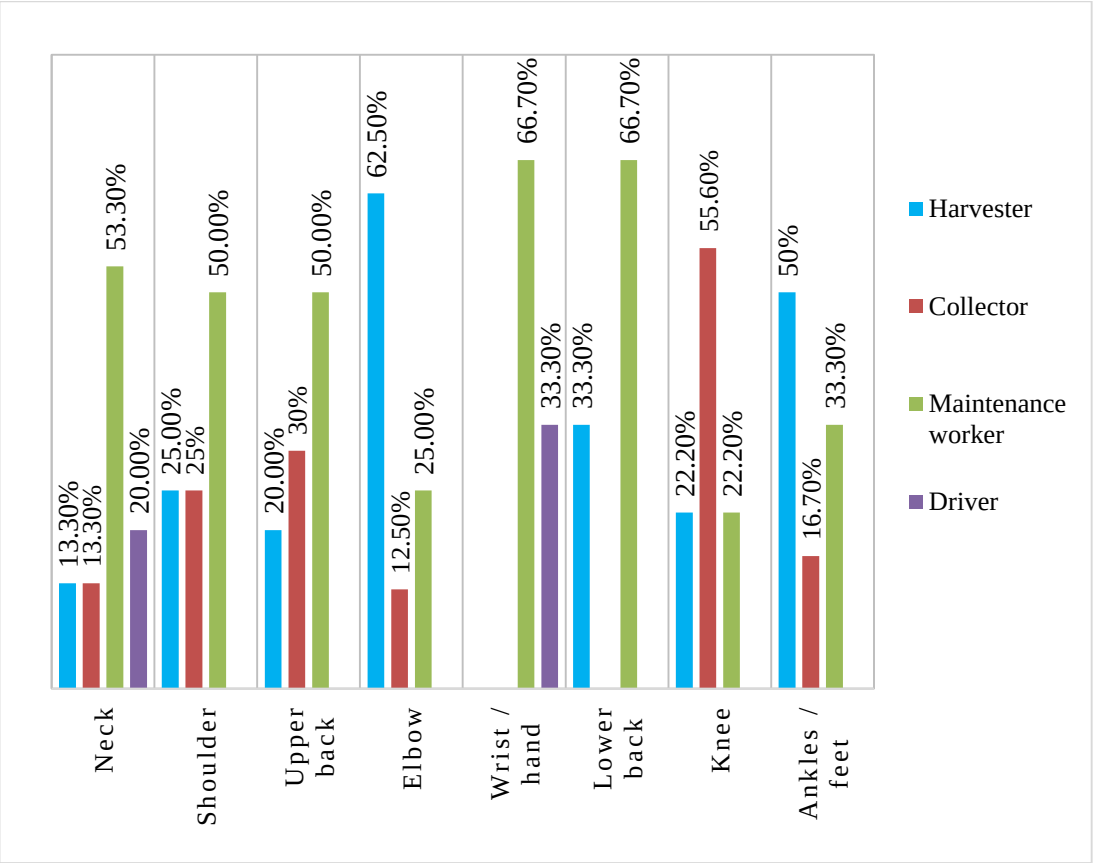

Figure III: Prevalence of work-related musculoskeletal symptoms by different body regions among workers.

Demographic factors	**Neck** **Mean ± SD**
Age (year)	34 ± 10.0
BMI (kg/m^2)	24.2 ± 3.9
Total work experience (years)	11.0 ± 7.0
Job tasks	4.0 ± 2.0
Daily working hour	7.0 ± 1.0

Table III: Distribution of pain the highest prevalence body region (neck) according to age, BMI, job experience, job tasks, and daily working hour.

Table IV: Association between demographics factors and prevalence of WMDSs.

Demographics Factors	Shoulder	Wrists / hands	Lower back	Knees	Ankles/ feet
	χ^2 (p)	χ^2 (p)	χ^2 (p)	χ^2 (p)	χ^2 (p)
Age	2.78 (0.43)	7.64 (0.06)	10.60 (0.01)*	5.01 (0.17)	4.20 (0.24)
BMI (kg/m^2)	11.34 (0.003)**	5.16 (0.08)	0.65 (0.72)	6.80(0.03)*	2.15 (0.34)
Total work experience (years)	3.70 (0.16)	6.42(0.04)*	1.98 (0.37)	2.96 (0.23)	1.49 (0.48)
Job task	17.70 (0.007)**	11.58(0.07)	4.80 (0.57)	13.25(0.04)	17.74 (0.07)
Daily working hour (hour)	4.90 (0.03)*	1.00 (0.32)	1.0 (0.32)	1.80 (0.18)	1.110.30)

*Significant at ($p < 0.05$) level , **Significant at ($p < 0.01$) level, (n=50)

3.5 Association between the prevalence of work-related musculoskeletal disorders and WERA physical risk factors

According to Figure IV, the majority of individual WERA score reported at medium-level of risk (28-44) nominated by maintenance (95.0%), harvesters (100.0%), collector (91.7%), and drivers (100.0%). Meanwhile, only one individual of maintenance workers recorded for high-level WERA score ranging from 45-54 that need immediate work change, and one individual of collector workers recorded for low-level risk which is WERA score of ranging from 18-27.

Table V shows chi-square statistical analysis ($\chi 2$-test) of the WERA physical risk factors and the prevalence of reported pain ache or discomfort among agriculture plantation workers. Based on the results, there is a significant difference between all variables in the WERA physical risk factor and the prevalence of reported pain ache or discomfort among agriculture plantation workers for all nine body regions. Among WERA physical risk factor variables for posture, posture risk on the shoulder is the only factor that is not significantly associated with the prevalence of reported pain ache or discomfort among plantation workers. Thus, significant association found were higher in posture on wrist ($p=0.01$), back (<0.01), neck ($p<0.05$) and leg ($p<0.05$) and ($p<0.05$).

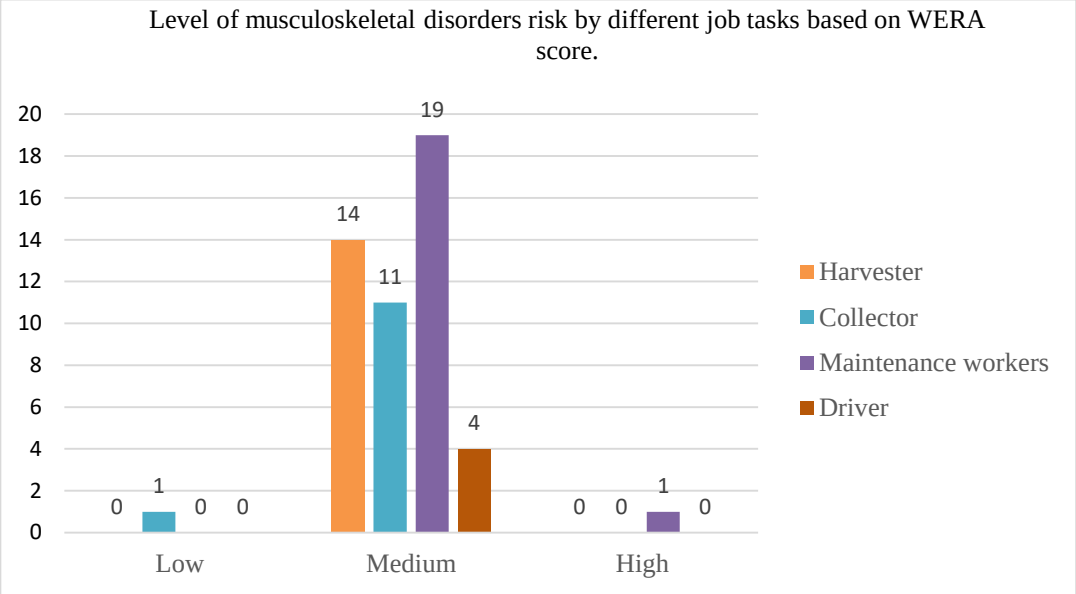

Figure IV: Level of musculoskeletal disorders risk by different job tasks based on WERA score.

Table V: Chi-square statistical analysis (χ2-test) of the WERA physical risk factors and the prevalence of reported pain ache or discomfort among agricultural workers.

WERA Physical Risk Factor		Shoulder	Upper back	Elbows	Mean (SD)
		χ2 (p)	χ2 (p)	χ2 (p)	
Posture	Wrist	6.07 (0.01)*	2.3 (0.12)	0.11 (0.74)	2.0 ± 0
	Back	10.95 (0.001)**	-	0.20 (0.66)	3.0 ± 0
	Leg	0.83 (0.36)	3.67 (0.05)*	6.29 (0.01)*	2.0 +0

*Significant at ($p < 0.05$) level , **Significant at ($p < 0.01$) level , (n=50)

4.0 DISCUSSION

4.1 Respondent background data

The study population was the participants by 86% male compared to 14% female between age range 26 to 36 years old. It was similar to other Malaysian studies due to methodological standardization and inclusion criteria (Deros et al., 2016; Ezrin Hani et al., 2016). The majority of the current study showed respondents (76.0%) had desirable BMI ranging from 18 to 25 kg/m^2

It was also explained a most of the respondents had no formal education due to migrants workers were dominant compared to the local workforce on the farm. Ng *et al*., (2015) agreed lower educational levels were found to have a better adaptation to labor-intensive work tasks as they had spent their childhood assisting their families in agricultural activities compared to those who went to school. As such, it may be postulated had higher tolerance towards fatigue and pain which lowering the developing MSDs. Lastly, plantation management has also assigned a working system either by an individual or a group, aided in reducing muscle fatigue, work capacity thus increase work productivity.

4.2 Prevalence of work-related musculoskeletal disorders.

This study is conducted to identify the prevalence of WMSDS among agriculture farmworkers in Sungai Tengi Selatan. The findings showed that the prevalence of overall WMSDs among workers during the past 12 months was 85%. The results of this cross-sectional study showed that the prevalence of WMSDs during the past 12 months is

equivalent to the previous studies in the agriculture sector, 83.8% and 98% for farmers in India and Thailand respectively (Patil et al., 2018; Tewtow et al., 2019).

The high prevalence of WMSDs among workers might be because of exposure to ergonomic risk factors included awkward posture, forceful exertion, and repetitive movement. In this study, the most commonly affected body part was the neck followed by the shoulder and upper back, However, low back pain is reported as the most common (Hemalatha et al., 2017; Min et al., 2016; Patil et al., 2018). The pain location may be different according to the most body part used the nature of work and working environment. According to (Swangnetr, 2014), it was reported that highly repetitive motion and extremes postures were likely to have a high risk of injury in the forearm, hand, and back region. Furthermore, another study conducted by (Min et al., 2016) had stated the evidence where the neck/shoulder region was affected by improper working postures, and the lumbar region was affected by lifting, hard physical work, or systemic vibrations. The highest complaint of neck pain among agricultural workers in this finding could be explained by most of the tall palm and fruit trees more than 6 meters in height. The workers had to bending the head and neck backwards to view a ripe fruit on the tree prior to cutting task. This is correspond with studies with working hands above shoulders over continuous periods of work time were associated with shoulder and neck pain, epicondylitis and rotator cuff syndrome (Arcury et al., 2014; Hanklang et al., 2014).Therefore, it can be easily assumed that work nature of farming activities are related to pain in different body regions.

4.3 Association between socio-demographics and work-related factors and prevalence of work-related musculoskeletal disorders.

Based on demographic factors, the most frequent age range of workers 26 to 35 years old with a mean of 32 has suffered from MSD. The average working hours of the workers, 42 (84%) worked overtime which is above than 8 hours and 8 (16%) worked below 8 hours daily. Furthermore, the findings showed that there is a significant association between age, BMI, average working hours, and years of experience with the prevalence of musculoskeletal symptoms with $p<0.05$.

4.3.1 Age

According to the study by (Abdullah, 2017a)(Abdullah, 2017b), there was an association between the age of the workers and MSD complaints. The MSD will increase as the age of the workers increased. In another study conducted by (Dianat et al., 2020), it has been reported that age ranged 18 to 69 years with a mean of 37.5 years old was significantly related to knee, lower leg, and foot pain. These previous studies were not consistent with the age ranged in present findings which were age 45 years old was significantly associated with lower back pain among agriculture plantation workers. However, a study conducted by (Patil et al., 2018) explained that age-related changes in bone and joints, muscle strength, the cumulative effect of activities, and injuries may be the reason for the musculoskeletal symptoms.

4.3.2 BMI

For the BMI, the study resulted that BMI was positively associated with p-value, <0.05 with shoulder (23.6 ± 3.2) and knee (24.8 ± 4.7, p=0.03) symptoms and agreed with similar studies in the literature. A study conducted by (Abdullah, 2017b; Kushwaha & Kane, 2016) reported that body mass index (BMI), weight, and height were identified as potential risk factors for certain MSD.

4.3.3 Total work experience

Based on the present study, the years of experience and duration of works also have an association with the MSD symptoms. The mean daily working time (8h) was found to be independently positively associated with the occurrence of musculoskeletal complaints in the shoulder area. Additionally, the findings revealed that the number of years worked as an agricultural worker was positively associated with the presence of symptoms in the wrist/hand areas. This consistent with (Mahto & Bhupal Gautam, 2018) which had stated, the occurrence of MSD increases with an increase in years of involvement in farming work. Furthermore, another study conducted in Thailand revealed that years on the job (experience) and age were highly correlated among the present farmer population (Swangnetr, 2014)

4.4 Association between working posture on manual handling activities and WERA scores

Workplace Ergonomic Risk Assessment (WERA) is an assessment to evaluate the risk in different job tasks posed by participants. This method is one of the assessments to observe and score the risk level according to the WERA form. The WERA score for every variable was categorized into three which are low, medium, and high. The final WERA score determined the category of risk level and actions that need to be taken for every participant in this study. The WERA score in this study was mostly derived for medium level, ranged from 28 to 44 indicating the workers' with awkward working posture need to be investigated and some changes are required immediately. . It was observed that forward bending and twisting was dominant in agriculture plantation jobs. The workers involved in collecting loose fruits and manual fertilization work were compelled to adopt forward bending with more than 60^{o} throughout the working hours for more than 2 hours per day. Moreover, they repetitively twisting of the wrist from a neutral position 20 times per minute in carrying out harvesting work of oil palm which they were using a chisel to cut the oil palm fruit clusters.

Findings of significant association were found between a physical risk factor (posture) assessed in WERA assessment and different location of pain with a p-value, $p<0.05$ among agriculture plantation task. The score for posture on the wrist and back were associated with shoulder pain while the score for posture on the leg was associated with upper back and elbow pain. These findings can be supported by (Dianat et al., 2020), which revealed that different scores of RULA assessment used in the study were one of

the independent factors associated with musculoskeletal symptoms in different body regions (neck, upper back, low back, and leg areas). Furthermore, the findings in the present study assumed that physical risk factors have a strong association with the prevalence of MSDs symptoms compare to other factors. Therefore, this means that working posture cause unacceptable postural loading on workers' musculoskeletal systems and consequentially contribute to the development of musculoskeletal pain in different regions of the body

5.0 CONCLUSION

The findings of this study showed there is a high prevalence of musculoskeletal symptoms which especially in the neck, shoulder, and upper. Factors like socio-demographics and job characteristics showed an association with the risk of musculoskeletal problems in different body regions. Also, ergonomic risk factors showed a stronger association than socio-demographic factors to the development of musculoskeletal symptoms among different body regions. Such ergonomic risk factors on related manual handling activities namely bending and twisting were found the highest risk of exposure to pose WMSDs among workers. Furthermore, the scoring system of WERA proved that workers need an advanced assessment to examine the physical risk factors related to WMSDs that are simple and achieve action levels that relevant to the broad variety of jobs. Therefore, the scoring system of WERA was helpful for an observational tool to examine the physical risk factors related to WMSDs and appropriate ergonomic services such as professional support, training, and education were also required to reduce the prevalence and to prevent the risk of MSS exposure among these workers, as well as ergonomic intervention design to reduce the exposure.

However, the limitations of the study are time was a primary constrain, specifically during field data collection due to the pandemic of Covid-19 that occurred in the country. Besides, the study was a cross-sectional design in which causality cannot be established. Besides that, there is a possible recall bias as several questions are required to report past occurrences and the presence of plantation management during the interview. Lastly, the analysis of the Workplace Ergonomic Risk Assessment relied primarily on the observer's assessment as different observations gave different judgments

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