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

ABSTRACT

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Agricultural industry is one of the highest risk sectors for work-related musculoskeletal disorders (WMSDs). Workers are challenged to use higher force in body demands that place greater muscle exertion to sustain an increased effort during activities. Domestically, only a few published studies have examined the prevalence and determinants of WMSDs on agricultural workers for ergonomics risk assessment (ERA). This cross-sectional study was conducted among 50 agricultural workers to determine the effects of the forceful exertion on musculoskeletal disorders (MSDs). A Standardised Nordic Musculoskeletal Questionnaire (SNMQ) and Workplace Ergonomics Risk Assessment (WERA) were used to determine the prevalence of musculoskeletal disorders and to identify the risk of musculoskeletal disorders among participants respectively. The most prevalent musculoskeletal disorders recorded were particularly neck (30.0 %), followed by shoulders (24.0 %) and upper back (20.0 %). There was a significant relationship between forceful exertion and shoulders pain ($\chi 2 = 7.96$, $p = 0.02$) and upper back pain ($\chi 2 = 7.82$, $p = 0.02$). According to WERA final score, a majority (96.0 %) of the participants were classified under medium risk level (28 to 44) of acquiring musculoskeletal disorders. An immediate investigation is required to improve working conditions for this population.

Keywords: agriculture, forceful exertion, musculoskeletal disorders, load lifting, WERA

LIST OF ABBREVIATIONS

ADC	Agricultural Development Corporation
BMI	Body Mass Index
CI	Confidence Interval
DOSH	Department of Safety and Health
ERA	Ergonomics Risk Assessment
FFB	Fresh Fruit Bunches
IBM	International Business Machines
MSD	Musculoskeletal Disorders
OR	Odds Ratio
QEC	Quick Exposure Assessment
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

Notably, agriculture is a fundamental industry that highly dependent on manual handling tasks poses ergonomics hazards among agricultural workers. As claimed by the Department of Occupational Safety and Health (2013, 2014, 2016) annual reports have recorded agricultural occupational injuries, fatalities, and illnesses in Malaysia for 492 cases, 480 cases, and 471 cases in the year 2014, 2015, 2016 respectively. Among these accidents and injuries reported from all sectors, ergonomics injuries attest to be the most pronounced cases with an increasing trend over the year (Ministry of Human Resources, 2015).

Attributable to cope with increased demand, agriculture areas expanding each year and the crops growth cycle is increasing so that more crops could be harvested. Added to the continuous nature of work in the agriculture setting, it constitutes the risk of being affected by the occurrence of musculoskeletal disorders (MSD) and work-related injuries especially among workers who are involved in labour-intensive practices (Meyer et al., 1997). Several global studies agreed to the incidence of MSD such as in India (Agrawal *et al.*, 2017; Das *et al*., 2013; Pal *et al*., 2015) and Korea (Jo et al., 2016). Other recent studies by Ng *et al*., (2015); Pal *et al*., (2015); Swangnetr *et al*., (2014) also proved for establishment of MSD particularly in the upper extremity that becoming progressively frequent in Asian agricultural workers.

Equally important, MSD arises from multifactorial phenomena including physical factors, psychosocial factors, and individual factors. Those combinations of variables were found to establish plausible relationships that contribute to the likelihood of suffering MSDs in Figure 1 of Bonger's model (Bongers *et al.*, 2002). All the risk factors interact with each other posing low resistance of the individual to cope with

subsequent work demands, thus increasing the possibility of WMSDs occurrence in the whole body, mostly in the neck, hands, wrists, shoulders, and low back in labourers (Acaröz Candan *et al*., 2019; Fathallah, 2010; Hossain *et al*., 2018; Houshyar & Kim, 2018).

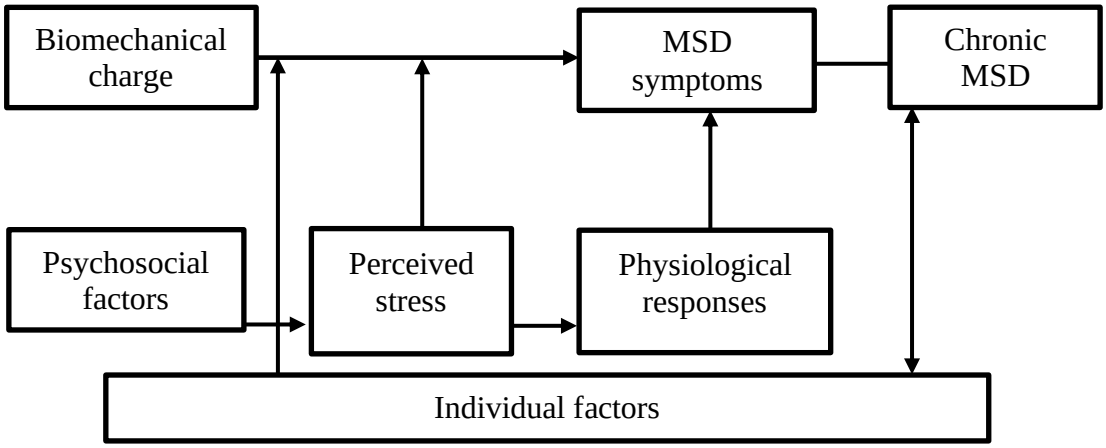

Figure 1.0 Model of the relations influence between the biomechanical, psychosocial and individual risk factors and their impacts on the development of MSD (Bongers et al., 2002).

Dependence on the workers' labour force, the workers are challenged to manually lift, push, pull, carry, move, manipulate, hold or restrain an item with maximum capabilities of the specific body part exerting force. Those manual tasks requiring strong effort put greater loads on the body parts of the muscle, tendons, and joints, causing pain and discomfort in long-term results. Elements such as weight and height of a load have to be lifted and the frequency of lift are attributable factors to the level of exertion on the muscle and joints (*ILO* Encyclopaedia of Occupational Health and Safety., 2020). This phenomenon should not happen because it causes problems in many forms towards workers' absenteeism, insurance, medical costs, loss of employees from other less physically demanding industries (Kirkhorn *et al*., 2010). The incidence can be supported by the fact that MSD is one of the most important causes of

occupational injury and disability in industrially developed and currently developing countries such as Malaysia (Genaidy et al., 1994; Maul et al., 2003; Shahnavaz, 1987).

Overall, agriculture workers are at high risk of developing work-related musculoskeletal disorders (WMSDs) that are associated with physical demands imposed on the body at work (Aptel M *et al.*, 2002; Bernard B.P, 1997; L & Wegman D.H, 2004; Malchlaire J.B *et al.*, 2001). Despite the high prevalence of ergonomics risk factors in agriculture activities, limited local studies were found for conducting ergonomics risk assessment (ERA) using a newly developed tool called Workplace Ergonomics Risk Assessment (WERA) for MSD risks determination among workers. Therefore, this study intended to examine forceful exertion agricultural activities and subsequently focused on the prevalence of musculoskeletal disorders among participants.

2.0 METHODOLOGY

2.1 Background.

A cross-sectional study was carried out in Selangor Agricultural Development Corporation (ADC) in Sungai Tengi Selatan Farm, Kuala Kubu Bharu, Selangor, Malaysia. The participants were selected based on a volunteer basis and the inclusion criteria were 1) full-time workers, 2) aged between 20 and 50 years 3) using a chisel, metal poke or hook, and wheelbarrow for tasks while the exclusion criteria were those working part-timer, who have spinal abnormalities and past accidents. A total of 50 participants who fulfilled the criteria were recruited used was purposive sampling and given written informed consent and a detailed explanation of study purposes. The methodology flow in the study was illustrated in Figure 2.1.

2.2 Study instruments.

2.2.1 Standardized Nordic Musculoskeletal Questionnaire (SNMQ)

This standardised questionnaire was commonly utilized by researchers over two decades ago as a screening tool consisting of just three musculoskeletal pain questions that were widely used in the absence of any other rigorously reliable evaluation tool. Developed by Kuorinka *et al.*, (1987), this kind of questionnaire is suitable for cross-sectional study type and also poses characteristic of sensitivity and useful to measure prevalence and repercussions of musculoskeletal pain and related events in studies of occupational and general populations (Dawson et al., 2009; Ohlsson et al., 1994).

The questions were covered about aches, and discomfort assessed musculoskeletal pains involved in nine body regions suffered by participants due to work-related. In total, SNMQ comprised of 11 questions asked about nine body regions, equating to 99 data items generated by the tool. It requires dichotomous “yes” or “no” response options that identifying areas of body regions that enable in identifying areas of the body experiencing musculoskeletal problems experienced for the past seven days or the last twelve months. Completion was aided by a body map to indicate nine symptom sites - neck, shoulders, upper back, elbows, wrists/hands, lower back, hips/thighs, knees, and ankles/feet. For the convenience of the participants, the Malay translated questionnaire was used in this study.

2.2.2 Workplace Ergonomics Risk Assessment (WERA).

The Workplace Ergonomics Risk Assessment (WERA) has been established to provide a screening tool for the rapid work function for physical risk factors associated with the WMSDs. As stated by Rahman *et al.*, (2012), the development of WERA occurred in two stages. The first stage involved a development method for recording the risk compromising WERA physical risk factors and five major body regions in Table 2.1. To assess the force usage by workers, the force was determined by lifting load (in kilograms), contact stress by using a handle tool or wearing hand gloves, and a number of working hours daily. The next stage comprises the development of a scoring system and activity level. A combination of both factors was considered significant to give a higher magnitude result of WMSDs. Thus, the overall score was determined based on the total number of all risk factors combined to achieve the final score and degree of action for more detailed appraisals as shown in Table 2.2.

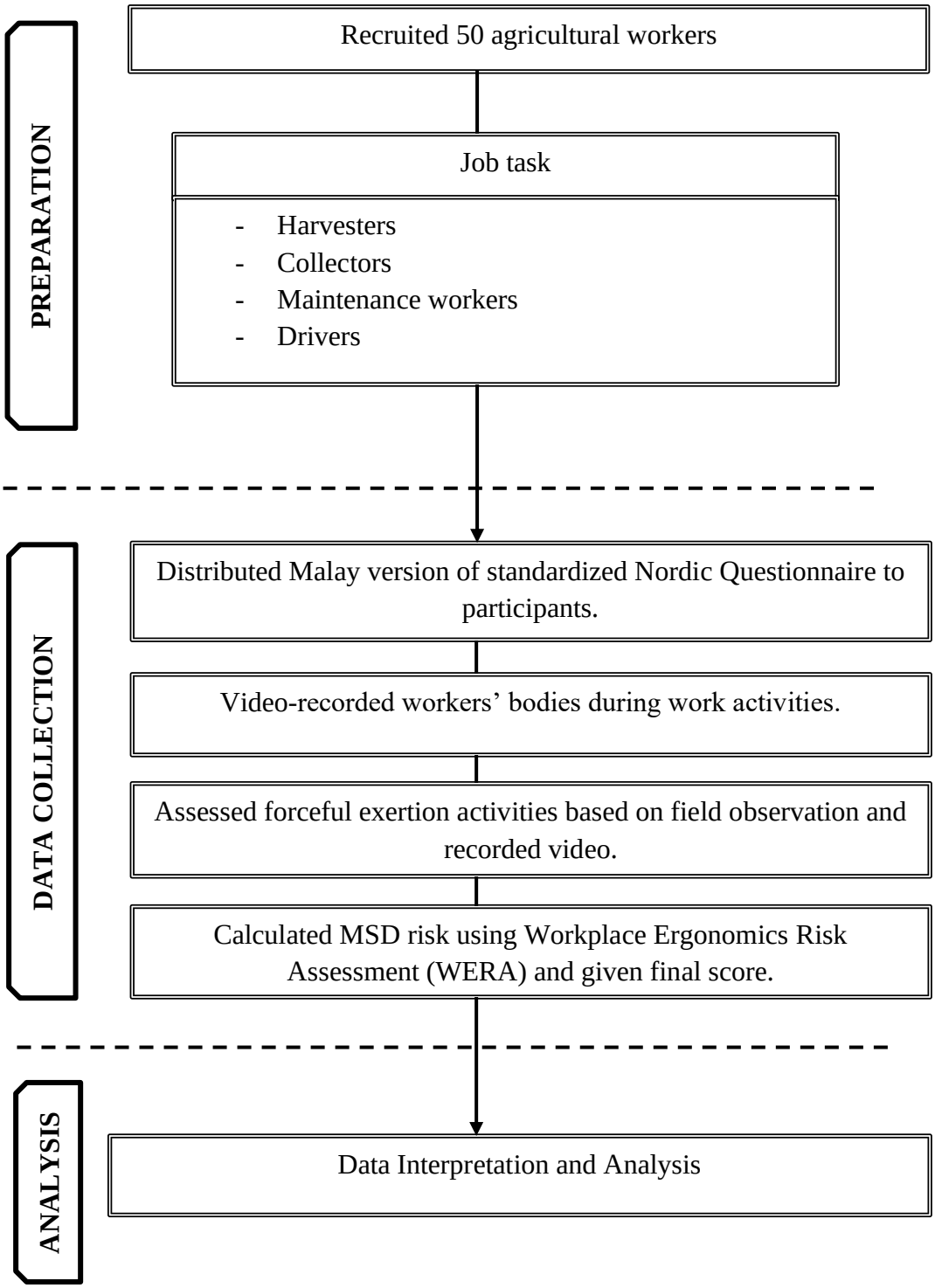

Figure 2.1 The methodology flow in assessing forceful exertion on musculoskeletal disorders on agriculture workers started with the preparation, data collection, and analysis phase. *Note that arrows indicate the flow of the process.

Table 2.1 Score for the combination of physical risk factor and total score for risk level.

WERA items	Combination of risk factor	Risk Level Score		
		Low	Medium	High
Shoulder	1a. Shoulder posture vs. 1b. Shoulder repetition	2-3	4	5-6
Wrist	2a. Wrist posture vs. 2b. Wrist repetition	2-3	4	5-6
Back	3a. Back posture vs. 3b. Back repetition	2-3	4	5-6
Neck	4a. Neck posture vs. 4b. Neck repetition	2-3	4	5-6
Leg	5a. Leg posture vs. 9. Task duration	2-3	4	5-6
Forceful	6. Forceful vs. 3a. Back posture	2-3	4	5-6
Vibration	7. Vibration vs. 2a. Wrist posture	2-3	4	5-6
Contact stress	8. Contact stress vs. 2a. Wrist posture	2-3	4	5-6
Task duration	9. Task duration vs. 6. Forceful	2-3	4	5-6

Table 2.2 Action level on Workplace Ergonomics Risk Assessment (WERA).

Risk Level	Final Score	Action
Low	18-27	The task is acceptable.
Medium	28-44	The task needs to further investigate and required change.
High	45-54	Task is not accepted and immediately change.

2.3 Data analysis.

All data from questionnaires were analyzed using IBM Statistical Package Social Sciences Statistic (SPSS) Version 22.0. For the main variables, descriptive statistics on generating socio-demographic and job characteristics of the study population were presented as mean, standard deviation, and percentage. Similarly, the prevalence of MSD of participants for each body region (neck, shoulders, upper back, elbows, wrists/ hands, lower back, hips/thighs, knees, and ankles/feet) from SNMQ was also descriptively analyses for each body parts to assess exposure risk and demographic information.

Correlations also were examined to find any possible relationships amongst the variables. Crosstabs was performed to explore the relationship between the prevalence of MSD of participants for each body region and forceful exertion contribution to WMSDs. All analyses were employed as a type 1 error rate of $p \leq 0.05$ and corresponding 95 % confidence intervals (CI) to assess the significance of predictive ability. To test the association between two variables, a Chi-squared ($\chi 2$) test was used on the contingency table for hypothesis testing. All P values presented are two-tailed and a P-value of < 0.05 were considered as significant to determine work-related musculoskeletal disorders on prevalence among participants.

3.0 RESULTS

3.1 Respondent background data.

The socio-demographic and job details of all participants in different job tasks were presented in Table 3.1. The percentage of forty-three men (86.0 %) was substantially higher than seven women (14.0 %) who participated in this study. Most of them aged between 26 to 35 years old (36.0 %, mean = 32.1 ± 10.0 years). The BMI was classified into four groups: normal, overweight, obesity and underweight groups. Mainly, they had a desirable BMI ranged 18 - 25 kg/m^2 with a mean of 23.2 kg/m^2 ± 3.5 kg/m^2. All most of the participants were married (66.0 %), the rest of them were single. In terms of education, the largest proportion was no formal education, whereas tertiary education was the least.

Meanwhile, for work-related factors information, the proportion of job tasks were prominent by maintenance workers (40.0 %) followed by harvesters (28.0 %), collectors (24.0 %), and drivers (8.0 %). It was able to identify that their total years of working experience was highest (48.0%) between five to 15 years (mean = 9.0 ± 7.0 years) accompanied by (36.0 %) and (18.0 %) working less than five years and more than 16 years respectively. Besides, the working time of the subjects was working more than eight-hours (mean = 8.0 ± 1.0 hours) accounted for 42 workers in the study were working for ≥ eight hours daily. It was favourable for participants to select one of the work breaks with (28.0 %), where twice work breaks was the slightest. Lastly, it was observed that half of the participants had been doing jobs in a team of 6 to 10 persons (68.0 %), more than 10 persons (24.0 %), and one person per task (8.0 %).

Table 3.1. 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			
Harvesters	14	28.0 %	
Collectors	12	24.0 %	
Maintenance workers	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 WMSDs among participants.

Nine body regions were assessed to determine the prevalence of WMSDs throughout agricultural activities. According to Figure 3.1, the most prevalent of the body was neck (30.0%) contributed highest by maintenance workers (53.3 %), meanwhile, drivers (20.0 %), harvesters (13.3 %), and collectors (13.3 %) had the lowest. Shoulders pain (24.0 %) was second prevalent among maintenance workers, while the drivers had nil reports of it. Upper back (20.0 %) was also regular among participants with the highest recorded with 50.0 %, 25.0 % and 25.0 % by maintenance workers, harvesters, and collectors respectively. It was specified that knees (6.0 %) was also frequently reported by collectors and lowest by both harvesters and collectors. Pain on hips/ thighs was eliminated in the study due to nil complaints reported in the self-reported questionnaire.

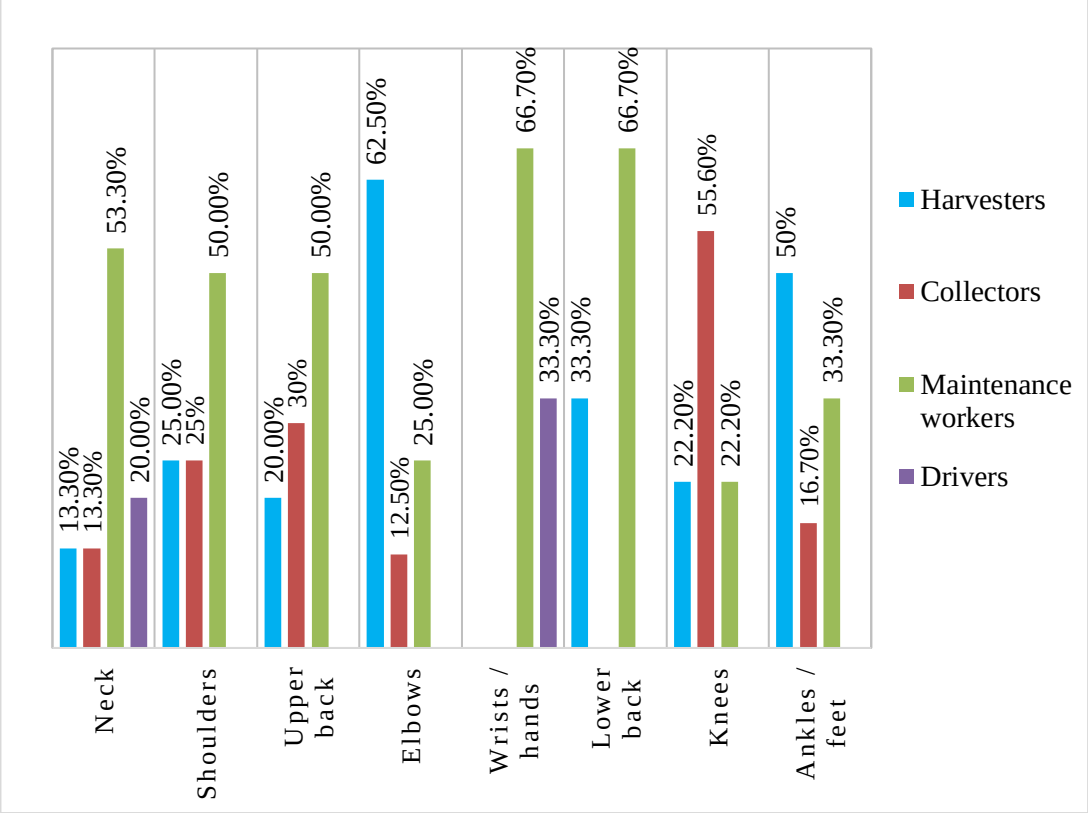

Figure 3.1 Prevalence of work-related musculoskeletal disorders across body regions among participants.

3.3 Association between socio-demographic, work-related information and prevalence WMSD among participants.

Among all the eight body regions, the neck was the most persistently reported WMSDs 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). Chi-square analyses in Figure 3.2 has concluded a statically significant relationship was found between prevalence of WMSDs in shoulders (p = 0.003), knees (p = 0.03) with BMI; wrists /hands (p = 0.04) with total work experience; shoulders (p=0.007) with job tasks; shoulder (p = 0.03) with daily working hour. Therefore, the null hypothesis was rejected.

Table 3.2 Association between socio-demographic, work-related information and prevalence of WMSDs.

Socio-demographic/ work-related information	**Shoulders**	**Wrists/hands**	**Lower back**	**Knees**
	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)
BMI (kg/m^2)	11.34 (0.003)*	5.16 (0.08)	0.65 (0.72)	6.80(0.03)*
Total work experience (years)	3.70 (0.16)	6.42(0.04)*	1.98 (0.37)	2.96 (0.23)
Job task	17.70 (0.007)*	11.58(0.07)	4.80 (0.57)	13.25(0.04)
Daily working hour (hour)	4.90 (0.03)*	1.00 (0.32)	1.0 (0.32)	1.80 (0.18)

*Significant at (p < 0.05) level

3.4 Prevalence of WMSDs on WERA physical risk factors.

Upon field observation on forceful exertion towards WMSDs among participants, Figure 3.2 explained five manual material handling tasks applicable in this study. Lifting and lowering activity were noted as the most dominant task on the application of bodily force that contributed highest by maintenance workers (n=20) succeeded by collectors (n=12), harvesters (n =9), and drivers (n=2). Moreover, maintenance workers have contributed to the highest count of the respondent (n=20) and (n=20) in manual handling such as carrying a load and pushing and pulling work activities respectively.

Under Table 3.4, a majority (96.0 %) of participants' WERA scores reported at medium level dominated by maintenance workers (n=19), accompanied by harvesters (n=14), collectors (n=11), and drivers (n=4). There was also a report for low-level acquiring MSD by a participant working as a collector and another participant in the maintenance department scored for high-level WERA final score, ranging from 45 to 54 that required an immediate work change.

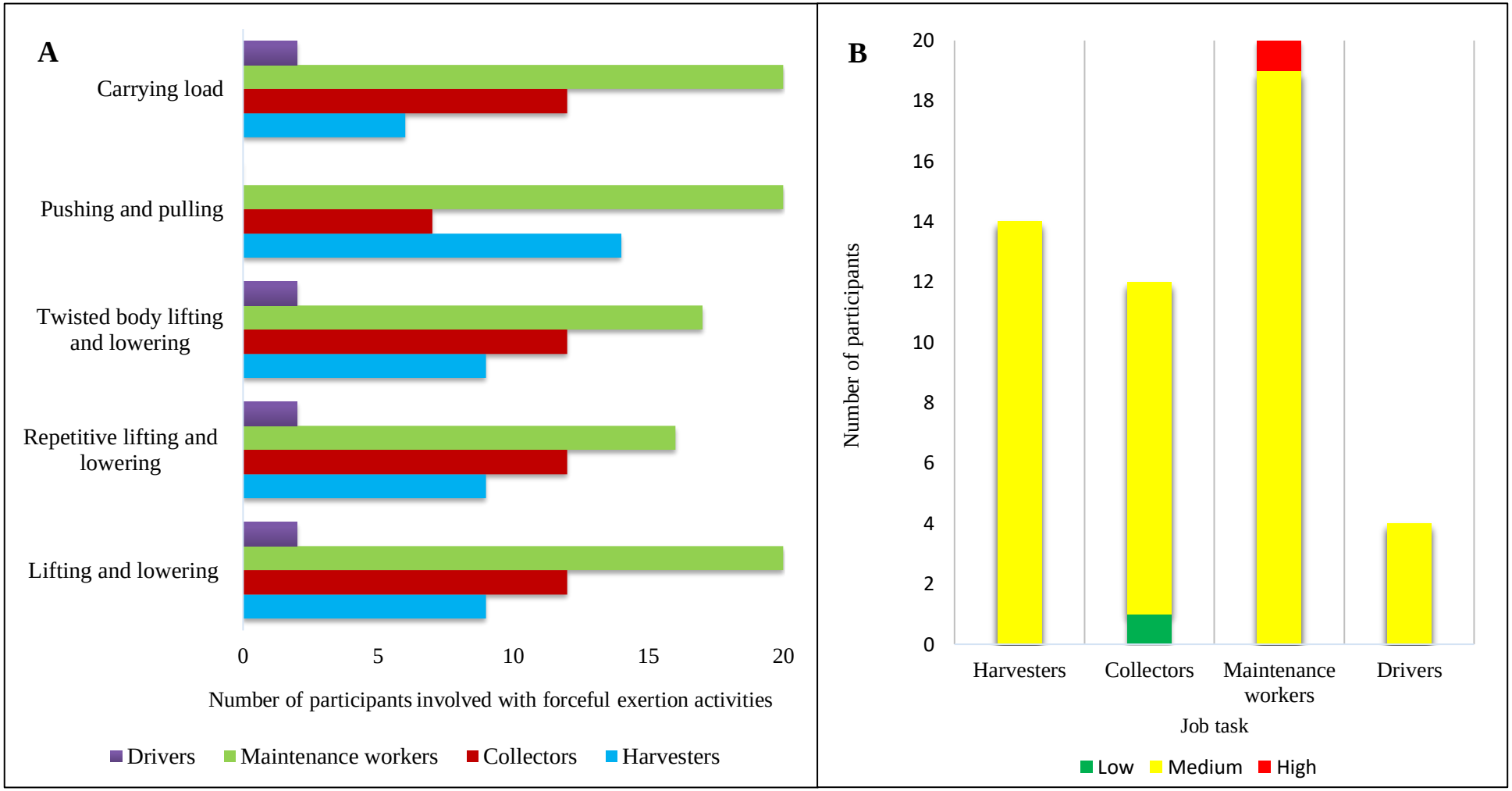

Figure 2.2: (A) Frequency of participants involved with forceful exertion activities according to job tasks; (**B)** Level of MSD risks by different job tasks based on WERA final score.

3.5 Association between the prevalence of WMSDs and WERA physical risk factors.

Chi-square statistical analysis ($\chi 2$-test) highlighted for statistically significant for back posture, wrists repetitive and load lifting to shoulders, upper back. The shoulders regions for self-reported pain was significant associated back posture ($\chi 2 = 10.95$, $p = 0.001$) and repetitive movement on wrists ($\chi 2 = 22.68$, $p = 0.01$). Likewise, the load-lifting risk factor was yielding a statistically significant between the prevalence of pain on the shoulders and upper back with ($\chi 2 = 7.96$, $p = 0.02$) and $\chi 2 = 7.82$, $p = 0.02$) correspondingly. Hence, the null hypothesis was rejected.

Table 3.3 Chi-square statistical analysis ($\chi 2$-test) between WERA physical risk factors and the prevalence of reported pain ache or discomfort among participants.

WERA Physical Risk Factor	**Shoulders**	**Upper back**
	$\chi 2$ (p)	**$\chi 2$ (p)**
Back Posture	10.95 (0.001)*	0
Wrist Repetitive motion	22.68 (0.01)*	1.79 (0.43)
Load Lifting	7.96 (0.02)*	7.82 (0.02)*

*Significant at ($p < 0.05$) level

4.0 DISCUSSIONS

4.1 Respondent background data.

The study population was the majority participated by the male (86.0 %) compared to female (14.0 %) 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; E. Sukadarin *et al*., 2016). The majority of the current study showed participants (76.0 %) had desirable BMI ranging from 18 to 25 kg/m^2. For comparison, the current finding was higher than the previous study in Jain *et al*., (2018) for normal BMI to achieve a high prevalence for musculoskeletal symptoms among manual working farmers. This might be due to the insertion of experienced physically fit adults in this study, consistent with the Malaysian Employers Federation, (2014) for every worker is entitled to the labour-intensive and physically demanding work of plantation tasks.

It was also explained that most of the participants had no formal education due to migrants workers were dominant in the population compared to local people working on the farm. Ng *et al*., (2015) agreed that lower educational level was found to have a better adaptation to labour intensive work task 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 for greater tolerance towards fatigue and pain which lowering developing MSDs. Lastly, the Selangor Agricultural Development Corporation (ADC) farm 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 WMSDs among participants.

The study finding indicated the prevalence of self-reported musculoskeletal symptoms was very high among the study population in any part of the body. This prevalence rate of the current study was equivalent to other cross-sectional studies with recorded prevalence for the past 12 months of 69.0 % and 43.4 % for farmers in Thailand and Malaysia respectively (Bhattarai *et al.*, 2016; Ng *et al.*, 2014). Secondly, the most frequent experience of ache, pain, or discomfort affected at multiple body regions was the neck followed by shoulders and upper back, which was different from comparable rates from other studies. It is impossible to compare specifically due to modified measurement tools, however Standardised Nordic Questionnaire used and vastly diverse study population. The study by Shan *et al.,* (2012) indicated that neck pain was the highest prevalence measured using a modified Standard Nordic Questionnaire (Malay version), which was 59.9 % among rubber workers. In contrast to other agriculture studies, the neck was found the least reported body region pain compared to body back pain occurring prevalent of MSD due to many farming tasks requires body posture to sustain physical stresses, lifting, forceful gripping, twisting, bending, squatting, and kneeling (Osborne *et al*., 2010; J. Park *et al*., 2010).

The highest complaint of neck pain among participants 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 bend the head and neck backwards to view a ripe fruit on the tree prior to the cutting task. This corresponds with studies with working hands above shoulders over continuous periods of work time were associated with shoulders and neck pain, epicondylitis, and rotator cuff syndrome (Arcury *et al*., 2014; Suda Hanklang *et al*., 2014). Shoulders pain was also reported as the second highest prevalent especially in

maintenance workers, as they are exposed to occupational exposures in manual handling such as the heavy lifting of fertilisers packaging bags weighted 80 kilograms each from a truck onto wheelbarrows and pushing and pulling on an uneven surface. As correspond with Nimbarte *et al*., (2013); Ponte *et al*., (2015), the situation in balancing the heavy load while pushing will also be resulting in straining the muscles in the lower back, shoulders and forearm arms.

4.3 Association between socio-demographic, job-related factors and prevalence of work-related musculoskeletal disorders.

4.3.1 Age.

Finding from the current study revealed 45 years of age is more likely to experience MSDs affecting their lower back ($\chi 2 = 10.60$, $p = 0.01$). Conflicting to the age range Ijaz *et al*., (2020) agreed with musculoskeletal symptoms will be starting to be more obvious and developed as people get elder was 26 to 35 years whereby workers reported pain specifically in the lower limb ($p = 0.0012$). However, several studies found the decrease in muscle strength begins around age 40 and more dramatic after age 65 associated with inactivity (Faulkner & Brooks, 1995; Zerba *et al*., 1995). This is consistent with other research results supporting that aged skeletal muscle is more vulnerable to injury as muscle decrement in force, power, endurance and later proved significant association with MSD development (Momeni *et al.,* 2020; Pradeepkumar *et al.*, 2020).

4.3.2 BMI.

Based on the outcome of this study, participants were found with a desirable BMI range of 18 to 25 kg/m^2 was significantly associated with shoulders ($p = 0.003$) and knees ($p = 0.03$). The latter was opposed to another study by Colim *et al*., (2020), researchers indicated that excess weight could overload the musculoskeletal structure for balancing and moving the body. The result of participants during vertical handling task with the same study profound that the obese group presented kinematics has significant differences ($p < 0.05$), compared with the non-obese group. Consistent with a study from Thailand (Luangwilai *et al*., 2014), abnormal BMI group in rice farmers population could increase the prevalence of MSD by odd of normal BMI group is 0.607 lower than in abnormal BMI group (95. % CI=0.377-0.977).

4.3.3 Total work experience.

Most had been working for at least one year on the farm. The significant difference indicated on wrists/hands ($p = 0.04$) with a mean duration of work was 9.0 years ± 7.0 for all workers. In a study by Min et al., (2016), scholars found a significant correlation between wrists/hands pain and work experience ($p < 0.001$) among older experienced farmers in Korea. They stated that as farming duration increased, MSD pain decreased based on subjects' experience. Likewise, for the study Park *et al.,* (2001), researchers indicated that compared to younger farmers, older farmers may have learned to change their working habits to escape pain, discomfort, and injury.

4.3.4 Work duration.

As believed by Ng *et al.,* (2013) and Hanklang *et al.,* (2014), the prolonged working hour has also been recognised ergonomics risk factor that is related to MSDs among farmers and were 7.6 times more likely to develop MSD compared to those without correspondingly. The Chi-square test in the current study discovered that working more than eight hours daily was significantly correlated to shoulders pain (p = 0.03). It was noticed that 84.0 % of workers had overworked from 6.30 a.m. until 4.00 p.m. for six days weekly as their wages were based on daily production and duration of work. WMSDs among workers may be due to an increase of weight added to the body in heavy lifting or pushing and pulling exertions, which consequently more of risk of pain due to impose on longer working duration (Basher et al., 2013).

4.3.5 Work breaks.

The finding in this study did find any significant difference in the frequency of work breaks and prevalence WMSDs among workers. It has been proven that they had been given flexibility on choosing the frequency of work breaks for an hour and a half by management per day. The possible explanation for this might be job tasks covered with continuous harvesting, collecting, pushing, or pulling wheelbarrows and other manual activities that included ergonomics risk factors of forceful exertion and repetitive awkward postures. Thus, this led to a high utilization of energy and musculoskeletal system for long periods without breaks. Sufficient work breaks in prolonged work resulted in risk factors for MSDs (Krause *et al.,* 2005).

4.4 Prevalence of WMSDs and WERA physical risk factors.

Specifically in this study, forceful exertion was an important determinant of WMSDs in WERA assessment, resulting in a medium risk level for most of the respondents' job tasks. Throughout job duration, the majority of participants were regularly engaged in lifting and lowering big loads such as fresh fruit bunches (FFB) and heavy-duty fertilizer bags. The former was widely concerned in MSD studies as an average of the total of 1000 kg of FFB needs to be lifted and transferred daily weighing seven kilograms to 20 kilograms each. A life cycle assessment study by Subramaniam *et al.*, (2010) estimated each FFB is harvested as frequently as three cycles/visits per month are carried out for each tree because it takes 10 to 21 days to produce one FFB. This indicated that the harvesters and collectors are physically forced demanding and required an extremely large amount of energy thus exposing high risky in terms of work safety and MSD (Nawi *et al.*, 2016; Nawi *et al.*, 2016; Syuaib, 2015).

Furthermore, it was revealed that the act of performing physically monotonous and repetitive work were incredibly ruled by maintenance workers (41.0 %) which transferral of heavy-duty fertiliser bags from trucks onto wheelbarrows by placed them against shoulders. This traditional approach to load or unload is often raising a risk of unsafe lifting that beyond time may lead to overexertion injuries. As coherent research by Sukadarin *et al.*, (2013), they established for loading activity of FFB and another heavy load from ground to the truck was giving a high risk to the workers' back and shoulders/arms and moderate risk for wrists/hands accordingly by using quick exposure assessment (QEC). This approved by a high frequency of tasks is a major

risk factor for WMSDs because the worker cannot fully recover in the short periods that are given between tasks (Barregard *et al*., 2003).

4.5 Association between the prevalence of WMSDs and WERA physical risk factors.

In Chi-square statistical analysis (χ2-test), load-lifting under WERA physical risk factors was positively associated with musculoskeletal pain of shoulders and upper back among participants. The WERA final score in this study was mostly derived for medium risk level, ranged from 28 to 44 indicating the workers' load lifting need to be investigated and some changes are required immediately. It was assumed it might due to the fact that the shoulders and upper back were frequently imposed with excessive load on the muscle or joint during the farm.

For shoulders complex, research by Thetkathuek *et al*., (2018) agreed that the risk factor for repetitive activities and labour enforcement among Cambodian farmers was the risk factor for shoulders disorders with respect to the force being applied. High translation forces and the increased ratio of translation and compression forces destabilise the glenohumeral joint, raising the likelihood of cumulative damage to shoulders MSD (Nimbarte *et al*., 2013). Meanwhile for musculoskeletal symptom of the upper back was closely related with repetitive and twisting body posture while engaging in heavy physical activities. Bridger,(2003) pointed out that approximately 60.0 % of upper body muscle problems are caused by load-lifting operations, while 20% are caused by pulling or pushing loads. These material handling continues escalating the risk of MSD due to the increase of weight added to the body (Akthe esson *et al*., 2011; Argubi-Wollesen *et al*., 2017). Therefore, cumulative forces resulted from these activities may cause soft tissue damage, leading to inflammatory response and pain resulting in discomfort among workers.

5.0 CONCLUSION

The results of this study indicated a high prevalence of musculoskeletal symptoms, particularly in the neck, shoulders, upper back among agricultural workers. Socio-demographics and job-related information such as age, BMI, total work experience, and daily working hours influenced the risk of a musculoskeletal problem in different body regions. Besides the evaluation of forceful exertion with WERA score, the assessment was useful to establish associations between forceful exertion and prevalence WMSDs risk in the workplace. Such ergonomics risk factors on related manual handling activities namely lifting load and pushing and pulling were found for the highest risk of exposure to cause WMSDs among workers. Therefore, the scoring system of WERA was helpful for an observational tool to examine the physical risk factors related to WMSDs that is simple and achievable to classify into action levels that relevant to the broad variety of jobs. Appropriate ergonomics interventions including the application of several engineering controls when lifting heavy loads are recommended to reduce musculoskeletal discomfort and maintain good health within this population. Nevertheless, the limitation for this study is designed for cross-sectional design which causality cannot be established. There is also possible recall bias among participants due to the presence of farm management during the interview that may report the WMSDs with lower prevalence than in reality. Pain or discomfort claimed in the self-reported questionnaire is also not proven by any medical proof from a physician, and therefore there may be some errors in the data.

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