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A Preliminary Study of Postural Problems among Oil Palm Workers: Is OWAS method suitable to investigate those problems?

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Abstract- **An ergonomics risk assessment is crucial in every organization; various exposure measurement techniques were developed. Among them, observational technique is the most commonly used. In agricultural sector such as in oil palm plantation, ergonomics problems are prominent. Oil palm fruit harvesters and collectors perform various types of manual work activities and work postures, which can exposed them to many different types of muscular skeletal disorders (MSDs). To have the accurate measurement results so that correct control measure could be observational techniques have to be chosen correctly. In this study, postural analysis was conducted to identify and understand the physical loads faced by manual oil palm fruit harvesters. Their activities and postures while performing harvesting and collecting fresh fruit bunches (FFB) activities were video recorded. Later, their body postures were assessed using Ovako Working Posture Analysis System (OWAS) method. It was found oil palm fruit harvesters were exposed to many awkward postures while performing harvesting and manual handling of FFB activities. The authors found it very difficult to quantify the actual load faced by the oil palm fruit harvesters, while they are performing each hazardous posture due to the unavailability of certain parameters such as: posture duration and repetitive work in OWAS. In addition, OWAS was not capable of quantify separately the workload of upper extremities. In essence, it can be concluded that OWAS method due to its limitations was not suitable for conducting postural analysis during harvesting and collecting of FFB.**

Index terms - Posture analysis, OWAS method, manual work, oil palm industry

1. INTRODUCTION

Ergonomics risk assessment has to be conducted to manage ergonomics risk factors at workplace. Various measurement techniques are available to assess ergonomics risk factors. There are 3 categories of exposure measurement techniques. Firstly is self-reported (e.g., questionnaire / subjective evaluation), secondly is observation (e.g. trained observer, video recording) and thirdly is direct measurement (e.g. electromyography, goniometry and inclinometry) [1].

From the mentioned exposure measurement techniques, direct measurement has been considered as the 'gold standard' in assessing biomechanical exposures due to its validity and reliability characteristics [1, 2, 3]. However its limitation of the application is apparent. For the example, direct measurement technique requires large numbers of workers, long time duration and are very difficult to be completed. In this type of measurement technique, human factor issue is noteworthy. Body contact is normally unavoidable. The work processes are interrupted and delayed because of the interaction between researcher and workers in term of setting up the equipment [4]. We are also worried of other surrounding factors and unpredictable situations that may affect the success of the equipment application. In relation to that Trask et al. (2007) revealed that in equipment monitoring, complete data is also difficult to acquire compared to other techniques such as observations and indirect measurement technique.

To date, observational techniques remain to be extremely common technique in ergonomic research studies. Because they are easy to use, cheap, ability to capture individual exposures for large populations and could generate the required result [5]. Due to that, many researches have been published to discuss various observational techniques. However the main issue is to ensure that those observational techniques are reliable in term of the selected risk factors and the postures covered [6].

Self-report and observation technique also known as indirect observational method is widely used in assessing biomechanical exposures compared to other assessment method [7,8]. Although the generated results are too subjective, however, many researchers tend to use this technique to assess the MSDs sign or symptom among workers. In direct observational techniques is widely used because it is cheap, easy to use, quick analysis and generating results and do not interfere in work activities [7,9]. Furthermore by using an appropriate questionnaire one can achieve the objective for recognizing the most significant at risk workers in developing Musculoskeletal Disorders (MSDs) [9].

1.2 Why exposure assessment is needed?

MSDs is a serious problem. The best way to prevent the MSDs is by intervention. Therefore, the MSDs risk factors need to addressed, so that effective control measures and intervention methods could be proposed [10, 11]. MSDs exposure assessment is used to identify the ergonomics risk factors[12, 13].

1.3 Oil palm workers, activities, ergonomics risk factors

Heavy lifting, pushing and pulling, awkward posture and repetitive movements are typical in agricultural environment. The tendency fresh fruit bunch (FFB) harvesters and collectors to suffer from musculoskeletal problems due to ergonomics risk factors exposure is high[14], [15] Oil palm workers are also exposed to the risk of workplace injury because most of the hazardous job, they have to perform manually [13, 14]. For example, harvesting oil palm FFB and pruning fronds all work are done manually. For short palm tree, workers have to use a chisel, meanwhile for tall palm tree, workers have to use a sickle to cut-off the FFB or frond. In tall palms, the sickle needs to be connected at the end of long pole. In each harvesting activity, the FFB harvester needs to lift the pole upright prior to start cutting the frond or FFB. Manual cutting of FFB is a tough job and harvester must be skillful and physically fit in order to perform successful cutting operation [15].

After cutting the FFB from palm tree, all cut FFB and loose fruits have to be collected. It is normal for the harvester to perform stooping and squatting posture while collecting the cut FFB and the loose fruits. Lifting FFB from ground into the wheelbarrow also requires a lot of efforts. Another issue that can be investigated is pushing a fully loaded wheelbarrow with FFB to designated area for ease of collection. In general, the weight of each FFB range from 10 – 20 kilogram. Normally, there are more than one FFB that need to be lifted and transferred. In total more than 100 kilogram of FFB need to be lifted and transferred daily.

2. METHOD

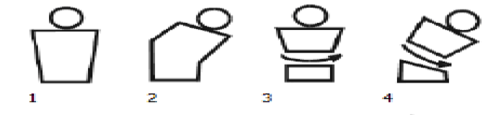
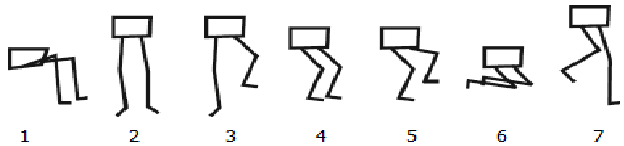
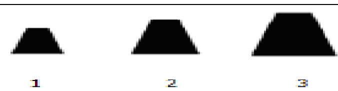
2.1 Observation and posture data collection (video camera)

Harvesting and collecting FFB activities in an oil palm plantation was recorded using a video camera. This was done to capture the actual of FFB harvesters' daily activities and postures so that they can be properly assessed in the laboratory. In addition, typical problematic postures performed by the FFB harvesters can be easily analyzed and addressed

2.2 Ovako Working Posture Analysis System (OWAS)

OWAS is an observational techniques that can be used to evaluate postural load faced by human worker during performing his/her work [16] . OWAS was developed in a steel industry company. At the beginning development, OWAS is dedicated to describe workloads during overhauling process of iron smelting ovens. The OWAS method can be used to collect simple observational information on the worker's (4 back, 3 arm, 7 leg) and loads (3 loads) according to a classification of work tasks [20]. It is valid to perform OWAS either by direct observation or video observation [21]. In term of procedures for video observation, snapshots of targeted working posture were taken during observations and fixed-time intervals are implemented. It was showed that OWAS analysis and perceived postural problems and discomfort are well associated [22]. OWAS analyzing system is shown in the Table 1.

Table 1 OWAS analyzing system

	**Back Posture** 1) upright 2) leaning forward 3) flexuous 4) leaning forward and flexuous
	**Forearms posture** 1) both below elbow joint 2) one below elbow joint 3) both above elbow joint
	**Legs work** 1) sitting position 2) standing with legs upright 3) standing with one leg upright 4) standing with legs bent 5) standing with one leg bent 6) kneeling on one or both knees 7) walking
	**External load volume for men [kg]** 1) below 10 2) within the range 10-20 3) above 20

To determine body position code using OWAS method, code of each targeted posture need to be inserted in the table as shown in Figure 1. The 4 digits code (back posture, forearms, legs work and external force) are then standardized to get the category in order to determine required action as shown in Table 2.

[Back Posture Code place here]	[Forearms Posture Code place here]	[Legs Work Code place here]	[External Volume Code place here]

		1			2			3			4			5			6			7			Legs
Back	Arms	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	Load Handled
1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	1	
	2	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	1	
	3	1	1	1	1	1	1	1	1	1	2	2	3	2	2	3	1	1	1	1	1	2	
2	1	2	2	3	2	2	3	2	2	3	3	3	3	3	3	3	2	2	2	2	3	3	
	2	2	2	3	2	2	3	2	3	3	3	4	4	3	4	4	3	3	4	2	3	4	
	3	3	3	4	2	2	3	3	3	3	3	4	4	4	4	4	4	4	4	2	3	4	
3	1	1	1	1	1	1	1	1	1	2	3	3	3	4	4	4	1	1	1	1	1	1	
	2	2	2	3	1	1	1	1	1	2	4	4	4	4	4	4	3	3	3	1	1	1	
	3	2	2	3	1	1	1	2	3	3	4	4	4	4	4	4	4	4	4	1	1	1	
4	1	2	3	3	2	2	3	2	2	3	4	4	4	4	4	4	4	4	4	2	3	4	
	2	3	3	4	2	3	4	3	3	4	4	4	4	4	4	4	4	4	4	2	3	4	
	3	4	4	4	2	3	4	3	3	4	4	4	4	4	4	4	4	4	4	2	3	4	

Figure 1 Body position code and the scoring table

Table 2 Posture category and action needed

Category	Description	Action needed
Class 1	Body position is regular and natural. Load is acceptable	Change not required
Class 2	Involves potentially hazardous postures. Static load is practically acceptable.	Change required in the near future
Class 3	Points out a clearly hazardous influence of body posture, while static load is fairly large.	Change required as soon as possible
Class 4	Postures and worker's body position which are defined as being considerably hazardous. Static load is also quite large.	Change required immediately

3 RESULTS AND ANALYSIS

3.1 Observation and posture data collection (video camera)

After recording the work method, seven typical postures that repeatedly seen were chosen from the original video image and placed in frames (Figure 2). Manual harvesting FFB from short and tall oil palm tree exposed workers to vary type of ergonomics problems. Managing ergonomics problems proactively is the ideal solution. But, in some circumstances, reactive approach in managing ergonomics problems is needed. This is due to the fact that physical demanding works, sooner or later may affect workers health and also will giving a huge impact to the business productivity[23]. Table 3 shows seven postures selected from the original video.

Posture 1

Posture 2

Posture 3

Posture 4

Posture 5

Posture 6

Posture 7

Figure 2 Seven postures selected from the original video image

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Table 3 Analysis of OWAS

Posture	Figure	Scenario	OWAS code	Action Category	Remarks
1		Knees bent and body leaning forward Holding and swinging chisel strongly	2341	3	Change required as soon as possible
2		Body straight Knees bent Holding and swinging chisel strongly	1341	2	Change required in the near future
3		Both hand above shoulder level Holding and pushing long-armed sickle. Using upper body and back to perform pushing	1321	1	Change not required
4		Pulling / pushing long-armed sickle strongly. Usually more than one time in each session.	1141	2	Change required in the near future
5		Stooping and squatting to collect loose fruits	3161	1	Change not required
6		Carrying bunch from ground into wheelbarrow	1173	1	Change not required
7		Pushing wheelbarrow containing FBB	2173	3	Change required as soon as possible

3.2 OWAS analysis

Step by step OWAS was conducted. The seven selected working postures were analyzed. Table 4 shows the result of analysis of the selected working postures.

Table 4 Problems found in OWAS results

Posture	Action needed	Remarks
1 & 7	Change required as soon as possible	The duration of the specific posture is not been considered. The score might be over estimated
2 & 4	Change required in the near future	Posture involve repetitive actions, however there is no repetitive consideration in the analysis. The score might be under estimated
3, 5 & 6	Change not required	Duration of posture and repetitive work are not been considered at all. The score might be under estimated

4. DISCUSSION

The relationship between incorrect working posture and the incidence of musculoskeletal injury is undeniable [20 , 21]. Without any delay, these issues need an immediate and effective attention to prevent a lifetime of suffering from the MSDs. Exposure measurement techniques are one of the researchers' efforts to cater this issue so that it can be managed properly. It also has to be understood that, simply developing any exposure measurement technique, is just not worth it. By neglecting reliability of those methods, the developed method may over or underestimate the risks of health outcomes. Other problems such as misclassification of exposures and inaccurate conclusions always happen [26][27].

The reliability of OWAS was presented by Takala et al. [22]. OWAS is widely used and well documented [26], and many case studies of ergonomics applications have been reported (such as, Deros et al.[21], Takala et al.[22], Gangopadhyay et al.[19]). OWAS is a simple method, which can be used by any individual who are not specifically trained in ergonomics [19] and it can perform postural analysis very quickly [28].

Findings from postural analysis using OWAS method show that posture 1 and posture 7 are hazardous; therefore, interventions and corrections are needed to be done as soon as possible. In this study, posture 2 and posture 4 are still considered acceptable and safe to be applied. However, postural correction might be required in near future.

Meanwhile, for posture 3, 5 and 6 OWAS analysis shows that postural change are not required.

But, after a few considerations such as: duration of each posture and posture repetition, the results found are still questionable. These issues were also highlighted in Vieira and Kumar [20]. The limitations of OWAS in assessing heterogeneous jobs were mentioned in Takala et al. [22] . In addition, based on postural observations, work load between different sides of the body were also obvious. For example, for left and right hand, it can be seen that in a specific posture (e.g. posture 1) right hand was used harder than left hand. However OWAS analysis cannot differentiate the load of those limbs [26]. There were also no assessments were made regarding neck, elbow and wrists in OWAS. For shoulder, OWAS could only perform basic assessment with respect to the shoulders. Broadness of the posture categories is also a prominent issue, which can lead to inaccuracy of the posture description [28].

5. CONCLUSION

Harvesters confront awkward postures in most of their working times. However, it is very difficult to quantify the exact load of each hazardous posture using OWAS due to the unavailability of certain parameter such as posture duration and repetitive works. The limitation of splitting left and right upper extremities is also an important issue to be highlighted. It has to be understood that OWAS method was developed in a steel industry to understand workloads that involved in the process of overhauling of iron smelting ovens. In other words, exposures to awkward postures in steel industry are totally different from agricultural industry. In addition, different exposure will give different workload and risk factors. From the above consideration, it can be concluded that OWAS method might be not the best method to study postural load in an agricultural setting, specifically during the harvesting and collecting of FFB activities.

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