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EFFECTIVENESS OF A PARTICIPATORY ACTION ORIENTED TRAINING INTERVENTION APPROACH AMONG HARVESTERS IN OIL PALM PLANTATION

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ABSTRACT

Consistent with the global demand for palm oil, the intensified upstream harvesting activities of oil palms' fresh fruit bunches, despite the harvesters evidences of various ergonomics risk factors leading to musculoskeletal disorders should be a cause for concern. Thus, this study describes the effectiveness of a modified and locally adapted Participatory Action-Oriented Training intervention program in improving the working environment of the harvesters. A training program modified and customized to the harvesters' working in oil palm plantation consist of 3 primary instrument (awareness video, interactive lecture and action checklist) with 3 reinforcing activities (to increase knowledge, enhance understanding and practical application). Based on the result of post-intervention assessment, the self-reported prevalence of MSD and KAP score among Intervention Group (IG) did not significantly differ from Control Group (CG). Instead of decreasing, the prevalence of MSD in the past 12 months and 7 days increased within IG. Qualitative findings in this research show that the negative psychosocial and organizational climate has severely affected the implementation of PAOT rendering the effect of the intervention approach. The interventions were ineffective on the IG as this study suffers from various situational barriers as obstacles to benefit the full extent of PAOT advantages.

Keywords: Participatory Action-Oriented Approach, Intervention, Ergonomics, Harvester, Oil Palm Plantation

1. INTRODUCTION

Thrive primarily under tropical climate, oil palm trees are mono-cultivated in large plantations primarily in Malaysia and Indonesia (Fairhurst and Mutert, 1999). The main product, oil of the palm (harvested from fresh fruit bunches) has vast intermediate derivatives and downstream application which ranges from industrial oleo-chemical products to consumer products beside food applications (Basiron, 2002).

This rapidly growing oil palm industry particularly in the Southeast Asia region is still heavily concentrated on the upstream sector in producing the primary oilseed commodity (ETP, 2013). Similar to various other agricultural practices, the upstream Oil Palm Plantation (OPP) sectors is intensively reliant on

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manual labor for harvesting the Fresh Fruit Bunches (FFB) from the palm trees (Adnan, 2012).

Ergonomics issues specifically Musculoskeletal Disorders (MSD) has been intensively advocated in the past few decades as over a billion of people worldwide of different age groups and gender are employed in agriculture (Chapman and Meyers, 2004; Fathallah *et al*., 2004; ILO, 2010; 2012; Kirkhorn *et al*., 2010. However, the recently emerging oil palm has yet to gain the attention it deserves despite the physically demanding manual labor tasks.

In addressing the multitude risk factors of MSDs, the joint effort by International Labour Organization (ILO) in cooperation with the International Ergonomics Association (IEA) has produced to date, several technical manual which are based on simple and low-cost practical solution concept in disseminating ergonomically sound workplace improvement applicable and adaptable for different local situation and work environment (Niu, 2010).

Following the success of Work Improvements in Small Enterprises (WISE) and Work Improvement in Neighbourhood Development (WIND), the Ergonomics Checkpoints, first published in 1996 was subsequently revised as the second edition in 2010. The manual emphasize on visual presentation contents and minimizing the analytical content in favor of practical solution based on ergonomics principles.

Adopting similar concept, Ergonomics Checkpoints in Agriculture was subsequently published in 2012 which cater specifically for the rural and agricultural setting. Following successful application in Vietnam, the manual in combination with participatory, action-oriented training approach has since been translated, customized and locally adapted in various countries showing effective outcomes (Kawakami *et al*., 2009).

As such, this study describe the implementation and effectiveness of an ergonomics intervention program developed based on these published manual and experiences of successful participatory action-oriented training program among harvesters of OPP managed by one of a profit-oriented large multinational companies in Malaysia primarily employing foreign labors workforce.

2. MATERIALS AND METHODS

2.1. Study Design

This study feature a quasi-experimental design conducted among harvesters working in OPPs to the south of Peninsular Malaysia. Prior to the intervention, an ergonomic risk assessment has been carried out using respondents from 12 OPP which fits the criteria of the study; FFB harvested manually and within early (first to third) harvesting year (Ng *et al*., 2013).

The selection of the eligible OPPs was based on the inclusion criteria primarily the homogeneity of the workplace and harvesters in terms of exposure to hazards (i.e., years of employment, working duration, job tasks, workplace characteristics, work organization). Only foreign labor specifically the Indonesian male workers were involved in this study as they made up entirely of the harvesters in most OPP in this study.

Using the criteria above, only two OPPs were eligible for this study. The rest of the other OPPs did not meet the requirement primarily due to unavailable corresponding pair (as intervention or control group) where the exposure of hazards were different (i.e., differences in terms of working hour, rest day, mixture of job tasks beyond harvesting, land contour and management style).

Both the eligible OPPs were within the same geographical area with almost similar land contour not too far apart from each other. In addition, although managed separately, the management team of both OPPs were consistently working together holding various formal and informal meeting together including activities for the harvesters.

Assigned randomly (using coin toss), one of the eligible OPP was allocated as Intervention Group (IG) while the other as Control Group (CG) with 49 participants and 21 participants in respective group who gave consent to participate in the study. At the end of the post-intervention, there were only 34 participants and 12 participants remaining in IG and CG respectively at 4th month followed-up.

The flow diagram of the intervention progress is as depicted in **Fig. 1**.

2.2. Intervention Program

Learning from the success of Participatory Action-Oriented Training (PAOT) approach in the past, a one day training program was organized in conducive environment to the participants (Khai *et al*., 2011). In the program, various approaches using multimedia resources, printed illustration and graphical materials were utilized in both interactive lecture and participatory discussion sessions.

There were three different main interventional instruments developed and modified based on existing references and resources; a video, an interactive lecture and an action checklist. Within these instruments, three interactive activities was interspersed in the program to reinforce, enhance and broaden the knowledge and their practical application in workplace (University of Calgary, 2004; RHEF, 2008; NWCPHP, 2012).

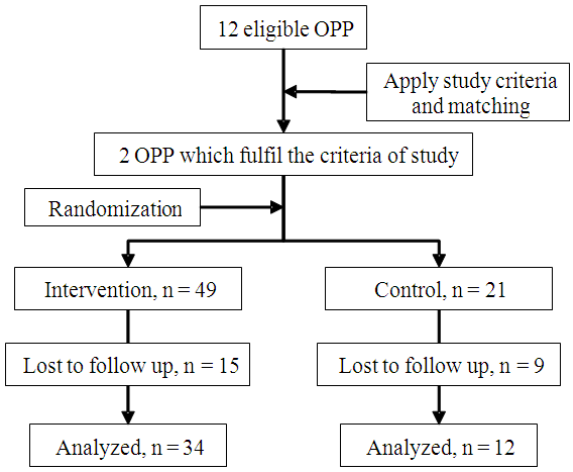

Fig. 1. Flow process of the intervention administration

In addition, positive attitude were stressed in the intervention program where appropriate praising and encouragement were given when participants gave positive remarks, comments or volunteer to questions. In order to ensure smooth flowing of the intervention program, meals, free flow of drinks, tea breaks and munchies were also provided for participants.

At the end of the program, all of the participants were also financially compensated as incentive for their participation in the intervention program spending their rest day as overtime.

2.3. Main Interventional Instruments

Using real-time scenario during harvesting tasks in oil palm plantation, the storyboard of the video focuses on hazards, risks and health effect which harvesters commonly encounter. Ergonomics issues during cutting and lifting FFB as well as testimonial of experienced harvesters were highlighted. The shooting of the video and interviews took place at a different OPP from the IG but with similar characteristics.

Further customized to adapt to the IG, the video was narrated in the native mother tongue language of the harvesters; Sasak Language. Professional videographer services were hired for the entire package of video shooting, overlaying narration and assembling the video in harmonized manner. The length of the video was kept at approximately 15 min to avoid participants feeling bored or lose interest.

For the simple interactive lecture using slideshow, a 10 min session introduces the concepts of ergonomics, health and productivities. Subsequently, the following 10 min describes PAOT which revolves around practical, simple and low-cost improvement. The participants were enticed to response and participate using pre-meditated and suggestive questions making the session more interactive.

Correspondingly, an action checklist consists of nine technical area was created, customized and modified from existing ILO publications which includes but not limited to WIND, Ergonomics Checkpoints in Agriculture and Stress Prevention at Work Checkpoints. Due consideration was also given to the time required for and available for completing the translated (Indonesian Language) 34 item action checklist.

The structure and use of the action checklist were similar to ILO's where each items starts with either an action word or suggestive phrase in the sentence (i.e.: Change, use, reduce, check, ensure, prepare). Each item was followed by a three choice (Yes, No or Priority) question: "Do you propose any action?" and a column for the participants to write down comments, notes or elaborate proposed action (**Fig. 2**).

The nine technical areas of the 34 items action checklist implemented covers the following:

- Transportation route and work design
- Manual handling and physical work environment
- Hand tools
- Personal protective equipment
- Welfare and facilities
- Social and religious support
- Working schedule
- Work organization
- Information, communication and recognition

2.4. Reinforcement Activities

The first activity involves a group discussion. Each groups were required to identify three good practices (and where applicable, low costs) they currently practice or apply in their daily job tasks. Subsequently, the participants were required to present good practices. This activity cross-check the participants comprehension, promote practical application and display their unified thoughts and perception or agreement.

For the second activity, a voting session was organized. During this activity, the participants were exposed to various pictures of different workplace improvement in agricultural settings. These pictures were pictures were selected from good practices observed which has been practiced among the harvesters as well as various other agricultural activities to increase the pool of examples.

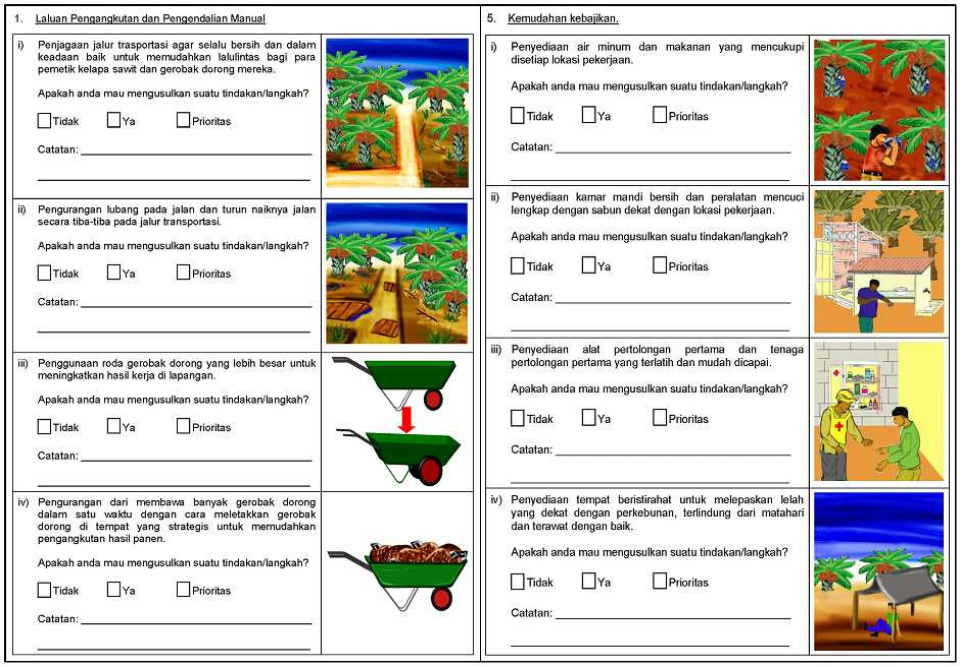

Fig. 2. Example of action checklist localized and adapted for use in oil palm plantation

Without restricting group communication or discussion, each participant were required to cast four votes, (each using label of distinctive color) in the respective four best categories; low cost improvement, productivity improvement, creative or innovative improvement as well as safety and health improvement. Thereafter, several participants were asked to justify their votes and discussed openly.

Similar to the first activity, the third activity require participants to suggest three practices in current job tasks which has room or opportunity for improvement. The participants were expected to express, share and listen to others' creativity and innovative thoughts (if any) towards improving their workplace particularly of their work tasks.

2.5. Control Group

While ergonomics intervention program was conducted for IG, a different aspect of health intervention program was carried out for CG due to ethical consideration. A half-day communicable disease health promotion program on two separate topics; dengue fever and HIV-AIDS was conducted.

Videos of respective topics were screened in the native language of the participants where each were followed by a short discussion focusing primarily on health effects and prevention of both the communicable disease of interest. Similar welfare and financial provision as were provided for IG were also provided for CG.

2.6. Measurement/Evaluation of Outcomes

In order to measure the degree of changes or improvement which has occurred post-intervention, three instruments were used as indicators. The body parts Symptoms Survey (BSS) questionnaire was used to assess musculoskeletal disorders while a Knowledge, Attitude and Practices (KAP) questionnaire was used to detect changes of the respective three dimensions.

Pre-intervention (Pre-Int) assessment using BSS and KAP was carried out prior to implementation of intervention program whereas socio-demographic background and occupational information were based on previously conducted study. The post-intervention (Post-1-Int and Post-2-Int) assessment was carried out at the interval of 2 months respectively after the implementation of intervention program.

During Pre-Int assessment, the information collected using BSS were self-reported prevalence of MSDs (for the past 2 months and 7 days). Subsequently, the Post-1-Int and Post-2-Int assessment determine the prevalence of MSDs (for the past 2 months and 7 days) within the 2 months interval after implementation of intervention and Post-1-Int assessment respectively.

For the assessment of KAP, the questionnaire used were implemented concurrently with BSS. However, the questionnaire used in this study were developed based on consideration of the key messages delivered during intervention as well as capacity of the participants.

The KAP questionnaire in this study measure KAP continuously which was similar to multiple-choice-answer question or binary-choice answers rather than the use of Likert scale as the participants had difficulty understanding the use of psychometric scales.

Following the use of action checklist which comprehensively covers various aspects of ergonomics, there were no clear method to evaluate types of changes post-intervention. As such, qualitative methods were used in this study. Specifically, interviews were conducted with participants while observation in terms of picture were taken as evidence (if present/possible) to show past and present changes.

2.7. Statistical Analysis

All the data entry and analysis was performed using SPSS version 18. Due to small sample size, most of the variables were not normally distributed hence does not permit the use of parametric tests. Mann Whitney U test were used for comparing variables of socio-demographic background, occupational information, MSD and KAP between both IG and CG.

Subsequently, comparison of the categorical outcome of MSD within group were performed using Cochran's Q test. On the other hand, continuous KAP score were analyzed using Friedman test. Both the analyses were followed by post-hoc analysis with Bonferroni correction in order to determine which of the pair among Pre-Int, Post-1-Int or Post-2-Int were significantly different of the other (Pett, 1997; Pallant, 2010).

3. RESULTS

Table 1 shows the socio-demographic background and occupational information of the participants. All the participants were male foreign labor from Indonesia working as harvesters in OPP. The harvesting activity was carried out manually where the FFB were at or below waist height.

There were no statistical significant differences of characteristics between the IG and CG. In addition, based on the feedback from the management of both OPP, there were no health or any intervention program which were introduced prior to, during and after this intervention program.

3.1. Implementation of Intervention Program (Qualitative Observation)

Based on the qualitative observation of the IG, the contents and activities of the intervention program were comprehensible to the participants. Specifically, during a spontaneous question and answer session immediately after the screening of the video, participants actively responded with various correct answers (**Fig. 3a**).

Besides that, participants were also able to identify and explain a wide variety of current good practices which were practiced. Likewise, most participants were also able to arrive at the same conclusion and explanation in the photo voting session's activity (**Fig. 3b**).

At the end of the intervention program, the participants in the IG agreed and proposed 10 items out of the 34 items in the action checklist. However, there were no visually observable workplace improvements at the end of the post-intervention follow-up corresponding to the results of agreed action checklist improvement.

Based on feedback from several interviews conducted with the participants in the IG, it appear that the participants encounter various difficulties, obstacles and hindrances in carrying out the 10 items which were proposed and agreed through thorough facilitated discussion by the participants during the intervention program which will be further detailed in discussion.

Nevertheless, we believe that PAOT were a valuable intervention tool once the limitations and issues detailed in this study were being overcome. During Post-1-Int follow-up at the participants' hostel, we noticed four occasions of improvement from Pre-Int which applies the simple, low cost and practical improvement in improving their safety and livelihood according to the concept which was promoted during the intervention program. These improvement were as summarized in **Fig. 4**.

3.2. Prevalence of Musculoskeletal Disorders

From the results of comparison between IG and CG in **Table 2**, there were significant difference of neck and feet disorders in the past 12 months. In this case, IG reported higher prevalence of neck disorder while CG reported higher prevalence of feet prevalence of feet disorder in the past 2 months.

Similarly, significant difference was also observed for elbow disorder in the past 7 days during Pre-Int with IG reported higher prevalence of elbow disorder than CG. No significant difference of disorders were observed for other body parts during Pre-Int, all body parts in Post-1-Int and Post-2-Int.

When compared within IG, the (past 2 months) revalence of lower back were significantly different at the end of the follow-up period (**Table 3**). Post-hoc analysis using Bonferroni correction McNemar test found significant increase of prevalence for lower back disorders (for the past 2 months) from Pre-Int to Post-2-Int but not the other pairs.

Similarly, the prevalence of disorders for the past 7 days were significantly different for neck, upper back, arms and thigh at the end of the intervention period.

Subsequent post-hoc analysis using Bonferroni correction McNemar test found increase of prevalence of both elbow and thigh disorders (for the past 7 days) from Pre-Int to Post-1-Int and Pre-Int to Post-2-Int respectively within the IG.

Nevertheless, for (past 7 days) prevalence of upper back and arms disorders, Bonferroni corrected post-hoc McNemar analysis did not find any significant difference among Pre-Int, Post-1-Int and Post-2-Int pair. This was due to the continuity correction of the McNemar test for small sample size when the off-diagonal disagreements was less than 25 but not for Cochran's Q test.

For comparison within CG (**Table 4**) there were no significant difference for prevalence of MSDs for both period except for (the past 7 days) prevalence of arms and total MSD at the end of the follow-up. However, similar to the previous finding, there were no significant difference among the Pre-Int, Post-1-Int and Post-2-Int pair due to small sample size which continuity correction was applied for McNemar test.

3.3. Knowledge, Attitude and Practices Score

Between IG and CG, the comparison shows that there were no significant difference observed for the entire follow-up period (**Table 5**).

(a) (b)

Fig. 3. (a) Participants in interactive question and answer session (b) Participants during voting activity using colored label

(a) (b)

Fig. 4. (a) Hilly slop was patched with jute sack filled with sand/soil for vehicle passage (b) Hilly route was carved as stairs in order to prevent slipping or falling

Table 1. Comparison of basic characteristics between IG and CG

	Intervention Group (n = 49)			Control Group (n=21)		
Characteristics	(%)	Mean	± sd	(%)	Mean	± sd
Age		29.33	7.476		28.71	7.498
Education						
	No formal	12.20			14.30	
	Primary	46.90			42.90	
	Secondary	20.40			23.80	
	Tertiary	20.40			19.00	
BMI						
	Underweight	22.40		23.8		
	Normal	75.50		66.7		
	Overweight	2.00		9.5		
Smoking						
	Yes	98.00			100.00	
	No	2.00			0.00	
Year of employment		22.94	10.281		21.95	8.582
Daily working hour		431.63	56.397		435.71	56.619

No significant difference found for all variables during Pre-Int (NTotal = 70)
No significant difference found for all variables at the end of Post-2-Int (NTotal = 46)

Table 2. Comparison of MSDs' prevalence between IG and CG

		Pre		Post-1		Post-2	
	Body parts	U	Z	U	Z	U	Z
2 months MSD	Neck	117.0*	-2.534	192.0	-0.348	190.0	-0.449
	Shoulder	186.0	-0.524	186.0	-0.524	171.0	-0.987
	Upper back	183.0	-0.647	182.0	-0.645	170.0	-0.986
	Lower back	198.0	-0.173	194.0	-0.299	196.0	-0.291
	Arms	151.0	-1.568	202.0	-0.062	150.0	-1.695
	Elbow	137.0	-2.064	160.0	-1.355	159.0	-1.320
	Thigh	172.0	-1.026	171.0	-0.987	171.0	-0.987
	Knee	164.0	-1.156	162.0	-1.273	192.0	0.348
	Feet	77.0*	-3.682	159.0	-1.320	164.0	-1.156
	Total MSD	199.0	-0.292	199.0	-0.292	198.0	-0.594
7 days MSD	Neck	195.0	-0.289	187.0	-0.491	169.0	-1.015
	Shoulder	184.0	-0.289	165.0	-1.154	181.0	-0.664
	Upper back	189.0	-0.471	188.0	-0.473	135.0	-1.993
	Lower back	193.0	-0.319	200.0	-0.121	142.0	-1.834
	Arms	183.0	-0.647	203.0	-0.029	135.0	-1.993
	Elbow	144.0*	-2.100	161.0	-1.456	137.0	-2.064
	Thigh	202.0	-0.076	148.0	-1.675	160.0	-1.355
	Knee	183.0	-0.647	163.0	-1.194	176.0	-0.816
	Feet	166.0	-1.192	158.0	-1.328	136.0	-1.994
	Total MSD	167.0	-1.187	199.0	0.292	191.0	-0.557

*significant at $p<0.05$

Comparison within the IG (**Table 6**) found that there were significant difference of knowledge, attitude and total KAP score at the end of the intervention follow-up period which was not observed for CG.

Post-hoc analysis using Wilcoxon Sign Rank test with Bonferroni correction for within the IG subsequently found that there were significant increase of knowledge score from Pre-Int to Post-1-Int whereas similar significant increase of attitude score was from Post-1-Int to Post-2-Int. The total KAP score observed also had significantly increase from Pre-Int to Post-1 and from Post-1 to Post-2.

Table 3. Comparison of 12 months and 7 days MSD within IG in all ten body parts during Pre, Post-1 and Post-2

		2 months							7 days						
		Pre-Int		Post-1-Int		Post-2-Int		Cochran's Q	Pre-Int		Post-1-Int		Post-2-Int		Cochran's Q
Body parts		n	%	n	%	n	%	(2, n = 34)	n	%	n	%	n	%	(2, n = 34)
Neck	Yes	23	68	19	56	25	74	2.667	10	29	17	50	20	59	6.870*‡
	No	11	32	15	44	9	26		24	71	17	50	14	41	
Shoulder	Yes	20	59	20	59	20	59	0.000	8	24	15	44	16	47	5.700
	No	14	41	14	41	14	41		26	76	19	56	18	53	
Upper back	Yes	22	65	15	44	17	50	1.900	11	32	14	41	20	59	7.000*
	No	12	35	19	56	17	50		23	68	20	59	14	41	
Lower back	Yes	18	53	21	62	27	79	7.412*‡	16	47	22	65	18	53	2.667
	No	16	47	13	38	7	21		18	53	12	35	16	47	
Arms	Yes	23	68	23	68	26	76	1.125	12	35	20	59	20	59	6.737*
	No	11	32	11	32	8	24		22	65	14	41	14	41	
Elbow	Yes	14	41	13	38	16	47	0.875	10	29	10	29	14	41	1.524
	No	20	59	21	62	18	53		24	71	24	71	20	59	
Thigh	Yes	11	32	14	41	14	41	1.000	6	18	15	44	13	38	8.375*Δ
	No	23	68	20	59	20	59		28	82	19	56	21	62	
Knee	Yes	18	53	24	71	19	56	3.647	12	35	21	62	16	47	6.100
	No	16	47	10	29	15	44		22	65	13	38	18	53	
Feet	Yes	24	71	16	47	18	53	5.200	12	35	19	56	17	50	3.000
	No	10	29	18	53	16	47		22	65	15	44	17	50	
Total MSD	Yes	32	94	32	94	33	97	0.667	26	76	32	94	29	85	3.857
	No	2	6	2	6	1	3		8	24	2	6	5	15	

Post-1 follow-up assessment conducted 2 months after Pre; Post-2 follow-up assessment conducted 4 months after Pre
*Significance level using Monte Carlo method (based on 10000 samples of 99% confidence interval) at $p<0.05$
Δ Bonferroni-corrected (one-tailed) post-hoc analysis, McNemar test significant at $p<0.0167$ from Pre to Post-1
‡Bonferroni-corrected (one-tailed) post-hoc analysis, McNemar test significant at $p<0.0167$ from Pre to Post-2

Table 4. Comparison of 2 months and 7 days MSD within CG in all ten body parts during Pre-Int, Post-1-Int and Post-2-Int

		2 months							7 days						
		Pre-Int		Post-1-Int		Post-2-Int		Cochran's Q	Pre-Int		Post-1-Int		Post-2-Int		Cochran's Q
MSD		n	%	n	%	n	%	(2, n= 12)	n	%	n	%	n	%	(2, n = 12)
Neck	Yes	3	25	6	50	8	67	5.429	3	25	5	42	5	42	1.600
	No	9	75	6	50	4	33		9	75	7	58	7	58	
Shoulder	Yes	6	50	6	50	9	75	3.000	4	33	3	25	7	58	3.714
	No	6	50	6	50	3	25		8	67	9	75	5	42	
Upper back	Yes	3	25	4	33	4	33	0.286	3	25	4	33	3	25	0.333
	No	9	75	8	67	8	67		9	75	8	67	9	75	
Lower back	Yes	6	50	8	67	10	83	3.429	5	42	8	67	10	83	4.750
	No	6	50	4	33	2	17		7	58	4	33	2	17	
Arms	Yes	5	42	8	67	6	50	2.800	3	25	7	58	3	25	6.400*
	No	7	58	4	33	6	50		9	75	5	42	9	75	
Elbow	Yes	1	8	2	17	3	25	1.200	0	0	1	8	1	8	1.000
	No	11	92	10	83	9	75		12	100	11	92	11	92	
Thigh	Yes	2	17	3	25	3	25	0.400	2	17	2	17	2	17	0.000
	No	10	83	9	75	9	75		10	83	10	83	10	83	
Knee	Yes	4	33	6	50	6	50	1.333	3	25	5	42	4	33	0.857
	No	8	67	6	50	6	50		9	75	7	58	8	67	
Feet	Yes	1	8	3	25	4	33	2.800	2	17	4	33	2	17	4.000
	No	11	92	9	75	8	67		10	83	8	67	10	83	
Total MSD	Yes	11	92	11	92	12	100	1.000	7	58	11	92	11	92	8.000*
	No	1	8	1	8	0	0		5	42	1	8	1	8	

Post-1 follow-up assessment conducted 2 months after Pre; Post-2 follow-up assessment conducted 4 months after Pre
*Significance level using Monte Carlo method (based on 10000 samples of 99% confidence interval) at $p<0.05$

Table 5. Comparison of KAP score between IG and CG

Test	Pre-Int		Post-1-Int		Post-2-Int	
Variables	U	Z	U	Z	U	Z
Knowledge	160.0	-1.123	193.5	-0.116	174.0	-0.655
Attitude	173.5	-0.647	127.0	-1.838	192.0	-0.302
Practices	193.0	-0.281	173.5	-0.814	195.0	-0.078
Total KAP	184.0	-0.504	183.0	-0.409	145.0	-1.353

Table 6. Within group comparison of KAP score for Pre-Int, Post-1-Int and Post-2-Int

	Median score				Post Hoc Wilcoxon Sign Rank Test	
Score	Pre-Int	Post-1-Int	Post-2-Int	Friedman Test χ^2	Pre-Int – Post-1-Int z	Post-1-Int – Post-1-Int z
Intervention Group				(2, n = 34)		
Knowledge	2.0	3.0	3.0	14.227*	-3.033‡	-0.806
Attitude	9.0	9.0	11.0	11.661*	-0.904	-2.704‡
Practices	9.0	9.0	9.0	3.319		
Total KAP	19.0	21.5	23.0	16.831**	-2.517‡	-2.618‡
Control Group				(2, n = 12)		
Knowledge	2.0	3.0	2.5	1.436		
Attitude	10.0	9.5	9.5	1.459		
Practices	9.0	9.0	9.0	1.471		
Total KAP	19.5	21.5	21.5	2.39		

Significant at: *p<0.01;
**p<0.001
‡p<0.025 (Bonferroni correction)

4. DISCUSSION

4.1. Interpretation of Results and Qualitative Findings

Prior to the intervention, although both IG and CG were homogeneous in terms of socio-demographic background and occupational exposure, there was significant difference of self-reported prevalence of neck, feet (in the past 2 months) and elbow (in the past 7 days) disorders between both groups. However, the differences of the prevalence diminishes in the subsequent Post-1-Int and Post-2-Int assessment.

Contradict to our hypothesis (that the intervention would significantly decreased self-reported prevalence of MSDs in the IG), the results of the analysis shows that there were no significant difference of the self-reported prevalence of MSD between both groups. Neither IG nor CG reported significantly higher prevalence of MSDs in any body parts than each other for both duration of self-reported prevalence.

In further contradiction to our hypothesis, comparison within IG revealed that the self-reported prevalence of lower back (in the past 2 months), neck, upper back, arms and thigh (in the past 7 days) increased significantly at the end of the follow-up period instead of decreasing. Similarly within the CG, there were also significantly higher self-reported prevalence of arms disorder and total MSD in the past 7 days.

Considering the outcome of action checklist implementation, the findings of the self-reported MSD were justified as participants did not agree on proposing changes for the items of the checklist which reduces ergonomics risk factors, specifically of the postural, biomechanical and excessive manual handling exposures. Hence, the ergonomics risk factors remain un-intervened.

Subsequent followed-up interviews with the participants reveal that the items in the checklist was in fact counter-productive to the piece-rate system as the harvesters were being paid correspondingly as was also reported by Yu *et al.* (2012). In our study, harvesters were being paid based on the total weight of daily harvested Fresh Fruit Bunches (FFB) divided equally within the members of the group assigned to a fixed area.

In an example, if transported load of FFBs in wheelbarrow were to be reduced (to reduce forceful exertion during pushing), the frequency of collecting FFBs on the same route to collection point will have to be increase whereas current practices will require them to collect the FFB passing through the route only once by overloading the wheelbarrow.

In addition, interviews with the OPP's management of the IG also found that due to inadequate labor force entry and high turnover, each workers in both IG and CG were currently assigned to cover larger area (Abdullah *et al*., 2011). Indirectly, the arrangement require the harvesters to work at a faster pace in order to conform to harvesting cycle of thrice a month (Ng *et al*., 2013).

In terms of KAP, it appears that the IG did not seems to fare significantly better than CG (there was no significant difference of KAP scores between IG and CG) during both Post-1-Int and Post-2-Int assessment. Nevertheless, when compared within IG, significant improvement of knowledge, attitude and overall total KAP was observed whereas KAP score within CG did not significantly differ over the intervention period.

Based on the results of post hoc test of knowledge score within IG, the significantly improved knowledge (from Pre-Int to Post-1-Int) following the intervention program were sustained (from Post-1-Int to Post-2-Int) whereas the change of attitude only occur after Post-1-Int.

Although we find it puzzling as there were no subsequent intervention or activities which may have contributed to the change in attitude, we postulate that this may be due to learning or maturity effect (Choi and Pak, 2005). Besides that, we found inconsistency of actual observed behavior of the participants in both IG and CG as compared to abnormally high practices score from the KAP questionnaire.

Similar disagreement has been reported in the past where Figa-Talamanca (1972) stress the importance of situational factors accompanying knowledge and attitude change in facilitating behavioral changes while Stanton *et al*. (1987) attribute the finding towards over-reporting of desired practices hence disagree KAP being used as proxy for actual observation.

4.2. Limitations of Study

In contrast to the typical limitation of insufficient follow up period for observing change or difference of MSD in any body parts, the case was different for intervention study in OPP. The unique characteristic in harvesting oil palm was that different body parts were particularly affected during different harvesting stage. For example, the lower back were most affected during early harvesting stage due to the need for stooping.

Over time, slow but imminent changes in terms of exposure to ergonomics risk factors among harvesters. The upper body parts became more affected as the oil palm trees potentially grew above 10 m of vertical height above ground level. As such, it would be potentially biased to follow up both the intervention group prospectively for a longer period in this study without including a comprehensively more robust study design and appropriate sample size.

The sample size of this study was particularly small which may nullify the results of statistical analysis. However, this shortcoming were inevitable as the numbers of harvesters in each OPP of our study were naturally small. The corresponding labor land ratio to the area size recommended was 1 harvester to 10 hectares where currently, the OPP in our study were facing critical shortage.

Furthermore, the dropout rate of this study which was approximately 35% also pose a threat to the validity of this study (Fewtrell *et al*., 2008; Howe *et al*., 2013). Nevertheless, as the dropout of this study were completely random and independent of the variables of interest in this study, the follow-up rate of 50%-80% is considered acceptable (Kristman *et al*., 2004). Respondents lost to follow-up were either transferred to work at a different OPP or returned to their home country.

Besides that, the scheduling and implementation of the intervention program was also not without difficulty consistent with various barrier discussed by Goetzel and Ozminkowski (2008). The management of the OPP appear to be hesitant of our initial intervention planning. In the final discussion, we had to consolidate the intervention of the IG into a single day reducing the numbers of contact hours with the participants.

Furthermore, the intervention program was to be conducted ahead of schedule as requested where by the OPP management. Due to productivity, logistics and security consideration, site visit for participants to identify good practices, area for improvement as well as familiarize and practice the use of action checklist which were part of the PAOT approach component were discouraged.

In the implementation of the intervention program, the management of the OPP had declined to participate as they were occupied with their core duties. However, the assistant manager were present as a representative of the OPP management to observe the course of the intervention program. As such, the full commitment of the management team was not attained.

Prior to the implementation of intervention program, several participants of the IG had also reveal that their relationship with the management of OPP were quite tense. They further elaborated that they were treated with hostility due to various conflicting issues such as coerced to work overtime even on the weekly one-day off besides neglected basic welfare and facilities provision both for work and livelihood.

Helali *et al*. (2009) in their study stress the importance of organizational climate and commitment as critical success factor while using the ergonomics action checklist. The authors further stress on positive psychosocial emotion, attitude and perseverance as they address the challenges spearheading the implementation of the intervention program. The study reported as much as 13 940 man-hours spent by the participants in their study during conducting ergonomics intervention.

Corresponding to the reconfigured intervention program in this study, it was also regretted that appropriate post-intervention assessment immediately after the implementation could not be carried out due to financial and time constraint. We had to compromise with the request of the participants to end the program as soon as possible as they had pending household chores remain uncompleted.

As was discussed by Loo and Richardson (2012) in an article, it appear that ergonomics issues in Malaysia has not been given the attention it deserved. Most managers fail to appreciate the potential benefit not only in terms of workplace safety and health improvement but ultimately the increase of productivity. The authors further elaborated that in the current state, there seems to be misconception of ergonomics which further widen the gap of awareness and practical application.

On the pre- and post-intervention assessment including data gathered qualitatively, there were also several bias applicable to this study. For example, social desirability bias describe the participants being compelled to give acceptable responses or faking good. Besides that, recall bias may also present in this study as participants were required to remember their MSD history (Choi and Pak, 2005).

4.3. Summary of the Findings

Participatory Action Oriented Training (PAOT) approach, was described by Kogi (2006a; 2006b) as combined participatory approach and the use of action checklist as the factor of successful intervention in small-scale workplaces or enterprises such as WIND. He stressed on the importance of simple, low-cost and good local practices as the foundation for facilitated improvement and by networking positive experiences.

In further elaboration, Kogi (2008; 2012a; 2012b) consistently stressed on the use of locally customized and adjusted toolkit (action checklist) to reflect basic ergonomics principles and facilitation of network of trainers as the key factor towards sustainable proactive risk management in various workplace setting.

Nevertheless, comparing the overall results of self-reported prevalence of MSD analyzed at the end of the follow-up post-intervention, it appears that the PAOT approach were ineffective in preventing MSD among harvesters in IG. Although there were improvement of KAP score within IG, it should be interpreted with caution as the increment did not appear to significantly differ from CG.

Furthermore, mixed outcomes of effectiveness has been reported in the study of participatory intervention in the past. When comparing participatory intervention across different industries, Rivilis *et al*. (2008) reported wide spectrum of positive health outcome even though the research method and reporting across study were heterogeneous.

Focusing on intervention conducted for agriculture sector alone, Lehtola *et al*. (2008) in an extensive systematic review reported that injury rates among agricultural workers were not effectively decreased by educational interventions while there were mixed results using legislative restriction in different countries. The authors further caution in interpreting the effectiveness of intervention for reducing injuries through financial incentives.

In any case, it should also be noted that the previously reported effectiveness of PAOT in various countries such as WIND were conducted among smallholders and farm owners or alongside local agricultural workers. However, the participants were foreign workers working in a profit-oriented large multinational companies with multi-level homogeneous management system.

Chapman *et al*. (2004) in an intervention study explains that the perception among vegetables growers were in favor of profitability resulted in disregarded effort of potential future safety benefits by the intervention. Similar trend was observed in this study not only of the profit-oriented large multinational companies but as well as the participants.

Supported by informal conversation with several participants in this study, we found that most, if not all harvesters, were breadwinner back in their home country (Indonesia) where job is scarce and the pay rate was insufficient as compared to the significantly higher pay rate as well as currency exchange rate in Malaysia. Hence, the participants who came far away from their home country with a primary objective; to earn as much money and as fast as they could.

5. CONCLUSION

Taking into consideration of various limitations as discussed, the results of this study indicate that PAOT were ineffective being applied on the OPP setting in our study, despite being consistently reported successful in

mitigating risks and improving workplace environment particularly among smallholders and farm owners.

Due to the limitations in this study, it is inappropriate to generalize the findings unless further in-depth study on similar organizational climate and limitations were conducted among profit-oriented large multinational companies with multilevel administrative management offices as were in this study.

Nevertheless, instead of replicating exact study, the resources should be better used to overcome the limitations, psychosocial and organizational stress reported in this study. As such, there challenges may require a holistically integrated approach intervention program in the future.

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7. REFERENCES

Abdullah, R., Ismail, A. and A.K. Rahman, 2011. Labour requirements in the Malaysian oil palm industry in 2010. Oil Palm Indus. Econ. J., 11: 1-12.

Adnan, H., 2012. Labor shortage to get worse with Indonesian oil palm boom. The Star Online 2012 May 29. Kuala Lumpur (Malaysia): Star Publications Bhd.

Basiron, Y., 2002. Palm oil and its global supply and demand prospects. Oil Palm Indus. Econ. J., 2: 1-10.

Chapman, L. and J. Meyers, 2004. Ergonomics and musculoskeletal injuries in agriculture: Recognizing and preventing the industry's most widespread health and safety problem. National Agricultural Safety Database.

Chapman, L.J., A.C. Newenhouse, R.H. Meyer and A.D. Taveira *et al*., 2004. Evaluation of an intervention to reduce musculoskeletal hazards among fresh market vegetable growers. Applied Ergon., 35: 57-66. DOI: 10.1016/j.apergo.2003.05.001

Choi, B.C.K. and A.W.P. Pak, 2005. A catalog of biases in questionnaires. Prev. Chronic Dis., 2: A13.

ETP, 2013. Deepening malaysia's palm oil advantage. ETP.

Fairhurst, T.H. and E. Mutert, 1999. Introduction to palm oil production. Better Crops Int., 13: 3-6.

Fathallah, F.A., J.M. Meyers and I. Janowitz, 2004. Stooped and squatting postures in the workplace. Proceedings of the Symposium for Stooped and Squatting Posture in the Workplace, Jul. 29-30, Oakland, California, USA.

Fewtrell, M.S., K. Kennedy, A. Singhal, R.M. Martin and A. Ness *et al*., 2008. How much loss to follow-up is acceptable in long-term randomised trials and prospective studies? Arch. Dis. Child., 93: 458-461. DOI: 10.1136/adc.2007.127316

Figa-Talamanca, I., 1972. Inconsistencies of attitudes and behavior in family-planning studies. J. Marriage Family, 34: 336-344.

Goetzel, R.Z. and R.J. Ozminkowski, 2008. The health and cost benefits of work site health-promotion programs. Annu. Rev. Public Health, 29: 303-323. DOI: 10.1146/annurev.publhealth.29.020907.090930

Helali, F., 2009. Using ergonomics checkpoints to support a participatory ergonomics intervention in an Industrially Developing Country (IDC)--a case study. Int. J. Occupat. Safety Ergon., 15: 325-337. PMID: 19744374

Howe, L.D., K. Tilling, B. Galobardes and D. A. Lawlor, 2013. Loss to follow-up in cohort studies: Bias in estimates of socioeconomic inequalities. Epidemiology, 24: 1-9. DOI: 10.1097/EDE.0b013e31827623b1

ILO, 2010. Ergonomic Checkpoints: Practical and Easy-To-Implement Solutions for Improving Safety, Health and Working Conditions. 2nd Edn., International Labour Office, Geneva, ISBN: 978-9221226666.

ILO, 2012. Ergonomic checkpoints in agriculture: Practical and easy-to-implement solutions for improving safety, health and working conditions in agriculture. International Labour Organization.

Kawakami, T., T.T. Khai, and K. Kogi, 2009. Developing the WIND Training Programme in Asia: Participatory Approaches to Improving Safety, Health and Working Conditions of Farmers. 1st Edn., ILO, Bangkok, ISBN-10: 9221230236, pp: 117.

Khai, T.T., T. Kawakami and K. Kogi, 2011. Participatory action-oriented training. International Labour Organization.

Kirkhorn, S.R., G. Earle-Richardson and R.J. Banks, 2010. Ergonomic risks and musculoskeletal disorders in production agriculture: Recommendations for effective research to practice. J. Agromed., 15: 281-299. DOI: 10.1080/1059924X.2010.488618

Kogi, K., 2006a. Advances in participatory occupational health aimed at good practices in small enterprises and the informal sector. Indus. Health, 44: 31-34. DOI: 10.2486/indhealth.44.31

Kogi, K., 2006b. Participatory methods effective for ergonomic workplace improvement. Applied Ergonom., 37: 547-554. DOI: 10.1016/j.apergo.2006.04.013

Kogi, K., 2008. Facilitating participatory steps for planning and implementing low-cost improvements in small workplaces. Applied Ergonom., 39: 475-481. DOI: 10.1016/j.apergo.2008.02.017

Kogi, K., 2012a. Roles of participatory action-oriented programs in promoting safety and health at work. Safety Health Work, 3: 155-165. DOI: 10.5491/SHAW.2012.3.3.155

Kogi, K., 2012b. Practical ways to facilitate ergonomics improvements in occupational health practice. J. Human Factors Ergonom. Socity, 54: 890-900. DOI: 10.1177/0018720812456204

Kristman, V., M. Manno and P. Cote, 2004. Loss to follow-up in cohort studies: How much is too much? Eur. J. Epidemiol., 19: 751-760. DOI: 10.1023/B:EJEP.0000036568.02655.f8

Lehtola, M.M., R.H. Rautiainen, L.M. Day, E. Schonstein and J. Suutarinen *et al*., 2008. Effectiveness of interventions in preventing injuries in agriculture-a systematic review and meta-analysis. Scandinavian J. Work Environ. Health, 34: 327-336.

Loo, H.S. and S. Richardson, 2012. Ergonomics issues in Malaysia. J. Soc. Sci., 8: 61-65. DOI: 10.3844/jssp.2012.61.65

Ng, Y.G., B.M.T. Shamsul, S.M.Y. Irwan, I. Mori and Z. Hashim, 2013. Ergonomics observation: Harvesting tasks at oil palm plantation. J. Occup. Health, 55: 405-414. DOI: 10.1539/joh.13-0017-FS

Niu, S., 2010. Ergonomics and occupational safety and health: An ILO perspective. Applied Ergonom., 41: 744-753. DOI: 10.1016/j.apergo.2010.03.004

NWCPHP, 2012. Effective adult learning: A toolkit for teaching adults. Northwest Center for Public Health Practice.

Pallant, J., 2010. SPSS Survival Manual: A Step by Step Guide to Data Analysis Using SPSS. 1st Edn., McGraw-Hill International, Maidenhead, ISBN-10: 0335242391, pp: 352.

Pett, M.A., 1997. Nonparametric Statistics for Health Care Research: Statistics for Small Samples and Unusual Distributions. 1st Edn., Sage Publication, London, ISBN-10: 0803970382, pp: 307.

RHEF, 2008. Rural health education foundation resource: A guide to facilitating adult learning. Australian Government Department of Health and Ageing.

Rivilis, I., D. Van Eerd, K. Cullen, D.C. Cole, E. Irvin and J. Tyson *et al*., 2008. Effectiveness of participatory ergonomic interventions on health outcomes: A systematic review. Applied Ergonom., 39: 342-358. DOI:10.1016/j.apergo.2007.08.006

Stanton, B.F., J.D. Clemens, K.M.A. Aziz and M. Rahman, 1987. Twenty-four-hour recall, knowledge-attitude-practice questionnaires and direct observations of sanitary practices: A comparative study. Bull. World Health Organ., 65: 217-217.

University of Calgary, 2004. Principles of Effective CME. Background Information for Facilitators of Small Group Learning. Office of Continuing Medical Education and Professional Development, Canada.

Yu, W., T.S. Ignatius, X. Wang, Z. Li, S. Wan and H. Qiu *et al*., 2012. Effectiveness of participatory training for prevention of musculoskeletal disorders: A randomized controlled trial. Int. Arch. Occup. Environ. Health, 86: 431-440. DOI: 10.1007/s00420-012-0775-3