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Original Article

The effectiveness of training on occupational safety and health behavior among rubber tappers in Indonesia

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ABSTRACT

Introduction: Rubber tappers are faced with various health risks during their work, which can be prevented by implementing occupational health and safety (OSH) behavior adequately. So far, the previous interventions in increasing OSH behavior still use a one-stage approach. Meanwhile, behavior change is not instantaneous but goes through stages. So, this research aims to improve occupational health and safety behavior through the use of PPE based on the multi-stage model.

Methods: This quasi-experimental research was conducted between June and August 2023 and involved 32 rubber tappers divided into intervention groups (n=16), which received educational and training interventions, and control groups (n=16), who only received educational intervention. Each group was assessed for scores on knowledge, skills, intention, self-efficacy, and behavior regarding PPE as OSH behavior in every stage of the multi-stage model, with 3 times data collections on each stage. The data was then analyzed using repeated measure ANOVA to determine the significance of differences in all scores between data collection and between groups, with a p-value of 0.05.

Results: There were no significant differences between the intervention and control groups across all variables at pre-test ($p > 0.05$), suggesting that the groups were comparable prior to the intervention. Following the intervention, the differences emerged—particularly in knowledge during the immediate post-test (mean difference = 1.813; $p = 0.025$; effect size 0.156). At the post-test, the intervention group had a moderately significant improvement over the control group in skill (mean difference = 3.000; $p = 0.006$, effect size = 0.226), knowledge (mean difference = 2.125; $p = 0.001$; effect size = 0.296), and behavior (mean difference = 2.375; $p = 0.017$, effect size = 0.174).

Conclusion: Providing education and training has a moderately significant influence on improving skills, knowledge, and behavior about PPE. Provision of education and training needs to be encouraged periodically to improve OSH behavior among tapper rubber.

Keywords: Behavior, Occupational Safety and Health, Personal protective equipment, Rubber tapper farmer

Introduction

The agricultural sector in Indonesia employs more than 27 million farming households, with more than 10 million working in the plantation sub-sector, including rubber tappers.[1] This sector has a higher risk of work accidents than others,[2] and is one of the three most perilous occupations in terms of work-related injuries and illnesses.[3] Tappers face health challenges, including

repetitive non-ergonomically positioned tasks, which lead to musculoskeletal disorders.[4] animals, sharp tools, farm equipment, pesticides, and biological agents.[5] Based on various risk factors, it is necessary to find solutions, both prevention and treatment, to prevent this condition.

Providing vital equipment, such as personal protective equipment (PPE), is considered a key means of preventing occupational health injuries. PPE was defined as a tool that can protect a person by isolating part or all of the body from potential hazards in the workplace.[6] This prevents and reduces the exposure of rubber tappers to heat, pesticides, farm equipment, and biological agents. Unfortunately, the use of PPE is still an issue among rubber tappers. Furthermore, data on PPE compliance among rubber tappers is still rare. Regarding compliance with the use of PPE, all rubber tappers in Karang Agung, Indonesia, do not use PPE properly.[7] More than half of the participants had a moderate compliance level with PPE in Southern Thailand.[8] Rubber farmers in Northern Thailand, less than a fifth of them use gloves and masks.[9] The causes of low compliance with the use of PPE need to be explored so that targeted interventions can be implemented based on identified needs.

Various factors influence the compliance of rubber tappers in using PPE. Desires and habits influence the use of PPE,[10] To increase compliance, you must become accustomed to it and build a sense of interest.[7] Those who do not comply with using PPE are often individuals who lack knowledge, have never received training, and are not under supervision.[11] Apart from that, tappers feel that using PPE is not easy.[12] The fear or difficulty experienced then interacts with cognitive factors, ultimately creating changes in self-efficacy.[13] Based on these phenomena, a lack of knowledge and training can lead to low self-efficacy, which can then decrease and ultimately reduce behavior.[14] After identifying the contributing factors, it is essential to seek appropriate interventions.

Previous research related to the use of PPE has primarily focused on identifying contributing factors.[7,10,11,14] Other research related to intervention only focuses on education to increase knowledge and behavior.[15] To date, no research has been conducted regarding interventions that can increase knowledge, attitude, intention, and self-efficacy sequentially and gradually, particularly among rubber tappers. The Multi-stage Model of Health Behavior Change (MSM) explains that changing behavior progresses through stages, which consist of eight stages, and each stage must be assessed.[16] This means that to progress to the next stage, you must first complete the previous stage. This model is defined as a pattern that can increase motivation and change behavior.[17] Except for the concept of long-term behavior, the time specifications were removed from the MSM, and cognitive and behavioral factors were used to identify the stages.[16] Behavior as an outcome and its implications should be an essential variable for future research.[18] This is supported by research on MSM, which is growing in the academic sector,[19] and community initiatives with outcomes that align with readiness for behavior change.[18]

This research, using MSM, is promising for rubber tappers to increase compliance with the use of PPE across all available stages. Although related research on rubber tappers has not been conducted, the data from this study could be novel. So, this research aims to determine the effect of education and training on knowledge, interest, self-efficacy, and attitudes towards using PPE among rubber tappers based on MSM.

Methods

A quasi-experimental study with a control group was conducted between June and August 2023, comprising three stages: the pre-test (Stage 1), the immediate post-test (Stage 2), and the post-intervention (Stage 3). The population of this study consisted of rubber farmers at a public plantation in Jember, Indonesia.

Two groups (n = 32) of rubber tappers from private rubber plantations were selected and

divided into an intervention group (n = 16) and a control group (n = 16). The number of samples was calculated using G*Power 3.1, with statistical tests including ANOVA repeated measures and an effect size of 0.3. The inclusion criteria were male or female rubber farmers who completed the written consent to participate in this research. Then, the exclusion criteria include migration to another farm, absence from one or more sessions of intervention.

The independent variable was training on OSH for rubber farmers. The variables examined were application, knowledge, self-efficacy, intention, and behavior regarding PPE. Each of these variables is explained as follows:

Education about OSH was a program delivered by the educator (researchers) and explained the definitions, purposes of using PPE, causes and prevention of work accidents, types of PPE (helmet, flashlight, glasses, mask, long shirt, long trousers, rubber gloves, and boat shoes), and the order of use. Education was provided through direct explanations by researchers, followed by the provision of leaflets as a learning medium for use at home. This learning material was developed based on the standard operating procedure of the rubber plantation factory and previous supported literature.[20] Also, Researchers use simple language to make it easier for farmers to understand and avoid medical jargon. This intervention is given to all groups.

Training on PPE was a program conducted by the researchers, demonstrating how to use and remove PPE sequentially. First, wear long sleeves, trousers, and boat shoes. Second, wash your hands with soap in the correct order. Third, wear a helmet. Fourth, wear a mask that covers your nose and mouth. Fifth, wear gloves. Sixth, wear goggles. The stages of taking off PPE include: first, taking off the shirt, trousers, and shoes. Second, take off glasses. Third, remove the mask. Fourth, remove the helmet. Fifth, remove the gloves. This training was provided through a direct explanation and a leaflet, which was given only to the intervention group.

Knowledge refers to the ability to recall previously learned material. In this context, the learning material is about OSH.

Skill refers to applying knowledge in a real situation. These variables measure the accuracy of PPE wearing from use to removal.

Self-efficacy in this study measures rubber tappers' belief in their capacity to wear PPE to protect them during work.

Intention is a variable that measures intention in PPE application during work.

All the variables (knowledge, skill, self-efficacy, and intention) were measured through a self-administered questionnaire. In contrast, behavior toward PPE was measured through direct observation. Observations were conducted using the one-blinding observation method, where respondents were unaware that they were being observed. The blinding was maintained by ensuring that observers were independent of the research team and were not informed about the respondents' group allocation. Observers were given an instruction and observation protocol, allowing them to follow a standardized procedure and limit subjective interpretation.

The rubber tappers were divided into two groups (intervention and control group). This group division is based on the work location during rubber tapping. Workers in sectors A and B form the control group, while those in sectors C and D form the intervention group. This study consisted of four stages. Each stage of the MSM model is represented in Table 1.

This research reveals the PPE-using behavior based on the MSM model, spanning the precontemplation, contemplation, preparation, action, and maintenance stages. The detailed activity of each stage was elaborated in Table 2.

Table 1: Theoretical framework of MSM

Stage		Activity
Inactive	Precontemplation	The individual has not yet realized that his behavior is problematic and has no intention of changing.
	Contemplation	Individuals begin to recognize the risks and consider the possibility of change, but no decision has been made.
	Disposition	Individuals begin to show an open and positive attitude towards change, building a strong intention to act.
	Pre-action	Individuals develop concrete plans and prepare themselves to begin making changes.
Active	Implementation	Individuals initiate concrete actions to change unhealthy behaviors.
	Habituation	New behaviors are done routinely and start to become habits.
	Fluctuation	Individuals experience ups and downs in motivation or temptation to return to old behaviors.
Inactive	Resumption	After experiencing a setback, individuals return to the path of change and resume healthy behaviors.

Table 2: Stage and activity of intervention based on the MSM model

Stage		Description	Activity nursing intervention	
			Intervention Group	**Control group**
Non-intentional (inactive)	1. Precontemplation (Day 0; 30 minutes discussion)	Goal: Information about respondents who do not carry out the expected OSH behavior regularly or think of initiating the behavior.	• Gathering respondents to build a relationship of mutual trust • Introducing team • Discuss the need for implementing OSH • Motivate to implement OSH and set goals • Explain research plan	• Gathering respondents to build a relationship of mutual trust • Introducing team • Discuss the need for implementing OSH • Motivate to implement OSH and set goals • Explain research plan
	2. Contemplation (Day 1-14; 45 minutes education)	Goal: Respondents are guided to have an intentional mindset. Respondent accepts new information about OSH with an open mind, and considers the pros and cons. **Both groups received education related to OSH. The difference is the intervention group received education and training about OSH, while the control group only received education.*	• Giving a pre-test about knowledge regarding OSH (Day 1) • Giving education about OSH • Giving a leaflet to take home • Giving an immediate post-test about knowledge regarding OSH (Day 7) • Giving a post-test about knowledge regarding OSH (Day 14)	• Giving a pre-test about knowledge regarding OSH (Day 1) • Giving education about OSH • Giving a leaflet to take home • Giving motivation for applying OSH during work • Giving an immediate post-test about knowledge regarding OSH (Day 7) • Giving a post-test about knowledge regarding OSH (Day 14)
Intentional (inactive)	3. Disposition (Day 15-28; 45 minutes training)	Goal: The respondent has an explicit decision to change behavior. A set goal accompanies the disposition stage. Carried out after respondents have knowledge related to OSH.	• Giving a pre-test about skills regarding OSH (Day 15) • Giving training about OSH • Giving a leaflet to take home • Giving motivation for applying OSH during work	• Giving a pre-test about skills regarding OSH (Day 15) • Giving motivation for applying OSH during work • Giving an immediate post-test about skills regarding OSH (Day 21)

	Stage	Description	Activity nursing intervention	
			Intervention Group	Control group
			• Giving an immediate post-test about the skill regarding OSH (Day 21) • Giving a post-test about skills regarding OSH (Day 28)	• Giving a post-test about skills regarding OSH (Day 28)
	4. Pre-action (Day 29-42; 45 minutes discussion)	Goal: the respondent decides the modality of increasing skill carried out after respondents have skills related to OSH. Carried out after respondents have skill related to OSH.	• Giving a pre-test about intention and self-efficacy regarding OSH (Day 29) • Giving motivation about OSH through group discussion • Giving an immediate post-test about intention and self-efficacy regarding OSH (Day 35) • Giving a post-test about intention and self-efficacy regarding OSH (Day 42)	• Giving a pre-test about intention and self-efficacy regarding OSH (Day 29) • Giving motivation about OSH through group discussion • Giving an immediate post-test about intention and self-efficacy regarding OSH (Day 35) • Giving a post-test about intention and self-efficacy regarding OSH (Day 42)
Actional	5. Implementation (Day 43-56)	Goal: Respondent acts based on intentions, goals, and action plans and manages distractions when carrying out OSH behavior. carried out after respondents have the skill related to OSH carried out after respondents have intention and self-efficacy regarding OSH.	• Observation pre-test about behavior regarding OSH (Day 43) • Giving motivation about behavior regarding OSH through group discussion • Giving an immediate post-test about behavior regarding OSH (Day 49) • Giving a post-test about behavior regarding OSH (Day 56)	• Observation pre-test about behavior regarding OSH (Day 43) • Giving motivation about behavior regarding OSH through group discussion • Giving an immediate post-test about behavior regarding OSH (Day 49) • Giving a post-test about behavior regarding OSH (Day 56)

This study employs several instruments to measure research results related to socio-demographic status, knowledge, skills, intention, self-efficacy, and behavior regarding PPE. All the instruments were closed-ended questions. Demographic data such as age, gender, marital status, education level, working period as a farmer, working period as a rubber tapper, daily working period, monthly wage, information about OSH, information about PPE, and health insurance ownership were presented in percentages. General Linear Model-Repeated Measure (GLM-RM) ANOVA within-subject to determine the difference in OSH (knowledge, skill, intention, self-efficacy, and behavior) between pre- and post-test in each group. GLM-RM ANOVA between subject effects to determine the impact of intervention on OSH between the two groups. The p-value used in this study was 0.05. The results of the normality (Kolmogorov-Smirnov test, $p > 0.05$), homogeneity (covariance matrix p-value> 0.05), and sphericity tests (p-value = 0.05) have been met. This study obtained ethical clearance, approved by the Faculty of Dentistry, Universitas Jember, Ethical Committee Review Board for Research, Number 2040/UN25.8/KEPK/DL/2023.

Results

32 rubber tappers participated in this study. All participants were involved from the beginning of the study through the 2nd and 3rd stages of the research process. Finally, the response rate from the participants was 100%.

Table 3 revealed the social demographic profile, which was divided based on group intervention. From the total of 32 tappers, the distribution of age is almost the same. Farmers aged 41-50 years old were a little domineering (n=10; 31.26%). More than half of the tappers were male (n=22; 68.75%), married (n=21; 65.63%), and working as tappers for more than 10 years (n=20; 62.50%). The distribution of working period among rubber tappers was the same between the two groups, whether 1-5 years, 5-10 years, or more than 10 years. Half of the tappers ever got information about OHS (n=17; 53.12%), PPE (n=18; 56.25%), and have health insurance (n=16; 50.00%). Whereas all the tappers have a monthly wage under IDR 2.555.622.

Table 4 shows the means and standard deviations (SD) for skill, knowledge, self-efficacy, intention, and behavior between the intervention and control groups. There was a consistent increase in the intervention group for almost all variables measured, both in the immediate post-test and the post-test. The most prominent increase was seen in skills, self-efficacy, intention, and behavior, which showed a positive effect of the intervention given. However, there was a slight decrease in the average score in knowledge, especially from the immediate post-test (12.38) to the post-test (12.31). Meanwhile, the control group also experienced an increase, but it tended to be smaller and inconsistent, especially in the intention variable, whose average score was relatively stable throughout the pre-test (31.25), immediate post-test (31.69), and post-test (32.13).

Changes in the average scores of skills, knowledge, intention, self-efficacy, and behavior in respondents in the intervention and control groups are presented in Figures 1-5 sequentially. The figures showed that all variables in the intervention group have increased scores over time. On the other hand, in the control group, an inconsistent score trend was found where all variables except intention increased during the immediate post-test but decreased during the post-test.

Table 3: Socio-demographic profile

Socio-demographic Characteristic	Intervention Group (n= 16)	Control Group (n= 16)	Total (n= 32)
	f (%)	f (%)	f (%)
Age (years)			
21 – 30	4 (25.0)	3 (18.75)	7 (21.87)
31 – 40	4 (25.0)	3 (18.75)	7 (21.87)
41 – 50	5 (31.25)	5 (31.25)	10 (31.26)
> 50	3 (18.75)	5 (31.25)	8 (25.00)
Gender			
Male	10 (62.50)	12 (75.00)	22 (68.75)
Female	6 (37.50)	4 (25.00)	10 (31.25)
Marital Status			
Married	10 (62.50)	11 (68.75)	21 (65.63)
Unmarried	2 (12.50)	4 (25.00)	6 (18.75)
Divorce	4 (25.00)	1 (6.25)	5 (15.62)
Education Level			
Not finished elementary school	5 (31.25)	4 (25.00)	9 (28.11)
Elementary school	7 (43.75)	6 (37.50)	13 (40.63)
Junior high school	2 (12.50)	3 (18.75)	5 (15.63)
Senior high school	2 (12.50)	3 (18.75)	5 (15.63)

Socio-demographic Characteristic	Intervention Group (n= 16)	Control Group (n= 16)	Total (n= 32)
	f (%)	f (%)	f (%)
Working period as farmer (years)	1 (6.25)	4 (25.00)	5 (15.62)
1 – 5	5 (31.25)	2 (12.50)	7 (2.88)
5 – 10	10 (62.50)	10 (62.50)	20 (62.50)
> 10			
Working period as rubber tapper (years)			
1 – 5	6 (37.50)	6 (37.50)	12 (37.50)
5 – 10	3 (18.75)	3 (18.75)	6 (18.75)
> 10	7 (43.75)	7 (43.75)	14 (43.75)
Daily working period (hours)			
> 4	4 (25.00)	3 (18.75)	7 (21.88)
4 – 6	4 (25.00)	3 (18.75)	7 (21.88)
6 – 8	4 (25.00)	7 (43.75)	11 (34.36)
> 8	4 (25.00)	3 (18.75)	7 (21.88)
Monthly wage (IDR)			
< Rp 2.555.622	16 (100)	16 (100)	32 (100)
> Rp 2.555.622	0 (0)	0 (0)	0 (0)
Have you ever given information about OHS?			
Yes	8 (50.00)	9 (56.25)	17 (53.12)
No	8 (50.00)	7 (43.75)	15 (46.88)
Have you ever given information about PPE?			
Yes	8 (50.00)	6 (37.50)	14 (43.75)
No	8 (50.00)	10 (62.50)	18 (56.25)
Do you have health insurance?			
Yes	7 (43.75)	9 (56.25)	16 (50.00)
No	9 (56.25)	7 (43.75)	16 (50.00)

IDR: Indonesia Rupiah; OSH: Occupational Health and Safety; PPE: Personal Protective Equipment.

Table 4: Mean and SD of skill, knowledge, intention, self-efficacy, and behavior in OSH between the intervention and control groups

Group	Variable	Time					
		Pre-test		Immediate post-test		Post-test	
		Mean	SD	Mean	SD	Mean	SD
Intervention	Skill	18.44	1.263	23.94	4.041	24.19	3.391
	Knowledge	9.75	1.693	12.38	2.029	12.31	1.302
	Self-efficacy	37.81	8.018	40.63	7.438	41.44	80.91
	Intention	30.69	4.062	34.31	3.535	34.44	3.669
	Behavior	15.50	2.422	17.00	2.608	17.50	2.556
Control	Skill	18.87	1.310	21.56	2.337	21.19	2.228
	Knowledge	9.13	1.996	10.56	2.308	10.19	2.007
	Self-efficacy	36.00	6.995	38.75	6.668	38.13	6.469
	Intention	31.25	4.509	31.69	4.672	32.13	4.773
	Behavior	14.31	3.219	16.25	3.568	15.13	2.778

SD: Standard deviation

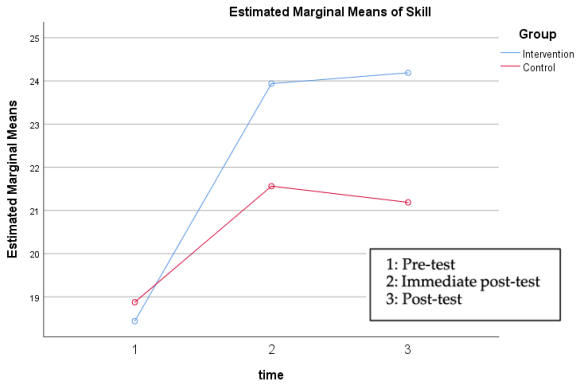

Figure 1: Progression of the mean skill between groups over time

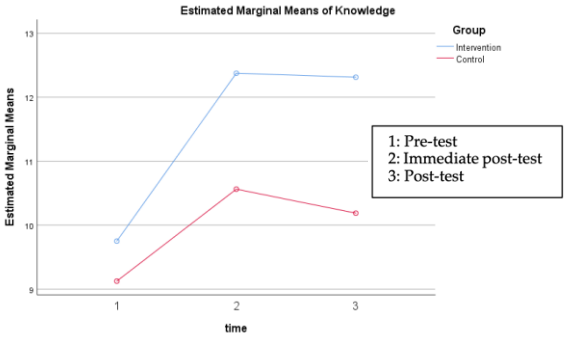

Figure 2: Progression of the mean knowledge between groups over time

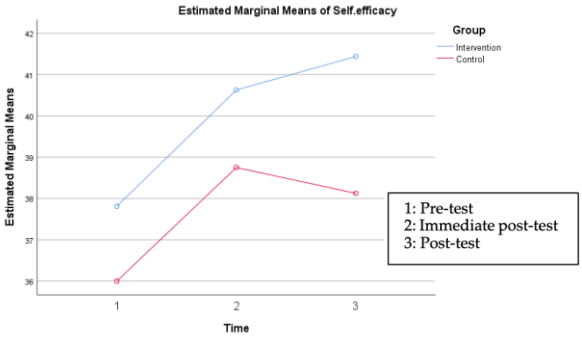

Figure 3. Progression of the mean self-efficacy between groups over time

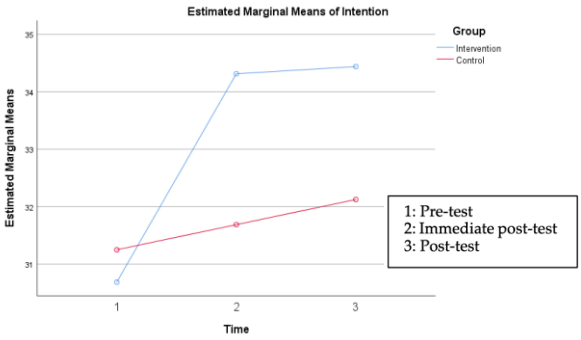

Figure 4: Progression of the mean intention between groups over time

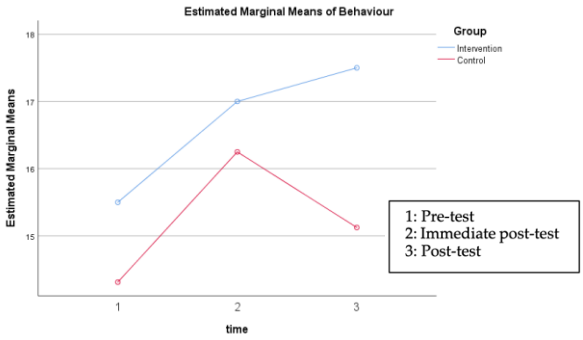

Figure 5: Progression of the mean behavior between groups over time

Furthermore, to confirm the interaction effect of "time" and "group", a repeated measures univariate ANOVA test was conducted, as shown in Table 5. The results of the repeated measures ANOVA analysis revealed a significant change in scores over time for all variables ($p < 0.001$). In addition, a significant interaction was found between time and group on most variables ($p < 0.001$), indicating that the intervention had a different impact compared to the control group, except for self-efficacy ($p > 0.05$). The largest effects were seen in skill (partial eta squared = 0.253 or small effect size) and intention (partial eta squared = 0.293 or small effect size, indicating a substantial influence of the intervention program.

Table 6 presents the results of the pairwise comparison test, which revealed that all variables (skill, knowledge, intention, self-efficacy, and behavior) experienced a significant increase from the pre-test to the immediate post-test ($p < 0.05$). However, no significant difference was found between the immediate post-test and post-test ($p > 0.05$), indicating that the increase could be maintained until the post-test.

Table 5: Repeated Measure univariate ANOVA results

Source	Measure		df	Mean Square	F	p value	Partial Eta Squared
Time	Skill	Greenhouse-Geisser	1.491	236.172	66.775	0.000	0.690
	Knowledge	Sphericity Assumed	2	39.781	65.543	0.000	0.686
	Self-efficacy	Sphericity Assumed	2	85.385	33.186	0.000	0.525
	Intention	Greenhouse-Geisser	1.442	70.641	25.607	0.000	0.461
	Behavior	Sphericity Assumed	2	26.823	33.734	0.000	0.529
Time * group	Skill	Greenhouse-Geisser	1.491	35.978	10.173	0.001	0.253
	Knowledge	Sphericity Assumed	2	5.010	8.255	0.001	0.216
	Self-efficacy	Sphericity Assumed	2	5.760	2.239	0.115	0.069
	Intention	Greenhouse-Geisser	1.442	34.244	12.414	0.000	0.293
	Behavior	Sphericity Assumed	2	5.656	7.114	0.002	0.192

df: degree of freedom.

Table 6: Pairwise comparison

Measure	Time		Mean Difference	Std. Error	p-value[b]	95% Confidence Interval for Difference	
						Lower Bound	Upper Bound
Skill	1	2	-4.094*	0.491	0.000	-5.339	-2.849
		3	-4.031*	0.421	0.000	-5.100	-2.963
	2	3	0.063	0.275	1.000	-.636	0.761
Knowledge	1	2	-2.031*	0.223	0.000	-2.596	-1.466
		3	-1.813*	0.196	0.000	-2.309	-1.316
	2	3	0.219	0.160	0.548	-.188	0.625
Self-efficacy	1	2	-2.781*	0.402	0.000	-3.802	-1.761
		3	-2.875*	0.408	0.000	-3.909	-1.841
	2	3	-.094	0.393	1.000	-1.090	0.903
Intention	1	2	-2.031*	0.447	0.000	-3.164	-0.898
		3	-2.313*	0.268	0.000	-2.991	-1.634
	2	3	-0.281	0.319	1.000	-1.090	0.528
Behavior	1	2	-1.719*	0.244	0.000	-2.336	-1.101
		3	-1.406*	0.195	0.000	-1.900	-.912
	2	3	0.313	0.228	0.540	-.265	0.890

*The mean difference is significant at the 0.05 level; [b]: Adjustment for multiple comparisons: Bonferroni.

Table 7: Multiple comparisons of groups over time

Time	Group comparison*	Mean difference	p-value	95% Confidence Interval		Partial Eta Squared
				Lower	Upper	
Pre-test	Skill	-0.438	0.344	-1.367	0.492	0.030
	Knowledge	0.654	0.347	-0.711	1.961	0.030
	Intention	1.813	0.051	-3.620	7.245	0.015
	Self-efficacy	-0.563	0.713	-3.661	2.536	0.005
	Behavior	1.188	0.248	-0.869	3.244	0.044
Immediate post-test	Skill	2.375	0.051	-0.008	4.758	0.121
	Knowledge	1.813	0.025	0.243	3.382	0.156
	Intention	1.875	0.459	-3.225	6.975	0.018
	Self-efficacy	2.625	0.083	-0.366	5.616	0.097
	Behavior	0.750	0.502	-1.507	3.007	0.015
Post-test	Skill	3.000	0.006	0.929	5.071	0.226
	Knowledge	2.125	0.001	0.903	3.347	0.296
	Intention	3.313	0.211	-1.977	8.602	0.052
	Self-efficacy	2.313	0.135	-0.761	5.386	0.073
	Behavior	2.375	0.017	0.448	4.320	0.174

*Variable

When viewed from the time of data collection, at the pre-test, there was no significant difference between the intervention and control groups in all variables ($p > 0.05$). This indicates a comparable baseline. After the intervention, differences began to appear, especially in knowledge during the immediate post-test ($p = 0.025$; effect size = 0.156). At the post-test, the intervention group showed a slightly significant increase compared to the control in skills ($p = 0.006$, effect size = 0.226), knowledge ($p = 0.001$, effect size = 0.296), and behavior ($p = 0.017$, effect size = 0.174). This indicates that the intervention has a significant effect on all three aspects. This result was revealed in Table 7.

Discussion

This study aimed to enhance PPE usage in component knowledge, skill, intention, self-efficacy, and behavior regarding OSH through the MSM Model. Especially in the intervention group, following the sequence of education and training, there was a significant increase in knowledge, skills, intention, self-efficacy, and behavior regarding PPE. It was noticeable from the pre-test that more than half of the tappers never got information about OHS and PPE. Providing education and training on OHS significantly increases knowledge, skill, intention, and behavior regarding PPE compared to the control group, which only receives education.

Apart from that, this study shows that interventions that are tailored based on characteristics of the respondent and agreement between the parties involved will be more effective than interventions that are applied generally. This approach focuses on personalizing interventions, taking into account respondents' unique needs, preferences, and situations, thereby increasing their relevance and impact.[21] In the context of program evaluation, this approach involves selecting an appropriate study design, collecting appropriate data, and conducting in-depth analysis to ensure that the intervention is successful in achieving its goals and providing the desired positive impact. Evaluative research also indicates that participatory and consent-based interventions with target populations tend to be more effective because they foster a greater sense of ownership and involvement among respondents. In addition, research shows that models adapted based on the changes experienced by respondents during the intervention are also more effective in improving behavior.[22] They take into account the personal dynamics of the individual experiencing these changes. This model emphasizes changing behavior and maintaining it at every stage with slow, sure, and long-term modifications of health behavior.[23] This collaborative, consensus-based approach is highly recommended in various types of social and educational interventions to increase their effectiveness and impact on intervention targets.

Furthermore, knowledge plays a significant role, especially when the learning material is tailored to the context of the rubber tappers' needs and characteristics. This makes it easier for educators to present learning materials that are relevant, specific, and promote active learning. Active learning is what helps tappers become more focused and achieve their goals more easily. Furthermore, assessing the success of each stage in MSM also makes the process easier and increases enthusiasm to learn. Ultimately, an increase in knowledge was more easily achieved in all groups that received educational interventions, and a significant difference in knowledge was observed between the two groups. In line with previous research, which states that the type of intervention, such as self-determination intervention, has a significant influence on adopting a healthy lifestyle.[24,25] Farmers of different types, such as rice farmers and rubber tappers, generally face similar risk factors related to occupational health and safety. In general, when educational materials are prepared in collaboration with farmers, it increases motivation for autonomy and support for basic needs, ultimately raising responsibility and enthusiasm to complete the educational or

training stages that have been prepared.[25,26] Providing educational or other interventions should better consider the needs of respondents. Apart from the intervention being useful, it was also easier for respondents to learn it, so their knowledge scores increased significantly.

Furthermore, good knowledge will become the basic foundation needed for skill development. Knowledge provides a theoretical understanding of a process or concept. In the context of health behavior change, understanding what needs to be changed (knowledge) is the first step before someone can make that change (skills).[27] In line with the previous research, which stated that good health education and identified individual characteristics can be more effective in increasing knowledge.[28,29] This is because learning will be more relevant, contextual, and in accordance with their desired learning style, thus generating more intrinsic motivation, which is more inherent and meaningful. When a person acquires new knowledge, they become more aware of the behaviors or skills necessary to make a change. With a clear understanding of the consequences or benefits of an action, a person is more likely to take appropriate steps to practice skills that support their health goals.

As previously discussed, comprehensive knowledge and well-developed skills contribute not only to greater behavioral intention but also to increased self-efficacy. When someone has good knowledge and adequate skills, they feel more confident to carry out the desired action. A person's confidence in their ability to perform an action directly influences their intention to do it.[30] With adequate skills and knowledge, individuals feel more able to face challenges, which ultimately increases their intention to act. Knowledge and skills reduce the uncertainty and anxiety a person may experience when facing a new task. With clear information and a good understanding, people tend to be more confident in their intentions to try something new because the risks and outcomes are more predictable.[30] Good knowledge often increases understanding of the benefits of an action or behavior change. When individuals deeply understand the reasons why certain actions are important or beneficial, they will be more intrinsically motivated to perform them.[31] These planning skills give them the tools to not only intend, but also realize their goals, because they know how to achieve the desired results.[32] Farmers with low self-efficacy tend to use PPE incompletely and inconsistently.[33] Research on tappers in India states that education and training modalities have a significant relationship in increasing self-efficacy.[34] The results of the previous research are slightly different from the results of this research. This is because no training intervention was given to the control group. With sufficient skills, a person is able to set realistic and strategic goals.[35] Education without training provides less real experience. This relates to training that provides an opportunity to try directly, thereby offering a real-life illustration or expertise of the proper and correct use of PPE. Ultimately, training can increase self-confidence and feelings of ability in the use of PPE. To increase self-efficacy and intention, in addition to providing education, we also offer skills training.

Once self-efficacy is formed, the intention to act becomes the next crucial step in determining consistent use of PPE. Strong intentions, supported by intrinsic motivation and self-belief, are the primary driving force behind positive action.[36] Positive intentions prompt someone to commit to taking actions that align with their goals. When someone has a strong desire to change or take action, they tend to be more consistent in implementing that behavior.[37] Previous research supports the result of this study that providing education and training increases the use of PPE among tappers.[38] Good intentions often stem from a deeper understanding of the importance of positive behavior, which in turn strengthens their efforts to maintain that behavior in the long term. Good intentions improve self-regulation, or a person's ability to regulate and control their behavior.[39] This includes the ability to set goals, manage

emotions, and refrain from harmful behavior. The stronger a person's desire to achieve something good, the more they will regulate their behavior to suit that goal. High self-efficacy strengthens the behaviors necessary to achieve desired outcomes, such as regularity in healthy behavior, increased productivity, or interpersonal kindness. Viewed from the MSM model in this research, the stages that have been implemented are pre-contemplation to implementation. So, further research can be carried out completely upon resumption.

The results of the study showed that the combination of education and training had a greater impact than education alone. This shows the importance of including elements of direct practice in every extension program or occupational safety training for farmers. In addition, in order for behavioral change to be sustainable, interventions should not only target individuals but also involve community leaders, agricultural extension workers, and farmer cooperatives as reinforcing agents. Social support and community supervision can help maintain consistent PPE use practices. Without support for the availability and affordability of PPE, education and training efforts can be less effective. Therefore, structural interventions are needed in the form of subsidies, the distribution of PPE, or incentives for farmers to implement the safe practices they have learned. Companies or related institutions should design a periodic monitoring system for the use of PPE in the field, including through village cadres or field extension workers, to provide regular reinforcement. Moreover, enhancing OSH behavior among workers through this intervention, as a means of fulfilling a human right, is a beneficial program for the workforce.[40]

However, this study has several limitations, including the fact that data were collected at three time points (pre-test, immediate post-test, and follow-up post-test), but the post-intervention period was relatively short. Behavioral changes, especially in the context of occupational safety, generally require a longer period of time and continuous reinforcement to be sustained in the long term. In addition, given the nature of the interacting farming community, there is a possibility that information exchange occurred between participants from different intervention groups, which could obscure differences in effects between groups and result in unintended learning effects. Furthermore, this study did not examine the mechanisms behind behavioral change in more depth, such as changes in risk perception, social norms, or cultural beliefs that may mediate the success of the intervention.

Conclusion

Providing education and training can significantly enhance knowledge, skills, intention, self-efficacy, and behavior in the use of PPE. Meanwhile, the control group, which received only educational intervention, did not experience a significant increase in self-efficacy. When comparing the two groups, significant differences are observed in knowledge, skills, intention, and behavior related to the use of PPE. Providing education and training on a scheduled and periodic basis can be carried out by plantation managers to improve and maintain adequate OSH behavior.

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