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The Acceptance Level of New Safety Helmet Design among Palm Oil Plantation Harvesters in Johor, Malaysia

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ABSTRACT

Agriculture has the highest number of occupational accident cases reported to the Department of Occupational Safety and Health, Malaysia in 2022. The most serious concern is a head injury, which can lead to serious injury or death. Because of the fundamental issue of discomfort, the current level of safety helmet usage is extremely low. The purpose of this study is to determine the level of acceptance of a new safety helmet design. This single group pre and post-test study were conducted on 124 harvesters in three Johor palm oil plantations by using a modified structured questionnaire. A training session on proper helmet use was conducted via video presentation. For three days, harvesters wore the new safety helmet design. Field observation was conducted on the practice item for the post-test. Descriptive analysis shows harvesters have a high score for knowledge, attitude, and practice. There is no significant difference ($p>0.05$) in practice before and after the implementation of training. There is a significant increase ($p<0.001$) in the acceptance level of the parameter (comfort, safety, ventilation, peak, fit, design, and heat) of the new safety helmet design on day 1, day 3 and day 6 among palm oil plantation harvesters. Overall, the harvesters have high knowledge, attitude and practice level and the new safety helmet design is well accepted by the harvesters. Training session implemented is helpful, however, the module needs to be improvised to increase the practice level.

Keywords: Safety helmet; comfort; harvester

INTRODUCTION

The agricultural sector plays an important role in the economic development of Malaysia. Palm oil has become the main sub-sector in the agricultural sector and has created a lot of job opportunities among local and foreign workers (Hussein et al. 2017). According to the Department of Occupational Safety and Health Malaysia, occupational accidents by sector until October 2018 were reported in the agriculture, forestry, and fishery sectors and are the second highest with 289 cases. Head injury is the main concern as it can result in severe injury and fatality. Thus, the usage of the safety helmet is essential to protect workers.

There are several issues associated with the use of safety helmets by harvesters in palm oil plantations and noncompliance of safety helmets, including comfort, ventilation, weight, and safety (Shuhada et al. 2015; Arumugam and Tamrin 2014). The tropical climate in Malaysia has a negative impact on the level of worker comfort (Dayana and Tamrin 2014). Therefore, the safety helmet needs improvement. According to Shamsul and Irwan (2015), a man sustained a brachial plexus injury because of a falling fruit bunch (FFB) that weighed between 10 and 20 kilogrammes and fell from a palm tree at a height of 5.5 meters[2]. Therefore, a safety helmet must be worn in palm oil plantations to prevent occupational accidents. Eye, head, and neck injuries may result from not wearing a safety helmet. Even though the workers had a decent understanding of the importance of wearing safety helmets, help is required to boost its use (Zolkifli 2016). Workers frequently take off their protective helmets to alleviate the discomfort caused by the heat and the conditions of the job (Dayana and Tamrin, 2014; Adnan et al. 2016). Hot and humid weather in Malaysia makes working conditions unpleasant for workers (Subhi 2022). This study offers information on the knowledge, attitude, and behaviour (KAP) of palm oil harvesters on the utilization of head protection.

The process of designing the new safety helmet was developed by taking into consideration of many aspects such as the opinion from the palm oil plantation management, expert opinion, through observation at the field of palm oil plantation and based on the most subjective preference of the safety helmet among the harvesters (Nazri et al. 2020). Thus, this study is to ponder the acceptance level (comfort, ventilation, design, peak, fit, safety, and heat) of new safety helmet designs among palm oil plantation harvesters.

METHODOLOGY

A cross sectional study was carried out at three palm oil plantations under Boustead Plantations Berhad (BPB) in Johor. The plantations involved were Kulai Young, Chamek and Telok Sengat. Purposive sampling was used for the selection of the plantation as it is determined by the management of the plantation. Stratified random sampling was used for a division of a population from each of the plantations. A total of 124 harvesters were randomly selected as respondents through the name list of harvesters. The sampling number of responders was calculated using the estate's total population as approved by management. In this study, 3 independent language sets of questionnaires were used: Bahasa Melayu, Bahasa Indonesian, and Bangladeshi. The translation was validated by a linguistic and field expert.

The questionnaire was adapted from a previous study (Shuhada et al. 2015). For quality control, the items in the questionnaire are based on the validated and reviewed by the manager safety & design engineer Malaysian Institute of Microelectronic Systems (MIMOS) and Senior Manager and Managers from Boustead Plantation Berhad. For the reliability test, the results from the pilot study showed that Cronbach's coefficient alpha value obtained was 0.716 for the pre-intervention questionnaire and 0.914 for the post-intervention questionnaire

The questionnaire includes a 10 cm line-type scale against the performance of the new design safety helmet (Gomide et al. 2021). Acceptance level is based on the parameters of comfort, ventilation, design, fit, safety, peak, and heat. Respondents need to mark (X) at the line provided to choose the scale of those parameters.

The characteristic of this helmet has more ventilation holes at the top and edge of the helmet compared to the existing safety helmet, and it has a shorter peak so that it does not limit the vision of the harvesters during harvesting. Five minutes training video in Indonesian and Bengali languages produced by an expert team led by an ergonomist was shown to the respondents. The contents of the video were the correct ways of using a safety helmet, how to identify broken safety helmets, do's and don'ts towards safety helmets. In addition, the observation method was used to collect data for practice items (post-test) on safety helmet usage and the result was used to compare with pre-test results of the same harvesters. The pre-test questionnaire was distributed to 124 harvesters which comprised 82 harvesters from Telok Sengat, 24 from Kulai Young and 18 from Chamek Estates before training session. Subsequently, training regarding safety helmet usage was given to the harvesters. The new safety helmet design was distributed to the harvesters to determine the acceptance level through post-test questionnaires for days 1, 3 & 6 and field observation to monitor their practice. The timeframe was selected to be within the estate based on the authorization period.

All the data were analyzed using Statistical Package for Social Sciences software version 25. The score for knowledge, attitude ad practice (KAP) was calculated as such below 50% were categorized as low level, 50%-75% as fair and above 75% as a high level (Anees et al. 2014). Non-parametric analysis of the Friedman Test was used to determine the significant increase in acceptance level. Crosstabs were used to find the difference in practice between the pre-test and post-test.

RESULT

124 male harversters from Kulai Young Estate, Chamek Estate, and Telok Sengat Estate were selected using simple random sampling. The sampling number of responders was calculated using the estate's total population as approved by management. Table 1 shows the distribution of socio-demographic data. Overall, majority of the harvesters have high level of knowledge, attitude and practice which were 58.1%, 45.2% and 87.1% respectively based on Table 2.

TABLE 1. Distribution of Socio-Demographic

Variables	Frequency (N)	Percentage (%)
Age		
Below 25	27	21.8
26 - 35	39	31.5
36 - 45	45	36.3
Above 45	13	10.5
Nationality		
Indonesian	83	66.9
Bangladesh	38	30.6
Malaysian	3	2.4
Education		
None	40	32.3
Primary	46	37.1
Secondary	38	30.6

Based on Table 3, the p-value for each of the parameters was less than 0.001 which shows that there was a significant difference acceptance level of parameters (comfort, ventilation, safety, design, heat, peak and fit) of the new safety helmet design in day 1, 3 & 6.

TABLE 2. Results of harvesters' level of knowledge, attitude, and practice

Variabless	Frequency (N)	Percentage (%)
Knowledge		
High	72	58.1
Fair	33	26.6
Low	19	15.3
Attitude		
High	56	45.2
Fair	44	35.5
Low	24	19.4
Practice		
High	108	87.1
Fair	12	9.7
Low	4	3.2

TABLE 3. The acceptance of new safety helmet design in day 1, day 3 & day 6

Parameter of acceptance	Day	Mean	χ^2	p-value*
Comfort	1	59.02	57.341	<0.001
	3	72.64		
	6	83.93		
Ventilation	1	67.91	25.721	<0.001
	3	74.75		
	6	81.30		
Safety	1	89.82	56.099	<0.001
	3	91.93		
	6	95.66		
Design	1	78.43	73.148	<0.001
	3	86.07		
	6	95.82		
Heat	1	71.23	25.509	<0.001
	3	78.95		
	6	79.45		
Peak	1	85.57	41.515	<0.001
	3	90.70		
	6	92.64		
Fit	1	87.16	23.450	<0.001
	3	86.66		
	6	88.48		

TABLE 4. Difference on practice of safety helmet usage before and after implementation of training

Practice items	Frequency (%)		p-value
	Yes	No	
Wearing safety helmet in plantation			
Before	40(90.9)	4(9.09)	0.125
After	44(100)	-	
Wearing chin strap			
Before	37(84.1)	7(15.9)	0.180
After	42(95.5)	2(4.5)	

Field observation on the practice of new safety helmets was conducted on the same group of harvesters without informing them. Table 4 shows the p-value for those items is more than 0.05 thus showing that there is no significant difference before and after the implementation of training on the practice of safety helmet usage.

DISCUSSION

58.1% of the harvesters scored high marks, 26.6% fair marks and 15.3% scored low marks regarding the evaluation of harvesters' knowledge of safety helmet usage. This agrees with previous research on the knowledge of harvesters in the palm oil plantation which is 83.3% which indicates that they already have the basic knowledge of safety helmet usage. The talks were delivered in layman's terms to convey the message clearly and directly.

Based on the data, 97.6% of the harvesters agreed that it is compulsory to wear a safety helmet during work. In accordance to Occupational Safety and Health Act (OSHA) 1994 Section 24, "It shall be the general duty of employees at work to wear or always use any protective equipment provided by the employer for the purpose of preventing risks to their safety and health". This also indicates that safety helmets must be provided by the management and based on the result obtained, 86.3% of the harvesters were aware of this matter. With regards to attitude towards safety helmet usage, 45.2% of the harvesters got a high score on attitude items. Meanwhile, 35.5% of the harvesters scored fair marks and another 19.4% low marks. Attitudes may help people to adjust to their work environment. Attitude can be changed through the improvement of knowledge (Jeong et al. 2018). Education can promote protective behaviour by affecting attitude (Bondori et al. 2018). 79.8% of the harvesters are comfortable when wearing a safety helmet on the plantation. However, 12.2% feel discomfort.

A previous study revealed that workers tend to remove their helmets when they experienced any discomfort (Adnan et al. 2016). 64.5% will wear the safety helmet if the management monitors and 48.4% wear the safety helmet to fulfil the management requirement. Almost half of the harvesters (46%) claimed that the interesting design of the safety helmet encourage them to wear it. Maslow (1987) emphasized the decorative, emotional, and symbolic attributes of design. If the helmet is designed accordingly, it will be worn and maintained correctly by the worker. 91.1% of the harvesters feel safe when wearing a safety helmet during work. This is because the resulting injuries can be prevented or minimized by wearing a safety helmet as it can absorb and disperse the impact (Chang et al. 2003). The evaluation of harvesters' practice shows 87.1% of them scored high marks, meanwhile the fair and low scores were 9.7% and 3.2% respectively.

Based on the first item, 96.8% claimed that they wore safety helmets at the plantation. However, 3.2% of the harvesters did not wear it. This is in support of the previous study that harvesters refuse to wear the safety helmet due to discomfort (Abeysekera et al. 1990). A helmet needs to be developed with acceptable weight, comfortable, fit, and adequate ventilation (Davis et al. 2001). Then, 92.7% of the harvesters used the chin strap and 89.5% tighten the loosened chin strap. The function of the chin strap is to secure the head and helmet to prevent it from rolling off. There are a few circumstances that will cause the helmets to roll off for workers who did not wear chin straps, such as heading up or down, windy conditions and slight impact (Ivan et al. 2014). Overall, harvesters' knowledge, attitude, and practice (KAP) level are already good in the first place. This shows that the management has delivered safety-related messages in an understandable way.

The previous studies emphasized the importance of safety commitment and manpower allocation for a successful safety management system implementation (Robson et al. 2007; Yu et al. 2002) Safety training is closely related to compliance, participation, and involvement of workers towards any safety requirement from management (Shehu et al. 2016). In term comfort, there was a statistically significant difference in day 1, 3 and 6, $\chi 2$ (2) = 57.341, $p < 0.001$. Post hoc analysis with Wilcoxon signed-rank tests was conducted, resulting in a significance level set at $p < 0.001$. There were significant differences between day 1 & 3 ($Z = -4.846$, $p < 0.001$) or between day 1 & 6 ($Z = -4.990$, $p < 0.001$) and day 3 & 6 ($Z = -4.323$, $p < 0.001$). This shows that the harvesters feel comfortable when wearing the new safety helmet design. The comfortability of a safety helmet is very important as it can influence the workers whether they want to wear it or not. Discomfort with the use of personal protective devices (PPD) has been one of the chief causes of their non-use (Davis et al. 2001). This is in support of the previous study that emphasized issues for the non-compliance of safety helmets are discomfort (Suhada, 2015). The result shows that the ongoing project for a new developing safety helmet using ergonomic principles gives more comfort to the workers.

For the ventilation of the safety helmet, there was also a statistically significant difference on days 1, 3 and 6, $\chi 2$ (2) = 25.721, $p < 0.001$. Wilcoxon signed-rank tests shows there were significant differences between day 1 & 3 ($Z = -2.718$, $p = 0.007$) or between day 1 & 6 ($Z = -3.690$, $p < 0.001$) and day 3 & 6 ($Z = -2.839$, $p = 0.005$). Based on the result obtained, shows that the new design safety helmet is well-ventilated. This is because compared to an existing safety helmet. Based on the previous study, one of the emphasized issues regarding non-compliance with existing safety helmets was due to poor ventilation (97.6%) and there were 66.7% of the harvesters complained about poor ventilation of the existing safety helmet which make them feel very hot and profusely sweating (Nazri et al. 2020).

For the heat parameter, there was also a statistically significant difference in day 1, 3 and 6, $\chi 2$ (2) = 25.502, $p < 0.001$. Wilcoxon signed-rank tests shows there were significant differences between day 1 & 3 ($Z = -3.89$, $p < 0.001$) and between day 1 & 6 ($Z = -2.744$, $p < 0.05$). Since the new safety helmet design has good ventilation and has an air gap between the head surface and helmet shell, therefore it will increase air flow thus reducing the heat. This agrees with the previous study that not well-ventilated safety helmet may reduce the airflow over the head. This is because reducing airflow rapidly will increase the head temperature and affects the heat dissipation from the head to the environment thus eventually could lead to an increase of heat-related stress during the long period of harvesting in the sun. Another study reported that the air gap between the head surface and the helmet shell may help to increase heat dissipation as the air gap allows cooling air to circulate through the helmet (Toh et al. 2015).

Other than that, regarding the peak of the safety helmet, there was a statistically significant difference on days 1, 3 and 6, $\chi 2$ (2) = 41.515, $p < 0.001$. Wilcoxon signed-rank tests shows there were significant differences between day 1 & 3 ($Z = -4.692$, $p < 0.001$) or between day 1 & 6 ($Z = -3.702$, $p < 0.001$) and day 3 & 6 ($Z = -2.461$, $p < 0.001$). This shows that the safety helmet did not limit the vision of the harvesters during harvesting. This is because the new design of the safety helmet has a shorter peak compared to the existing safety helmet. The previous study showed that 68.5% of the harvesters complained that the existing safety helmet limits their range of vision when conducting their work and 71.0% complained that the existing safety helmet disturbed them in conducting their work appropriately especially caused by tips of the safety helmet by 43.5%8. Meanwhile, for the fit of the safety helmet, there was a statistically significant difference on days 1, 3 and 6, $\chi 2$ (2) = 56.099, $p < 0.001$. Wilcoxon signed-rank tests shows there were significant differences between day 1 & 3 ($Z = -1.993$, $p = 0.046$) and day 3 & 6 ($Z = -2.274$, $p = 0.023$). This shows that the safety helmet is well-fitted among the harvesters. Since the palm oil harvesters worked for more than 6 hours daily, it is fundamental for the safety helmet to be comfortable and well-fitted to increase the usage of the safety helmet throughout their working hour. However, there is no significant difference between day 1 & 6 ($Z = -1.867$, $p = 0.062$)

In terms of the design of the safety helmet, there was a statistically significant difference on days 1, 3 and 6, $\chi 2$ (2) = 73.148, $p < 0.001$. Wilcoxon signed-rank tests shows there were significant differences between day 1 & 3 ($Z = -4.972$, $p < 0.001$) or between day 1 & 6 ($Z = -5.243$, $p < 0.001$) and day 3 & 6 ($Z = -5.138$, $p < 0.001$). This shows that the harvesters are well accepted the interesting design of the safety helmet. This is in support of the previous study reported that 42.5% of the harvesters claimed that the interesting design of the safety helmet will encourage them to wear safety helmets (Muhammad Taufik Yap, 2015).

Overall, the idea of a new design was based on the ergonomics problem raised by the existing safety helmet. The process of designing the new safety helmet was developed by considering many aspects such as the opinion of the palm oil harvesters, the opinion of palm oil plantation management, the expert opinion and through observation at a field of palm oil plantation itself.

Practice items were compared among 44 harvesters regarding safety helmet usage before and after the implementation of training. The findings showed that there are no significant differences in the practice items before and after the training session. However, the trends increase in the post-test result. This is in contrast with the previous study, the trends decreased on the post-test result as most harvesters did not put on both safety helmets (46.7%) and chin straps (73.3%) (Muhammad Taufik Yap, 2015). Earlier in the pre-test, 90.9% of the harvesters responded that they wear safety helmets during work. However, after the intervention, the percentage increases to 100% during field observation. This is in line with the findings in attitude level in the pre-test where 46% of the harvesters responded that the interesting design of the safety helmet will encourage them to wear it and in support of the result of acceptance, especially for design parameters of the new safety helmet. Only 84.1% of the harvesters claimed that they put on chin straps while working but during observation, this increases to 95.5%. This may be attributed to improvement in knowledge and attitude as good practice results from theoretical understanding that helps workers acquire new skills (Lewise et al. 2004). However, harvesters tend to state in pre-test that they would comply by wearing a safety helmet and chin strap but fail to do so when no one is observing them at work. This aligned with the attitude item on the pre-test that 64.5% wear the safety helmet if the management monitored. Management of practice will enhance workers' performance and participation in their work responsibilities (Ichniowski et al. 1997).

CONCLUSION

In conclusion, 58.1% of the harvesters were considered to have a high level of knowledge, 45.2% of them have a high level of attitude and more than half of the harvesters (87.1%) were considered to have a high level of practice of safety helmet usage. The new safety helmet design is well accepted by the harvesters as there is a significant increase in acceptance level of parameters (comfort, ventilation, heat, safety, design, peak and fit) of the new safety helmet design on day 1, day 3 and day 6. However, there is no significant difference in practice items before and after the intervention.

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DECLARATION OF COMPETING INTEREST

None

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