ORIGINAL ARTICLE

Testing Occupational Hazard Self-Evaluation Module (OHSEM) Intervention among Workers of SME (Manufacturing) in Northern Malaysia

Syazwan Syah Zulkifly[1], Nor Halim Hasan[2], Mohd Rafee Baharudin[3]

[1] School of Business Management, Universiti Utara Malaysia, 06010, Sintok, Kedah, Malaysia
[2] Department of Occupational Safety and Health Sarawak, 93100, Kuching, Sarawak, Malaysia
[3] Faculty of Medical and Health Science, Universiti Putra Malaysia, 43400, Serdang, Selangor, Malaysia

ABSTRACT

Introduction: Workplace accidents have been a persistent problem in Malaysia's manufacturing industry, particularly for small and medium-sized enterprises (SMEs). Employee behavior has been identified as a significant contributing factor to these accidents, and research has suggested that improving safety knowledge and attitudes can enhance safety behavior. Despite this, there have been no empirical intervention studies in Malaysia to investigate the effectiveness of safety intervention programs aimed at improving SME worker safety behavior. Therefore, this study aimed to assess the efficacy of the Occupational Hazard Self-Evaluation Module (OHSEM) intervention in enhancing safety knowledge, attitudes, and behavior (KAB) among SME workers in the manufacturing sector. **Methods:** A quasi-experimental design with control group was utilized to evaluate the effectiveness of the OHSEM intervention. The intervention was implemented over a 12-week period on production workers in the experimental group, while the control group received no intervention. A self-administered questionnaire was distributed to 88 production workers in both groups before and after the intervention to measure the improvement of safety KAB. Descriptive analysis and an independent t-test were used to analyse the data. **Results:** The post-test results showed that safety KAB for the control group was moderate (mean = 2.11), while the mean score in the experimental group was high (m=4.17). Furthermore, the t-test result revealed a significant difference in safety KAB mean scores between the experimental and control groups. **Conclusion:** This study provides empirical evidence on the effectiveness of the OHSEM intervention in enhancing safety KAB in SMEs in the Malaysian SME (manufacturing) sector.
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Keywords: Safety knowledge-attitude-behavior (KAB), Manufacturing, Malaysia, SME

Corresponding Author:
Syazwan Syah Zulkifly, PhD
Email: syazwan.syah@uum.edu.my
Tel: +6019-5742368

INTRODUCTION

Prior studies had mutually acknowledged that unsafe working behavior is the leading reason of workplace accidents since decades. In 1940s, Heinrich concluded that unsafe behavior is accountable for 88% of industrial accidents (1). Furthermore, it has been demonstrated that person-factor, such as risky conduct, are the main determinant for industrial accidents, along with other factors including engineering, technology, unsafe working environments, and system malfunction (2). Similarly in Malaysia's manufacturing industry, main causes of accidents are stated as unsafe acts i.e., cutting corners and failure to wear personal protective equipment (PPE). This is followed by hazardous condition of workplace (4, 5). Apart from that, it is also discovered that the underlying factor that causes accidents in Malaysia is incompliance with safety standard of tools, machineries, and vehicles.Besides, lack of supervision is also found to be contributing factor to industrial accident cases (5).

Safety behavior is said to be the most contributing factor that causes industrial accidents, hence numerous researchers have investigated to ascertain the its antecedents. Many researchers discovered that the safety climate affects safety behavior (6,7). On one hand, management safety commitment (8,9). Aside from these factors, safety training has been shown to have a significant impact on safety behavior (10,11). Given manufacturing is the main contributors towards accident statistics in Malaysia, it is also reported that 80% - 90% of the accident cases came from Small and Medium Enterprises or renowned as the SMEs (12,13) . Moreover, it is revealed that 77 % of the occupational accidents occur in the SMEs came for its small and micro segment with 40 % and 37% respectively (12).Recording the highest industrial accident cases in Malaysia every year (14,15) puts SMEs in a vulnerable situation as accidents impose adverse impacts on their busineses in terms of financial and non-financial loss (3,4).

Apart from that, there also exist previous studies which had proven that safety leadership is a factor that influences safety behavior (16,17). Safety leadership is considered as a key component that contributes to decreasing number of workplace injuries (18). A study in Malaysia suggested that safety leadership which translates to the act of monitoring and coaching has high potential to transform workers' attitude, safety knowledge, and behavior in manufacturing firms (19).

According to previous literature, industrial accidents in Malaysia mostly happened due to incapability of operating in safe manner especially among workers who work in dangerous working condition. Additionally, manufacturing is one of the industries with the highest rate of occupational injuries, based on its various significant occupational hazards (20). Based on this discussion, this research advocates that production workforces should participate in identifying work hazards as well as associated risks which they face while working. Apart from that, it is also suggested for workplaces to predict the consequences of hazards to ensure that safety behavior at work is always practiced by the employees. This is parallel with a previous research with mentioned that a proactive hazards identification in a workplace could strengthen the management of occupational health and safety (21). It is the role of each level of the employees within the manufacturing setting to identify hazards as well as assess the associated risks. Morover, the imposed risks control based on risks' assessments, together with accident analysis and predictive procedures, are the measures that should be taken to avoid workplace accidents. As such, it is suggested that by identifying the work place hazards and assessing the possible consequences, safer working conditions for manufacturing employess shall be established (22). Moreover, it has been proven that hazard identification and risk assessment prior to starting a job or task is part of the pre-job safety analysis elements in ensuring workers' safety (23). This fact is supported by a consensus that an individual's perception of the risks associated with workplace hazards influences his or her safety behavior (24).

This paper aims to prove that workers' self-evaluation of potential hazards at their workplace could improve employees' attitude and knowledge towards safety while also changing their unsafe behaviors. This can be achieved by conducting intervention research to improve safety behavior among Malaysian employees working in hazardous workplaces. The intervention programme emphasizes worker self-assessment of hazards while being monitored by their supervisors. This is because it has also been proven that supervisors play a critical role in improving safety behavior among Malaysian SME manufacturing workers (11). This paper also argued that by imposing an intervention to improve workers' safety knowledge and attitude, and at the same time modifying their unsafe behaviour, the management of SME manufacturing in Malaysia would reduce accident cases in a long term run. However, emperical studies regarding safety behaviour interventions, especially in Malaysia are limitedly found for reference (25).

MATERIALS AND METHODS

Study Design

This study uses the research design of post-test quasi-experiment with control group. The safety intervention to the experimental group took place about 12 weeks. After the completion of the intervention, a self-administered questionnaire was imposed as the instruments towards both experimental and control groups.

In this study, a particular intervention programme focused on the employees' self-evaluation of dangers was carried out by modifying the Japanese-origin Kiken Yochi Training (KYT).KYT method is conducted through small group discussions and dialogues on the subject of workplace hazards and situations (26). By doing so, it will help the employees to comprehend and identify accidents that is possible to occur, as well as identifying risky areas as well as the required responses. The implementation of KYT improves the employees' awareness of hazard. At the same time, it also provides incentive for the workers to work in team, increase their communication of hazard knowledge, and then improves the workers' problem-solving skills (27). Among the advantages of implementing KYT is reducing mistakes by the workers during working time thus improving the manufacturing firms' safety performance.

A review study has shown that KYT implementation benefits the manufacturing firms to reduce the industrial accident rates across the world(59). However, another previous study also highlighted that while implementing KYT in workplaces, the factor of local culture must also be considered to ensure its effectiveness (42). Thus, Occupational Hazard Self-Evaluation Module (OHSEM) was constructed by modifying the elements of KYT to suite the culture of Malaysian workers (25). OHSEM consists of five sections namely, Topic I: Identifying the critical hazards/ at-risk behaviour, Topic II: Evaluating the consequences, Topic III: Determining the control measures, Topic IV : Implementing the control / safe behaviour, and Topic V: Maintaining safety behaviour proposed by previour research (25). The OHSEM has been developed according to the established Design and Development Research (DDR) protocols (28) and validated by 15 experts using Fuzzy Delphi Method (FDM) (29).

Population and Sampling

The samples are selected from small manufacturing corporations defined as "factory" by "Factories and Machinery Act 1967", located in the northern industrial region of Malaysia. The selected manufacturing companies are located in the northern industrial region of Malaysia. The sampling frame is based on the list of SME manufacturing firms involve in OSH Compliance Support Door to Door Program provided by the Department of Occupational Safety and Health (DOSH) located in Pulau Pinang, Kedah, and Perlis. Local production workers from the selected SMEs who ranked below than supervisory level were included in the sampling criteria to dismiss language barrier effect towards the results. Table I depicts the inclusion and exclusion criteria for this study's sampling purposes. The population of the study is 1,190. For the purpose of this research also, the sample size is calculated by G*Power software, and the number is 88 respondent for each experimental and control group, as shown in Figure 1.

Table I: Inclusion and Exclusion Criteria for Sampling

Item	Inclusion Criteria	Exclusion Criteria
1	High accident	Low accident
2	Production line workers	Workers from other than production line
3	Below than super-visor level	Supervisors and above
4	Local workers	Foreign workers

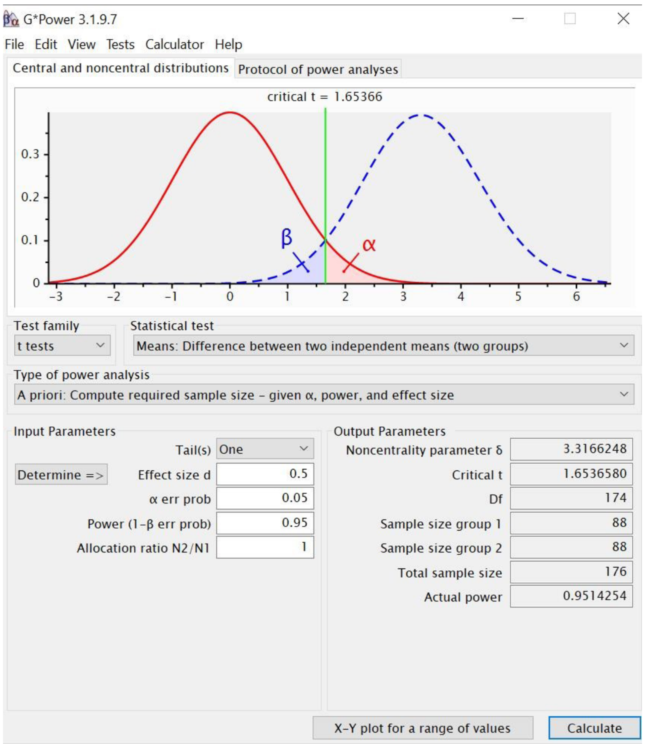

Figure 1: Sample size. Sample size of this study is determined by G*Power.

Instruments

A self-administered questionnaire was utilised to assess the intervention's effectiveness by measuring safety KAB of the respondents. The variables namely safety KAB were measured by items which are adapted from previous research (9,30,31). The items were measured by five- point Likert scale. Based on a study by Wiersma (1998) (32), Likert scale owns advantange which allows the respondents to opt for the best scale describes their observations based on the survey questions. The research instrument were pre-tested among 100 manufacturing workers in the central region of Malaysia and factor analysis together with reliabilty analysis were performed. Based on the results reported in (33), the Cronbach's alpha value for safety KAB are all above 0.9, indicates outstanding reliability (34). In addition, the KMO values for all variables are more than 0.50 with Bartlett's Test results satisfies the pre-requisite criteria. All factor-loadings for safety KAB above the cut-off values of 0.65 (35) as per reported in (33).

Data Analysis Technique

Present research measured the different of safety KAB between the experiment and control group to unveil the efficacy of OHSEM intervention. Accroding to a review study (36), safety KAB are consistently used by researchers to measure the effectiveness of interventions in medical field. KAB, which also interchangeably stated as knowledge-attitude-practice (KAP), is an important theoretical model of health education, which asserts that behaviour change is affected by knowledge and attitude (37). Research on KAB is the same as other types of research in the sense of research methods. However, if the main objective of a research is measuring change, a KAB research is best conducted by applying the pre/post-test design (38). In the areas of education and psychology, KAB or KAP are usually applied to measure learning performance (37,39).

In OSH field, KAP or KAB were applied by previous researchers to measure the effectiveness of interventions (40,41). These research utilised self-administered questionnaire to measure the safety knowledge, attitude, and behaviour. In addition, numerous scholars in previous research have utilised self-administered questionnaire to measure safety behaviour (42,43). Although behaviour is often based on actions and best to be measured through observations, present research proceeded to measure safety behaviour through questionnaire.

The data analysed data via SPSS software Version 20. First, the level of KAB for both experimental and control group were determined by mean value. The Davis's Convention provides a guideline for interpreting means of measures, where a mean value ranging from 3.68 to 5.00 is considered high, 2.34 to 3.67 is considered moderate, and 1.00 to 2.33 is deemed low (44). Furthermore, o assess significant differences in safety knowledge, attitudes, and behavior (KAB) between the experimental and control groups, a two-sample t-test analysis was employed in this study.

Ethical clearance

This study was approved by Research Ethics Committee for Research involving Human Subjects, Universiti Putra Malaysia No. UPM/TNCPI/RMC/1.4.18.2 (JKEUPM).

RESULTS

Respondents' Background

Based on the results shown in Table II, the respondents comprised 55 (62.5%) male and 33 (37.5%) female respondents for the experimental group, while the respondents for control group are 52 (59.1%) male and 36 (40.9%) are female. For the educational level, the majority of them have a HSC/STPM/Certification qualification for the experimental group and MCE/SPM/SPMV for control group which is indicated at the same value 28.4% (n= 25). Next, for the experimental group, 38 (43.18%) are within the age of 20 to 30 years old, 34 (38.64%) are aged 31- 40 years old, 14 (15.91%) are within the age of 41-50 years old, and the remaining 2.27% are above 50 years old. Meanwhile, 32 (36.4%) of the respondents in the control group are aged 20-30 years old, 34 (38.6%) are within the age of 31-40 years old, 20 (22.7%) are between 41 and 50 years old, and two are above 50 years old.

Moreover, most of the respondents of both group shown that 44 (50%) of the respondents in the experimental group, and 30 (34.1%) of the control group have less than 5 years tenure in their respective companies. Then, 24(27.27%) of the experimental group and 28 (31.8%) of the control group's respondents have 5 to 10 years working experience in their respective factories respectively. Furthermore, 10(11.36%) of the respondents from the experimental group own 11 to 15 years working experiences, whereas,15 (17.0%) of them from the control group have the similar years of work experiences. The remaining percentage of the respondents for both groups have more than 15 years experiences of work. As depicted in Table II also, 22 (25%) of the respondents from the experimental group, and 19 (21.6%) of the respondents from the control group have experienced accidents at the workplace. Besides, 63 (71.59%) of the respondents from the experimental group have experience attending any OSH-related training. On the other hand, 60 (68.2%) of the respondents in the control group have experience in undergoing OSH-related training.

Descriptive Analysis Results

This study employs descriptive analysis in obtaining the mean values to measure safety KAB level among the samples. According to Davis convention, each variable's level is considered low when the mean value is within 1.00- 2.33 range, medium (mean = 2.34-3.67), whereas it is considered high if the mean value falls between the range of 3.68-5.00(56). Based on the results, safety KAB level for the control group is considered as moderate (mean=2.16 and 2.11) post-test. Nonetheless, safety KAB level for experimental group is high (m=4.17) for post-test. This result indicates that workers who received intervention had higher levels of safety behavior than workers who did not receive intervention. The details are depicted in Table III.

Table II: Background of the Respondents

		Experimental Group		Control Group	
		N	%	N	%
Gender	Male	55	62.50	52	59.1
	Female	33	37.50	36	40.9
Education Level	LCE/SRP/PMR	13	14.77	15	17.0
	MCE/SPM/SPMV	22	25.00	25	28.4
	HSC/STPM/Cert.	25	28.41	22	25.0
	Diploma/Adv.Dip.	15	17.05	15	17.0
	Degree & Above	13	14.77	11	12.5
Age	20-30 years old	38	43.18	32	36.4
	31-40 years old	34	38.64	34	38.6
	41 – 50 years old	14	15.91	20	22.7
	51 years old and above	2	2.27	2	2.3
Tenure	Less than 5 Years	44	50.00	30	34.1
	5 – 10 Years	24	27.27	28	31.8
	11 – 15 years	10	11.36	15	17.0
	More than 15 years	10	11.36	15	17.0
Accident	Yes	22	25.00	19	21.6
	No	66	75.00	69	78.4
OSH Training	Yes	63	71.59	60	68.2
	No	25	28.41	28	31.8

Table III: Descriptive Analysis

Variable	Group	Mean/Level			
		Pre-test		Post-test	
Safety KAB	Intervention	2.05	Moderate	4.17	High
	Control	2.16	Moderate	2.11	Moderate

T-Test Analysis

The two-sample t-test, also known as the independent sample t-test, was run to determine a statistically significant difference between the means of two separate groups (45,49). Table IV shows the results after the 12-week OHSEM intervention programme was imposed to the experimental group. Whereas, no intervention was performed towards the population in the control group. The t-test was run towards the data collected by questionnaires measuring safety KAB from the experimental group and also control group.

First, Levene's test was performed in an independent t-test to determine variance homogeneity of two data groups. If the p-value is lower than 0.05, it is determined that population variances diverge. According to the results, the p-value was recorded as $p>0.05$, indicating that the population's variance was homogeneous.

Second, the calculated value of t-test is t (187.48) = 25.01, $p<0.05$. Henceforth, the mean value of safety KAB for experimental group was significantly differed to the value of control groups.

DISCUSSION

Based on to the descriptive tests, a safety intervention programme towards supervisors, named as OHSEM, could lead to an increased of the prevalance of safety KAB among production workers in small manufacturing firms. This finding is similar to the previous study (45), whereby transformational leadership intervention which administered on swimming supervisors had lead to an improvement of safety behavior among swimming instructors . Moreover, mean value of safety KAB for the experimental group significantly increase from pre-test to post-test, whereas, the values for control group remains similar for both tests. Previous studies have also compared mean values of experimental group and control group for safety behaviour (46) and safety attitude (47)to evaluate their intervention programs. Morever, the significant different of mean between the experimental group and control group for the measured variables by applying independent t-test also be found in previous research (40,48). Similarly, present study found a significant different in mean values of post-test in terms of safety KAB between experimental and control group, confirming the efficacy of OHSEM intervention. This statement is supported by findings of previous study (49) which revealed that tailored interventions were found to be more effective in promoting behavioural change among workers in manufacturing sector.

In addition, Levene's test applied to the research data resulting the p-value, $p>0.05$, indicating that the population's variance was homogeneous.

CONCLUSION

This research aims to determine whether the implementation of safety interventions toward supervisors can lead to the improvement of safety knowledge-attitude-behavior (KAB) among workers in Malaysian SME manufacturing sectors which are demonstrating high number of accident cases at their workplace. This research's primary goal is to implement OHSEM intervention by supervisors in order to improve their safety leadership roles, which is expected to influence workers' safety KAB. The results in this quasi-experimental study show a significant difference in mean values between the experimental and control groups, supporting the OHSEM's causal effect. Furthermore, the inferential analysis confirmed the intervention's effectiveness.

This research is hoped to assist the government agencies in developing efficient strategies involving safety that are specifically targeted at production workers and will aid in the reduction of industrial-related accidents in the manufacturing firms. Apart from that. this intervention also serves as a guideline to initiate modules of safety behavior practices in Malaysian manufacturing industry.

However, this study also has limitations that should be highlighted. Because the respondents were not assigned at random in a quasi-experimental design, its validity was reduced. However, in order to address the validity concerns, this research has taken the initiative to create a control group. For future studies, other researchers are encouraged to incorporate a pre-test to address historical bias and to collect time series data so as to improve the research's validity.

Table IV: Independent Samples Test (Post-test)

		t-test for Equality of Means								
		Levene's Equality of F	*Sig. (2-tailed)*	*t*	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Safety KAB	Equal variances assumed	0.00	0.98	25.01	198.00	0.00	2.05	0.08	1.89	2.21
	Equal variances not assumed	0.01	0.91	25.01	187.48	0.00	2.05	0.08	1.89	2.21

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