ORIGINAL ARTICLE

Assessment of Knowledge, Attitude and Practice on Occupational Safety and Health Among Laboratory Workers in OSHMS Certified and Non-Certified Public Universities in Malaysia

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ABSTRACT

Introduction: The use of chemicals in teaching laboratories exposes students and laboratory staff to risk arising from hazardous chemicals. Accidents related to poor management and handling of chemicals have been reported in teaching laboratories. Good implementation of occupational safety and health (OSH) in organisation that has implemented OSH-Management System (OSH-MS) plays an important role in reducing accidents at the workplace. The aim of this study is to assess the level of knowledge, attitude and practice (KAP) related to the OSH aspect in chemical handling among workers in OSH-MS certified and non-certified public universities in Malaysia. **Method:** This is a cross-sectional survey involving laboratory workers in four public universities in Malaysia. A total of 120 laboratory staff were recruited and data on KAP was collected using self-administered questionnaires disseminated physically and via online platforms. Items in the questionnaire were adapted from previous studies and published guidelines. Data obtained were entered into statistical software for analysis. **Results:** About 76% of workers in certified universities have high knowledge, 94% have a positive attitude, and 88% have good practice in OSH. In non-certified universities, 70% have high knowledge, 97.1% have a positive attitude and 81.4% have good practice in OSH. Good practice level was significantly higher in certified universities. Knowledge, in general, was associated with younger age and higher education level while attitude was linked to gender. **Conclusion:** There were higher percentages of good OSH practice among laboratory workers in OSH-MS certified universities. Structured and systematic OSH governance can facilitate better OSH practice and implementation in certified public universities.
Malaysian Journal of Medicine and Health Sciences (2022) 18(5):3-12. doi:10.47836/mjmhs18.5.2

Keywords: Occupational Safety and Health, OSH-MS, Laboratory, Workers, Education

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INTRODUCTION

Occupational Safety and Health (OSH) is one of the most crucial aspects in ensuring a safe and healthy workplace. It deals with the safety and health of workers in the work setting and it mainly focuses on preventing hazards. In Malaysia, legislation with regards to safety and welfare of workers is covered under the Occupational Safety and Health Act 1994 (1) and under this act, both employer and employees hold the responsibilities to provide a safe and healthy work setting. Although there is a law to cover the safety and health of workers from various industries, work-related accidents are still a major concern as workers are always exposed to hazards in the workplace (2).

The issues pertaining to OSH are not only a concern in high-risk industries but also in education institutions such as teaching laboratories where chemicals are used daily for experimental and research purposes. In the study by Makhtar et al. (3), the authors explained that there is an increasing trend of accidents that had occurred in sectors categorised within the Public Services and Statutory Bodies group from 2015 to 2016 followed by a slow decreasing trend in 2017. Among those accident reports, 47 of the cases happened in educational facilities, which mostly involved poor handling and management of chemical spills. The use of chemicals in laboratories exposed both students and laboratory staffs to chemical risk. Knowledge on the use of equipment, safety rules and safe environment is crucial in building the attitude of laboratory staff to perform and complete their tasks in a safe manner (4). In addition, lack of awareness on OSH can lead to unsafe practices, and hence can become a major contributor to work-related accidents (5). Che Hassan et al. (4) also stated that in order to provide

safe and healthy conditions for students, the laboratory staff need to have enough knowledge on safe working conditions. Good attitude in terms of safety and health, and good practices while being in the laboratory should be the ethics upheld by laboratory workers so that it can be transferred to students.

The importance of safety and health in universities is of paramount importance and just having procedures such as safe work methods and housekeeping to prevent unwanted incidents as well as ill-health may not necessarily be sufficient. Various programs such as promotion and awareness on OSH are required together with monitoring and program improvement (6). These plans and programs will need to be relevant to the scope of the work and will need to involve critical success factors to be effective such as commitment from top management and resources among others. Hence, one of the ways to manage work-related accidents and ill-health is by establishing an Occupational Safety and Health-Management System (OSH-MS) (7, 8). Management system is a systematic, open and comprehensive process to manage risk (9). Globally, a large number of organisations have implemented OSH-MS and have obtained certification as a way to manage its own safety and health and in Malaysia, there have been a number of universities that have obtained certification related to OSH.

There were several accidents reported in Malaysian teaching laboratories which involved teachers, laboratory staff and even students. Most of the accidents are related to poor management of chemical spills which then lead to explosions. It was reported that in an incident in 2013 that involved a small explosion, a total of 19 students and teachers experienced nausea due to strong chemical odour (10). In 2016, a mercury spill incident occurred at a teaching laboratory in Labuan and caused students to be hospitalized (11). A similar case was also reported in Port Dickson in the same year where 11 chemicals including mercury fell off the rack during the cleaning process which caused chemical spillage (12).

As provided in the Use and Standard of Exposure Chemical Hazardous to Health (USECHH) Regulation 2000 of Occupational Safety and Health Act 1994, Chemical Health Risk Assessment (CHRA) must be conducted at any workplace that utilises chemicals classified as hazardous to health (13, 14). CHRA is a type of assessment that is mandatory to be conducted by employers to assess the risk arising from the use, handling, storage or transportation of chemicals classified as hazardous to health. Teaching and research laboratories, such as university laboratories, handle significant amounts of hazardous chemicals for learning and research purposes. In educational facilities, CHRA may not be necessarily conducted in a teaching laboratory due to various limitations although laboratory workers are exposed to chemical hazards almost every day.

The implementation of OSH-MS in any organisation or universities for that matter is one way to ensure OSH risks are properly managed. Having an effective OSH-MS will provide protection from accidents and reduce ill-health and injuries (7). From the information found on university websites in Malaysia, there are a limited number of higher educational institutions that have gained certification on OSH-MS. However, this does not necessarily means that these organisations do not have a system, but it brings to show that the system they have in place are not certified.

Many studies on knowledge, attitude and practice (KAP) on OSH have been conducted over the years. However, only a few focused on teaching laboratories in the education sector. Most of the studies, such as studies conducted by Goswami et al. (15) and Narayanan (16) were all aimed at workers in medical laboratories while KAP studies on OSH among workers in teaching laboratories were very limited. Research that has been carried out in the educational sector related to OSH mostly focused on students and not the employees and staff (17). Hence, when considering chemical hazards that exist in laboratories, the KAP study on OSH related to chemical handling is necessary to give an overview of the current data that represents Malaysian universities. Good KAP is required in order to avoid accidents and mishaps when handling chemicals that are hazardous to health.

This study was undertaken with the objective to assess the levels of KAP and to relate it with the existence of OSH-MS certifications as well as other related factors among laboratory workers in public universities in Malaysia. This study can provide an overview to related authorities on the role of OSH-MS as a way to manage risks not only in laboratories but also for the whole university.

MATERIALS AND METHODS

This study was a cross-sectional survey carried out at four (4) public universities located in the Peninsular and East of Malaysia, where two (2) are certified with OSH-MS certification while the other two (2) are non-certified universities. Data collection was performed between February to April 2020. The sampling frame of this study was science-based faculties and from the faculties identified, the laboratory workers who work with chemicals were selected through purposive sampling method. Self-administered questionnaire on KAP related to chemical handling was developed or adapted from the published regulation and guideline related to OSH (14, 18) and several previous studies (15, 16, 19–21). The items developed and adapted for the questionnaire are as presented in Table I. The questionnaire was later

Table I: Measurement items on knowledge, attitude and practice on OSH developed from relevant literature or guidelines

Measurement item	Relevant Literature / Guidelines
Knowledge	
Lab workers are protected by OSHA 1994. There is no specific regulation for chemical handling in Malaysia.	Arifin et al. (20)
CHRA is only required in high-risk industries. Health surveillance is required for workers exposed to chemical hazardous to health listed under Schedule I of USECHH regulation 2000.	Use and standards of exposure of chemicals hazardous to health regulations (14)
Fume cupboards are designed or intended to be used as a storage area for volatile chemicals. Handling of hazardous chemical inside the fume hood is meant to protect handlers from dermal hazard Acids should be stored separately from other chemicals	Guidelines on storage of chemical hazards (18)
If someone suffers chemical poisoning due to inhaling of fumes or dust of hazardous chemical, it should be reported to the nearest Department of Occupational Safety and Health office.	Notification of accident, dangerous occurrence, occupational poisoning and occupational disease regulation (42)
Hazard symbol and its meaning	Classification, labelling and safety data sheet of hazardous chemicals regulations (27) Walters et al. (19) Narayanan (16)
Attitude	
Safety and Health is a high priority when I am performing my job I should wear PPE when handling with chemicals even when I am in a busy situation If I saw another employee committing an unsafe practice without PPE, I would say something directly to him or her.	Narayanan (16)
When transferring chemicals into another container/bottle, I should label the container with the chemical name. Chemical Health Risk Assessment should be conducted in laboratories in educational sector although the cost is very expensive Warning signs should be posted at conspicuous place at every entrance to area of hazards.	Use and standards of exposure of chemicals hazardous to health regulations (14)
It is always necessary to report minor chemical spills Disposal of chemical way down the sink is always safe	Walters et al. (19)
Practice	
I make sure I know the hazards posed by the chemical before I start using it If my boss/supervisor/coordinator told me to go for safety training, I will go	Fadeyi et al. (21)
I read SOPs (Standard Operating Procedure) before starting my work	Walters et al. (19)
I don't handle any chemicals without referring to the label or Material Safety Data Sheet I report workplace injury or illness to safety officer or related individual regardless of severity	Narayanan (16)
I always store chemical such as acids inside the fume hoods	Guidelines on storage of chemical hazards (18)
I categorize waste (including used chemicals, sharp objects, hazardous glass, used gloves and non-hazardous trash) before disposal	Goswami et al. (15)
I always relabelled the container/bottle after transferring a chemical into it	Use and standards of exposure of chemicals hazardous to health regulations (14)

distributed to a total of 120 laboratory workers from 28 laboratories across four public universities where they were assessed on their KAP on OSH related to chemical handling.

The questionnaire consists of five (5) sections as the following: (a) socio-demographic information (10 items), (b) safety training (3 items), (c) knowledge on OSH (9 items), (d) attitude on OSH (8 items), (e) practice on OSH (8 items). There were two different types of questions namely; 'Yes' or 'No' questions for knowledge questions and 'Likert Scale' for attitude and practice questions. For knowledge questions, 1 point was given for correct answers and 0 points given for wrong answers. A total of 14 scores were given for knowledge questions. The score ranges for knowledge are categorised as the following;

- High Knowledge : 12 – 14 (85% -100%)
- Medium Knowledge : 8 – 11 (60% - 84%)
- Low Knowledge : ≤7 (≤59%)

For attitude questions, 0 points were given for those who answered 'Strongly Disagree', 1 point for 'Disagree', 2 points for 'Agree' and 3 points given for 'Strongly Agree'. A total of 24 scores were given for attitude questions. The score ranges were categorized into;

- Positive Attitude : 17 – 24 (70% - 100%)
- Negative Attitude : ≤16 (≤69%)

For practice questions, 0 points were given for those who answered 'Rarely' and 'Never', 1 point for 'Occasionally', 2 points for 'Frequently' and 3 points given for 'Very Frequently'. A total of 24 answers were given for practice questions. The score ranges were categorized into;

- Good Practice : 17 – 24 (70% - 100%)
- Poor Practice : ≤16 (≤69%)

This questionnaire was tested on its validity and reliability to ensure that the questionnaire items are getting measured according to the study objectives. Content validity was performed by giving the questionnaire to two OSH experts in Universiti Putra Malaysia to review and evaluate whether the items tested define the content of the study in terms of its clarity and relevance. Next, test-retest reliability was conducted among 15 laboratory workers who found similar inclusive criteria as the 120 laboratory workers who participated in the survey. A test-retest coefficient showed that most of the test items achieved 0.76 – 0.69.

The survey was distributed in person for most part of the data collection but an alternative method of online platform via google survey document was also utilised due to the movement control order implemented in Malaysia in March 2020. All participants were required to answer the survey according to the format provided in the questionnaire. An estimated duration of 5-10 minutes was recorded for participants in completing all the questionnaire items. Data analysis was performed by using IBM SPSS version 25.

RESULTS

General overview

A total of 120 laboratory workers have participated in this study, where 50 (41.7%) of them were from OSH-MS certified universities and another 70 (58.3%) were from OSH-MS non-certified universities. Amongst the 120 participants, there were more males (52.5%) than females (47.5%) where most of them were from the age group of 36-45 years old (51.7%). Most of the participants have served for ≤14 years (70.8%), while the others have been in service for 15-19 years (16.7%) and ≥15 years (12.5%). Majority (94.2%) of them have attended safety training, while in terms of education background, 12.5% are certificate holders, 40.8% Diploma holders, 44.2% Bachelor's degree holders, and 2.5% Master degree holders. A detailed socio-demographic information is shown in Table II.

Knowledge, attitude and practice level of laboratory workers on OSH

In general, 72.5% of the respondents scored high level of knowledge while 26.7% of them scored medium level and another 0.8% scored low level of knowledge. As for the attitude level, the majority (95.8%) of the laboratory workers have a positive attitude while only 4.2% of them have a negative attitude towards occupational safety and health. Meanwhile, in terms of practice on occupational safety and health, 84.2% of the laboratory workers have good practice while 15.8% of them have poor practice on occupational safety and health.

Comparison of knowledge, attitude and practice level on OSH health between laboratory workers in OSH-MS certified and non-certified public universities

This study shows that 76% of laboratory workers in OSH-MS certified universities have high knowledge on OSH, 24% have medium knowledge and none of them have low knowledge. Whereas, in OSH-MS non-certified universities, 70% of the laboratory workers have high knowledge on OSH, 28.6 % have medium knowledge and 1.4% have low knowledge. As for the

Table II: Socio-demographic information of laboratory workers in certified and non-certified public universities (n = 120)

Socio-demographic information		OSHMS Certified Universities (n=50)	OSHMS Non-certified Universities (n=70)	Total
		N (%)	N (%)	N (%)
Gender	Male	37 (74)	26 (37.1)	63 (52.5)
	Female	13 (26)	44 (62.9)	57 (47.5)
Age	≤35	21 (42)	28 (40)	49 (40.8)
	36-45	27 (54)	35 (50)	62 (51.7)
	≥46	2 (4)	7 (10)	9 (7.5)
Length of Service (year)	≤14	37 (74)	48 (68.6)	85 (70.8)
	15-19	7 (14)	13 (18.6)	20 (16.7)
	≥20	6 (12)	9 (12.8)	15 (12.5)
Safety Training	Attended	50 (100)	63 (90)	113 (94.2)
	Never Attend	0	7 (10)	7 (5.8)
Types Safety Training	Chemical Handling	48 (96)	53 (75.7)	101 (84.2)
	First Aid	33 (66)	36 (51.4)	69 (57.5)
	Emergency Response	39 (78)	37 (52.8)	76 (63.3)
	OSHMS	26 (52)	25 (35.7)	51 (42.5)
Education Level	Certificate	3 (6)	12 (17.1)	15 (12.5)
	Diploma	22 (44)	27 (38.6)	49 (40.8)
	Degree	23 (46)	30 (42.9)	53 (44.2)
	Master	2 (4)	1 (1.4)	3 (2.5)

level of attitude on OSH, 94% of laboratory workers in OSH-MS certified universities have a positive attitude and only 6% have negative practice. Whereas, in OSH-MS non-certified universities, 97.1% have a positive attitude and 2.9% have a negative attitude. Majority (88%) of the laboratory workers in OSH-MS certified universities have good practice on OSH and 12% have poor practice whereas in OSH-MS non-certified universities, 81.4% have good practice and 18.6% have poor practice on OSH.

When the data was analysed for its averages, the Mann-Whitney U Test results indicated that there was no significant difference in the knowledge level between laboratory workers in OSH-MS certified universities (Median, (interquartile range); 13.00 (2.25)) and non-certified universities (13.00 (2.00)), where p>0.05. Likewise, there is also no significant difference in the attitude level between laboratory workers in OSH-MS certified universities (23.00 (3.00)) and non-certified universities (23.00 (3.00)), where p>0.05 (p=0.900). However, the tests show that there is a significant difference in the practice level between laboratory workers in OSH-MS certified universities (22.00 (3.25)) and non-certified universities (20.00 (5.00)), where p<0.001. A detailed information on the results is shown in Table III.

Association between knowledge, attitude and practice level with other variables

Results of the bivariate analysis indicate that gender (p=0.680), work experience (p=0.080), safety training (p=1.000) and OSH-MS certification (p=0.811) show no evidence of association with knowledge level as p>0.05. However, age (p=0.006) and education level (p=0.003) show a significant association with the level of knowledge, where p<0.05.

The result of the test indicates that none of the independent variables such as gender (p=0.368), age (p=0.584), work experience (p=0.615), safety training (p=0.263), education level (p=0.855) and OSH-MS certification (p=0.648) showed any evidence of association with attitude level as p>0.05.

Bivariate analysis between practice and socio-demographic and occupational factors was conducted and results of the test showed evidence of association between gender (0.049) and practice level as p<0.05. Whereas, other independent variables such as age (p=0.680), work experience (p=0.065), safety training (p=0.306), education level (p=0.185) and OSH-MS certification (p=0.448) do not show any evidence of association. Table IV presents the results of bivariate analysis between knowledge, attitude and practice level with independent variables.

DISCUSSION

This study assessed the knowledge, attitude and practice with regards to OSH among laboratory workers in OSH-MS certified and non-certified universities in Malaysia. This is the first study carried out to assess the differences which may arise from the implementation of a certified management system in educational institutions in Malaysia. Certified management systems in this study represents the recognition from a third party of the compliance of the organisation to the requirement that it subscribes to. In this study, for the universities that are not having certifications, it does not mean that the university does not have a working OSH management system in place. Instead, it generally implies that the system is there in its entirety or partially and it has not

Table III: Comparison of the level of KAP on occupational safety and health among laboratory workers between OSHMS certified and non-certified public universities (n = 120)

		OSHMS Certified Universities (n=50)	OSHMS Non-certified Universities (n=70)	Total N (%)	*p*-value#
Knowledge Levels, n (%)	High	38 (76)	49 (70)	87 (72.5)	0.190
	Medium	12 (24)	20 (28.6)	32 (26.7)	
	Low	0	1 (1.4)	1 (0.8)	
Median (IQR)		13.00 (2.25)	13.00 (2.00)		
Z Statistics		-1.671			
p-value^		0.095			
Attitude Levels, n (%)	Positive	47 (94)	68 (97.1)	115 (95.8)	0.089
	Negative	3 (6)	2 (2.9)	5 (4.2)	
Median (IQR)		23.00 (3.00)	23.00 (3.00)		
Z Statistics		-0.126			
p-value^		0.900			
Practice Levels, n (%)	Good	44 (88)	57 (81.4)	101 (84.2)	0.022*
	Poor	6 (12)	13 (18.6)	19 (15.8)	
Median (IQR)		22.00 (3.25)	20.00 (5.00)		
Z Statistics		-3.780			
p-value^		<0.001*			

^Mann-Whitney U Test # Chi-square test *p-value is significant at 0.05 level

Table IV: Association between knowledge level and independent variables (n = 120)

Variables, n=120	Knowledge			Attitude			Practice		
	High n= 87	**Medium/Low n= 33**	***p*-value**	**Positive n=115**	**Negative n=5**	***p*-value**	**Good, n= 101**	**Poor, n= 19**	***p*-value**
Gender			0.680			0.368			0.049*
Male	47 (54.0)	16 (48.5)		59 (51.3	4 (80.0)		49 (48.5)	14 (73.7)	
Female	40 (46.0)	17 (51.5)		56 (48.7)	1 (20.0)		52 (51.5)	5 (26.3)	
Age			0.011*			0.584			0.680
≤35	34 (39.1)	15 (45.5)		48 (41.7)	1 (20.0)		43 (42.6)	6 (31.6)	
36-45	50 (57.5)	12 (36.4)		58 (50.4)	4 (80.0)		50 (49.5)	12 (63.2)	
≥46	3 (3.4)	6 (18.2)		9 (7.8)	0		8 (7.9)	1 (5.3)	
Length of Service			0.121			0.615			0.065
(year)	62 (71.3)	23 (69.7)		81 (70.4)	4 (80.0)		68 (59.1)	17 (89.5)	
≤14	17 (19.5)	3 (9.1)		20 (17.4)	0		20 (19.8)	0	
15-19	8 (9.2)	7 (21.2)		14 (12.2)	1 (20.0)		13 (12.9)	2 (10.5)	
≥20									
Safety Training			1.000			0.263			0.306
Attended	82 (94.3)	31 (94.0)		109 (94.8)	(80.0)		96 (95.0)	(89.5)	
Never Attend	5 (5.7)	2 (6.0)		6 (5.2)	1 (20.0)		5 (5.0)	2 (10.5)	
Education Level			0.003*			0.855			0.185
Certificate	6 (6.9)	9 (27.2)		15 (13.0)			(10.9)	(21.1)	
Diploma	42 (48.3)	7 (21.2)		46 (40.0)	3 (60.0)		40 (39.6)	9 (47.4)	
Degree	36 (41.4)	17 (51.6)		51 (44.4)	2 (40.0)		48 (47.5)	5 (26.3)	
Master	3 (3.44)	0		3 (2.6)	0		2 (2.0)	1 (5.2)	

Bivariate Analysis (Chi-square test was used except when cells have expected frequencies of less than 5; this was replaced with Fisher's Exact Test)
*p-value is significant at 0.05

gone through any process by a third party to assess its compliance to the OSH standards that is available in Malaysia.

The International Labour Organisations (ILO) emphasised the implementation of OSH Management System as a way to improve the safety culture in an organisation as well as ensuring the compliance to the OSH regulations at the same time. OSH Management System, as developed by the ILO, comprises a few elements including policy, organizing, planning and implementation, performance monitoring, audit and review (22). Internationally-recognised standards, the OHSAS18001:2007 has been long established and used in many industry-type organisations and facilities (23). This system consists of similar elements to the ILO guidelines, such as policy, planning, implementation, checking and management review. In Malaysia, the ILO-based OSH-MS have been widely used in the country too (24), however with the introduction of the ISO45001 in 2018, this standard replaces the recognition of both OHSAS standard and the Malaysian standard which is known as MS1722:2011. Since the phasing-out process is carried out within three years' time, the certified universities recruited in the present study were still basing their management system based on the previous standards.

Jobs in higher learning institutions, especially in the field of engineering sciences, medicine and technologies pose risks because the teaching and learning process involves working in laboratories where chemicals or machineries are used (20). Various activities inside the educational facilities or campus such as in the lecture rooms, cafeterias, libraries and car parks can trigger emergence of hazards that may result in injuries and ill-health to either students, lecturers, staff, or even visiting guests (25). Bayram and Ün̆gan (9) studied the significance of implementing OSH-MS in educational institutions such as university and college, as many cases of injuries and deaths involving students and instructors have happened over the years. While these accidents mostly happened in laboratories, literature such as by Almutairi et. al. (26) suggests the importance of having a proper management system in universities to reduce accidents.

The safety and health of workers working in public universities in Malaysia are protected under the Occupational Safety and Health Act 1994 (13) as public universities fall under Public Services and Statutory Bodies that is listed in schedule I of the act. In terms of chemical usage in universities, two related regulations under the OSHA 1994 that covers chemical handling in the workplace include Classification, Labelling and Safety Data Sheet Regulation (CLASS) 2013 (27) and Use and Standard of Exposure to Chemical Hazardous to Health Regulation (USECHH) 2000 (14). CLASS Regulation 2013 provide guidelines on the classifications of hazards, packaging of chemicals and the hazard communication of chemicals used in an organisation while the USECHH Regulation 2000 provides guidelines on the standard of chemical exposure, the requirement for personal protective equipment and the requirement for monitoring including chemical exposure monitoring, medical surveillance and health surveillance (13). It is noted that the usage of chemicals in the academic field exposes not only laboratory staff but students to chemical hazards (28) and improper handling of these chemicals can result in mishap in the laboratory (19). It is also important for laboratory workers to be educated

about chemical safety as a way to minimise laboratory accidents from happening.

According to Awang et al. (29), the implementation of OSH-MS in an organisation can lead to the development of a good safety culture. In the present study, in terms of general results, approximately two-third of the respondents have high knowledge towards OSH, 96% have a positive attitude and 84% have good practice on OSH. When analysis was stratified according to certification status, 76% of laboratory workers in OSH-MS certified universities have high knowledge on OSH, 94% have a positive attitude and 88% have good practice. While in the non-certified universities, 70% have high knowledge, 97.1% have a positive attitude and 81.4% have good practice on OSH.

This study found no significant difference in the knowledge and attitude level between laboratory workers in OSH-MS certified and non-certified universities. The generally high knowledge and attitude scores obtained in this study may reflect the extent of safety training received. In total, almost all of the participants (94%) received safety training which is surrounding chemical handling, first aid, emergency response and basic OSH training. When asked further, it was noted that the training was conducted on an annual basis. When compared to a recent published study, unlike the present study, it was reported that more than one-third of medical laboratory staff in government hospitals in Saudi Arabia did not attend safety training or laboratory orientation (30). It is expected that the knowledge level of workers will improve after attending safety training which will also lead to improvement of attitude, showing a possible relation between knowledge and attitude. Since workers have received similar safety training, their level of knowledge was about the same. Thus, as attitude level could be influenced by knowledge level, it could be that the attitude level between the two groups was not very different. Previous studies by Narayanan (16) and Goswami et al. (15) highlighted the fact that intervention programs including training in upgrading the level of safety knowledge has beneficial impacts. Training should not be one-off, instead it should be a continuous and systematic in-service program, as a way to maintain a good knowledge and awareness on safety measures as well as to reduce the rate of accidents (15). There is a significant difference in the percentage value of practice level scored by the participants between the two groups. Generally, good practice levels among laboratory workers in certified universities were higher as compared to the non-certified universities. This brings attention to the implementation of good OSH implementation in certified universities. Structured and systematic OSH governance can facilitate better OSH practice and implementation in certified public universities. Good OSH practice can present itself in the form of reduced ill-health and injuries. This is supported by the fact that effective management of OSH can contribute in terms of reducing the risks of accidents and absenteeism due to injury or illness as well as increasing productivity (29).

There have not been many studies that compare the KAP levels in certified and non-certified universities in terms of its OSH performance. Existing literature generally presents data on KAP among the staff in general terms. The study carried out by Rosliza et al. (31) on safety culture among university staff concluded that 73% of their respondents have a high knowledge level. Results from a KAP study towards OSH conducted in Malaysia by Mohamad Yusoff et al (32) also found that the majority of the respondents (90.4%) have a positive attitude on OSH. By comparing previous data with the present study, the figures do not vary widely. Similarly, the study also concluded that 87.5% of the respondents have good practice on OSH. In another study conducted by Ramli et al. (33) on awareness of staffs in a public university, it was reported that in terms of consciousness with regards to OSH, data obtained showed that safety policy was ranked the highest (with mean of 4.6) while the lowest rank was obtained for safety committee (3.72). When compared with data elsewhere, the study conducted in Yemen (34) among staff in clinical laboratories shows that only 38% of the respondents had high knowledge. Another study conducted in Iran (35) showed that only 10.5% have high knowledge and while 75.7% have a positive attitude with regards to OSH. However, when compared to the study conducted in Europe, specifically in Sweden and Norway (36), the result for the present study is slightly lower than their findings among health care staff. In general, the level of knowledge, attitude and practice (KAP) differs from study to study, but the findings were almost similar when the present study is compared to the Malaysian-based literature, yet it widely varies when compared to countries outside of Malaysia. This study found no association between knowledge level and independent variables such as gender, work experience and safety training. However, younger age and higher education level were significantly associated with the level of knowledge on OSH. The result is different from the findings in one study by Odu et al. (37) in Malaysia where no evidence of association was found between knowledge on safety culture and socio-demographic characteristics. Similarly, in another study conducted in Malaysia by Rosliza et al. (31), job title, employment status, and work experience has proven to have an association with knowledge level on work safety culture. However, the current result is similar to a study in Iran where an association between education level and knowledge level on OSH was proven to be significant (35).

None of the independent variables such as gender, age, work experience, safety training and education level showed any evidence of association with levels of attitude towards OSH. These findings really deviate from many previous studies which have proven the

association of attitude level with socio-demographic characteristics. For instance, the study on attitude towards safety culture among employees at the intensive care unit by Hamouda (38) revealed the association between attitude level and work experience. In another study, an association between attitude on OSH and age was proven significant in 2009 by Nasab et al. (35) where older workers were found to have more positive attitudes as compared to workers who are younger. Similar findings were proven by Hurst (39) and Heidari et al. (40), showing a positive relation between attitude on safety and age.

The bivariate analysis results indicated no association between practice level and independent variables such as age, work experience, safety training and education level. However, the test indicated that there is an association between the female gender and better practice level on OSH. The result was similar with findings from 2013 by Rosliza et al. that has proven evidence of association between gender and practice level. On the contrary, other studies such the ones by Odu et al. (37), Sui (41) and Nasab et al. (35) have not proven any association between gender and practice but they found a meaningful relation between practice level and age.

This study had several limitations and one of which is that this study did not utilise any standard questionnaire as a way to measure the level of KAP. This means that it may not be a balance comparison to compare the KAP levels indicated in this study with studies elsewhere. Instead, this study developed and adapted questions related to chemical handling, exposure and storage from valid sources such as Malaysian regulations and guidelines related to the OSHA 1994 and peer-reviewed literature. Secondly, the study participants recruited consisted solely of laboratory staff who handle chemicals. Laboratory staff are among the support staff in science-based faculties and their number is small and does not represent the whole university. As such, the results of this study could not be representative of a university as a whole, instead it only reflects the specific population recruited. The strength of this study is that this study recruited participants across a large number of science-based laboratories in public universities and the results of this study can be used as a basic data to gauge the knowledge and awareness levels specific to chemical handling.

CONCLUSION

In summary, this study found good practice levels to be significantly higher in certified universities among laboratory workers who handle chemicals. Higher knowledge in general was associated with younger age groups and higher education level while better attitude was linked to the female gender. Structured and systematic OSH governance can facilitate better OSH practice and implementation in certified public universities. The organisations with OSH-MS certification will need to comply with all legal and other requirements that the organisation subscribes to in order to maintain its certification status and such organisations are likely to be stricter in terms of ensuring that all activities and processes adhere to safety and health procedures and work instructions.

Having said that, although OSH-MS certification was not linked to higher knowledge and better attitude among staff in matters relating to OSH, the implementation of a suitable, adequate and effective management system which is continually improved is crucial and needs to be implemented to manage the OSH risks in the organizations. Good OSH implementation will develop a good image, morale and increase productivity of workers. Since laboratory workers will need to convey safety and health information to students, it is important for them to have a good knowledge, attitude and practice on OSH first. Therefore, continuous safety training is necessary for laboratory workers in order to maintain, at the same time, to improve their knowledge on OSH particularly on laboratory safety which is a dynamic field due to the advancement of technology. A stricter system will influence the workers to be more compliant to the safety and health rules while working, thus preventing accidents from happening.

ACKNOWLEDGEMENTS

We would like to thank the administrative board of each of the participating universities and faculties for the privilege to conduct our research among their employees. Thanks to the faculty representatives who assisted us throughout the data collection period and thank you to all the participants for taking the time out of their busy working schedules to contribute to this study. The present study has received fundings from the Fundamental Research Grant Scheme under the Ministry of Higher Education Malaysia and Project ID 13328 entitled "Critical Success Factors to the Successful Implementation of Occupational Safety and Health Management System at Public Universities in Malaysia" with reference number FRGS/1/2019/SKK06/UPM/02/12.

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