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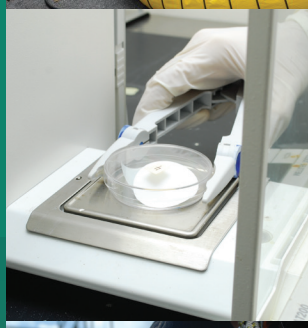

National Institute of Occupational Safety and Health (NIOSH)
Ministry of Human Resources Malaysia

Journal of Occupational Safety and Health

The Journal

- Aims to serve as a forum for sharing research findings and information across broad areas in occupational safety and health
- Publishes original research reports, topical article reviews, book reviews, case reports, short communications, invited editorial and letter to editor.
- Welcomes articles in occupational safety and health related fields.

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Contents

Introducing the Journal of Occupational Safety and Health

The National Institute of Occupational Safety and Health (NIOSH) is delighted to announce the publication of Journal of Occupational Safety and Health (JOSH).

JOSH is devoted to enhancing the knowledge and practice of occupational safety and health by widely disseminating research articles and applied studies of highest quality.

JOSH provides a solid base to bridge the issues and concerns related to occupational safety and health. JOSH offers scholarly, peer-reviewed articles, including correspondence, regular papers, articles and short reports, announcements and etc.

It is intended that this journal should serve the OSH community, practitioners, students and public while providing vital information for the promotion of workplace health and safety.

Apart from that JOSH aims:

• To promote debate and discussion on practical and theoretical aspects of OSH

• To encourage authors to comment critically on current OSH practices and discuss new concepts and emerging theories in OSH

• To inform OSH practitioners and students of current issues

JOSH is poised to become an essential resource in our efforts to promote and protect the safety and health of workers.

From the Editor in Chief

Workplace safety is a priority. Much needs to be done to encourage employees, employers and industries to put occupational safety and health at the top of their agenda. The most important thing is our commitment in taking action; our commitment to make the necessary changes to ensure that safety is at the forefront of everyone's thinking.

The Journal of Occupational Safety and Health (JOSH), the first to be published in Malaysia, aims to boost awareness on safety and health in the workplace.

It is no longer sufficient to simply identifying the hazards and assessing the risks. We aim to increase understanding on the OSH management system. We aim to strengthen commitment to workplace safety and better working conditions. We believe these aims can be achieved through participations and involvement from every industry.

We hope the contents of the journal will be read and reviewed by a wider audience hence it will have a broader academic base, and there should be an increased cumulative experience to draw on for debate and comment within the journal.

It is our hope that the journal will benefit all readers, as our purpose is to serve the interest of everybody from all industries. Prime focus will be on issues that are of direct relevance to our day-to-day practices.

I would personally like to take this opportunity to welcome all our readers and contributors to JOSH (Vol 14, No 2). I look forward to receive contributions from the OSH community in Malaysia and elsewhere for our next issues.

Ayop Bin Salleh
Editor-in-chief

Original Article

Air-Conditioned Building Occupants' Preferred Temperature: A Comparative Study

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ABSTRACT **:** *The purpose of this study is to assess the preferred temperature (T_{pref}) of human participants exposed to air-conditioned temperature variations in climate chamber experiments. Findings were later compared with an earlier T_{pref} experiment by de Dear et. al. (1991). Twenty nine healthy college-age participants underwent thirty minutes of preconditioned session before casting their thermal preference and thermal sensation votes every 10 minutes for the remaining 150 minutes of the experiment. These affective votes were correlated against average of ambient air temperature and participant's body temperature taken 30 minutes before the experiment ends. The mean T_{pref} was 25.1°C (± 1.2), mean skin temperature of 33.7°C (± 0.6) and mean body temperature of 36.3°C (±0.3). It can be concluded that T_{pref} gathered in the preferred temperature experiment shows significant difference in participants' temperature preference which was 0.6 °C cooler than earlier experiment suggesting change in how indoor ambient temperature is preferred. In addition, mean skin temperature and gender did not influence participants' T_{pref}.*

Keywords - *Preferred Temperature; skin temperature; thermal sensation; thermal preference; climate chamber.*

1.0 INTRODUCTION

A building designed to incorporate non-uniform air-conditioning set-points that are based on spatial requirements is believed to consume less energy (Baizhan Li, Meilan Tan, Hong Liu, Xiaolei Ma, & Wenjie Zhang, 2010; Zhao, 2007), and at the same time to reduce the prevalence of Sick Building Syndrome among office workers (Baird & Berglund, 1989; Shove, Walker, & Brown, 2013). Furthermore, there are concerns that the widespread use of air-conditioning may reduce the ability of a population to acclimatize to hot weather (Kannan, 2012; Liao, 1977).

In order to provide the thermal conditions suitable for building occupant's thermal comfort, many field measurements and controlled experiments were conducted to suggest the suitable preferred temperature across different metabolic rate, age groups and climate zones (de Dear, Leow, & Ameen, 1991; Djamila, 2014; Fanger, 1970; Fanger, Højbjerre, & Thomsen, 1977; Fanger, Langkilde, 1975; Rohles, 1969). Office workers preferences have found to reflect individual differences in response to their office temperature. Findings from test rooms or climate chamber experiments reported that office workers' cognitive performance, efficiency and productivity may deteriorate under less preferred temperature (Hancock & Vasmatzidis, 2003; Pilcher, 2002; Rohles, 1969; Sellaro, Hommel, Manaï, & Colzato, 2015). In the light of these investigations, findings of this study will be compared against an earlier preferred temperature climate chamber experiment by de Dear et. al. (1991), in order to identify the current air-conditioned building occupant's preferred temperature. The latter study was chosen due to

similar sample size, experiment duration, using ambient air temperature as stimuli and not recruiting participants with thermal histories from extreme climatic conditions. In order to investigate the influence of body temperature on preferred temperature, core temperature were monitored in this study instead of evaporative weight loss. Given the 22 year gap in using climate chamber experiment to determine occupant's temperature preference, it is likely to investigate whether an invariant finding is still relevant.

2.0 METHODOLOGY

2.1 Participants

Participants in this preferred temperature experiment comprised of twenty nine healthy college-aged students from The University of Sydney, Australia during winter season. There were twelve male and seventeen female students, of whom twelve were South Americans, eight were Chinese, three were Anglo Saxons, two were Indians, two were Middle Easterners and two were Europeans. All participants had been acclimatized to Sydney's temperate climate conditions. Situated at coordinate 33.87°S, 151.21°E, Sydney experiences the hottest month in January with an average temperature of 23°C and the coldest is July at 13°C with the most daily sunshine hours in December. The wettest month is March with an average of 164mm of rain. Meteorological data during experiment periods were observed.

2.2 Preferred Temperature Experiment

According to Cabanac et al. (1971), the preferred temperature is also known as the most pleasant temperature, where it is inversely proportional to body temperature (T_b) (Burton, 1935)(Equation 1) . A certain temperature stimulus may elicit a pleasant or unpleasant response based on how well it can restore the internal body temperature to its thermoregulatory set point (Cabanac, 1971).

$$T_b = (T_c \times 0.7) + (T_{sk} \times 0.3) \quad \text{.....Eq. 1}$$

where, T_c is core temperature and T_{sk} is skin temperature.

2.3 Instruments

Participant's core and skin temperatures were monitored throughout the three hour experimental period. Participants' core temperatures were detected using a CoreTemp® sensor (Figure 1a) ingested 8 hours before the scheduled session. The sensor's signal (of 262 kHz or 300 kHz) passes harmlessly through the body to the CorTemp® Data Recorder worn outside the body (Figure 1b). The core temperature was recorded every five minutes. Seven-point skin temperatures, at the forehead, left hand, left forearm, left abdomen, left anterior shin, left anterior thigh and left instep, were measured using wireless thermistors (i-Buttons) (Figure 1c). The digital thermometer measures temperatures from -55°C to +100°C, typically in 0.2 seconds with an accuracy of ±0.5°C within 0°C to +70°C. The skin temperatures were recorded every five minutes.

a) CoreTemp® Seonsor b) CoreTemp® recorder c) iButtons

Figure 1: Instruments Used in the Preferred Temperature Experiment

Participants were instructed to wear standard uniforms, which included a long-sleeved cotton twill shirt, denim long trousers, socks, covered shoes and their own underwear (Figure 2). The clothing insulation value of this light summer ensemble was 0.60 clo (Rohles, Woods, Nevins, 1973). For subjective vote gathering purpose, an iPad© IEQ questionnaire application

was developed to administer two psychometric scales on a fast 60-second turnaround. All selections were saved to the iPad© memory in a time-stamp comma separated file.

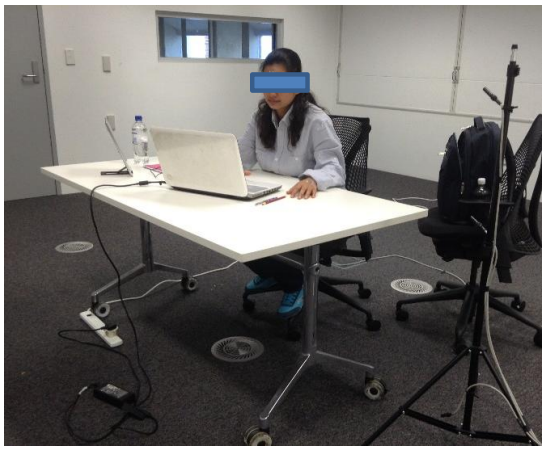

Figure 2: Participant of Preferred Temperature Experiment in Climate Chamber.

2.4 Preferred Temperatures Experimental Procedures

Experiment sessions were conducted in the Indoor Environmental Quality Lab, The University of Sydney, Australia, using the facilities described in (de Dear, Nathwani, Cândido, & Cabrera, 2012). Participants were exposed to adjustable indoor ambient temperatures under variable air valve (VAV) conditions in a climate chamber. Set point adjustments and monitoring of the ambient air temperature and relative humidity in the occupied zone of the climate chamber were 0.6 m above the floor and were logged every five minutes by the Building Management and Control System (BMS) – Automated Logic. The chamber was set to an operative temperature of 25.7°C. This temperature was obtained using Fanger's comfort equation in order to calculate a PMV value of zero with the specified clothing ensemble, activity level (W/m^2 = 60), relative humidity (30%) and air velocity (0.13 m/s) (Fanger, 1970; ISO7730, 2006).

At least two days before their experimental session, participants were briefed about terms used in the preferred temperature experiment and how to express their thermal sensations and preferences. They were also briefed on the dos and don'ts when handling the CoreTemp® sensor. Participants were advised against smoking, drinking caffeine and alcohol after ingesting the CoreTemp® sensor in order to avoid body temperature alteration.

On the day of the experiment, thirty minutes of pre-conditioning in the climate chamber were allocated, wherein participant was asked to conduct sedentary tasks quietly before casting their first vote. Participants were asked to vote their thermal preference and thermal sensation every 10 minutes for the remaining 150 minutes of the experiment. The questions that assessed thermal preference and sensation were:

i) Do you want to change the air temperature? (Scale used: 1 = want warmer temperature; 0 = no change; -1 = want cooler temperature).

ii) How would you rate your current thermal sensation? (Scale used: (-3 = cold; -2 = cool; -1 = slightly cool; 0 = neutral; 1 = slightly warm; 2 warm; 3 = hot).

2.5 Data Analyses

One-sample t-test was run to determine whether there was a significant mean different between earlier participants' preferred temperature (de Dear et al., 1991) and recruited participants using SPSS version 20. Similarly to the de Dear et. al. (1991), the preferred temperature for a single participant was calculated from the mean ambient air temperature in the climate chamber during the last thirty minutes of the experiment. It was observed that most participants in the earlier experiment

appeared to have reached steady state around two hours after the exposure period. Pearson correlation was used to identify the relationship between body temperature (independent variable) and preferred temperature (dependent variable).

3.0 RESULTS AND DISCUSSION

The preferred temperature experiment started from 30th August 2013 until 24th September 2013 with two sessions per-day, i.e.: morning session (9:00 a.m. - 12:00 p.m.) and afternoon session (1:00 p.m. -4:00p.m.). Each participant was given the freedom to choose his/her experiment slot. Preferred temperatures (T_{Pref}) from 29 participants were normally distributed, as assessed using Shapiro-Wilk's test (p >0.05) and there were no outliers in the data, as assessed by inspection of a boxplot. Figure 3 shows mean T_{Pref} detected at 25.1°C (±1.2). Table 1 shows results of anthropometric data, T_{Pref}, TSV and physiological assessments from 29 participants. One-sample t-test conducted indicates significant difference between the earlier T_{Pref} of 25.7°C reported by de Dear and co-workers (1991) and results from current participants. Moreover, the mean T_{Pref} did not differ significantly between male and female (Table 2).

Mean skin temperature (T_{sk}), mean core temperature (T_c), mean body temperature (T_b) and mean thermal sensation vote (TSV) were averaged over the final 30 minutes of the experiment where participants expressed that they were in their thermal neutral state. The T_{pref} reported by de Dear et. al. (1991) is slightly warmer compared to our current T_{pref}, with exception to nine participants who perceived 26°C as their T_{pref}. Mean T_{sk} of the current sample at 33.7°C (± 0.6) was warmer but not significantly different from the 33.1°C (± 0.6) as reported by (de Dear et al., 1991).

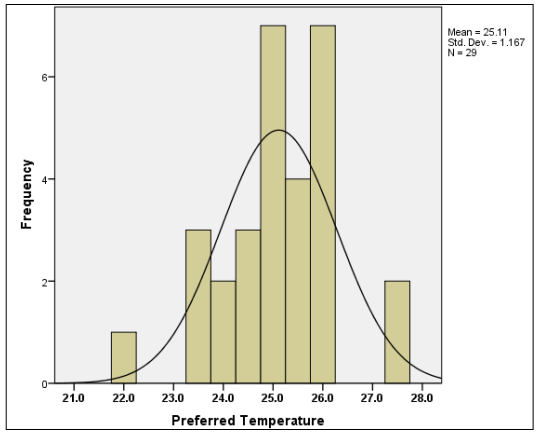

Figure 3: Mean Preferred Temperature

Table 1: Anthropometric Data, Preferred Temperature, Thermal Sensation Vote and Physiological Assessments

	Mean (std dev.)							
	Age (years)	Weight (kg)	Height (cm)	T_{Pref} (°C)	Mean T_{sk} (°C)	Mean T_c (°C)	Mean T_b (°C)	Mean TSV
Participants, n = 29	31.2 ±5.2	69.5 (±18.5)	171.7 (±11.7)	25.1 (±0.3)	33.7 (±0.4)	37.2 (±0.3)	36.3 (±0.3)	0 (±0.1)

Table 2: Preferred temperature according to gender.

		Mean (std dev.)			
Gender	n	Age	Weight (kg)	Height (cm)	T_{Pref} (°C), std.dev.
Male	12	31.5 (±4.7)	83.1 (±10.2)	177.2, ±8.1	25.1, ±1.4
Female	17	28.2 (±3.3)	56.2, ±7.3	162.1, ±6.3	25.1, ±1.0

A significant but weak positive relationship was observed between the mean T_{pref} and T_b (r=0.419; $p<0.05$). This finding is not in agreement with similar studies on T_{pref} and T_b which detected inversed relationships between the two said temperatures (Cabanac, 1971; (Ohnaka, Tochihara, & Watanabe, 1994). Both Cabanac (1971) and Ohnaka et. al. (1994) conducted their experiment to suggest the affective responses of subjects (i.e. one and nine subjects, respectively took part in the experiments) when exposed to variations of water temperature as the stimuli instead of ambient air temperature. In this study, it was found that half of the participants did not opt for cooler ambient air temperature despite having T_b higher than 36.3°C. Therefore, it is assumed that healthy participants that were subjected to mild metabolic tasks ($W/m^2 = 60$) and stimuli within the thermal neutral temperature of 25°C may not be entirely influenced by their T_b when making decisions on their T_{pref}. However, further climate chamber experiment is needed to verify the latter claim.

Despite conducting the experiment during winter, eight participants perceived the preconditioned 25.7°C as warm and preferred a cooler ambient temperature. The inverse relationship between outdoor and indoor temperature in thermal history was not fully evidenced. This response could be partly due to the fact that experiments were conducted when Sydney, Australia was experiencing the warmest winter on record. Nine warm days reaching at least 30°C, and no cold spells below 20°C, were recorded from August until October in 2013 (Bureau of Meteorology, 2014).

4.0 CONCLUSION

This study takes into consideration the role of preferred temperature (T_{pref}) as a function of mean body temperature (T_b) (Cabanac et al., 1971). T_{pref} serves as a reference where there is no feeling of thermal pleasantness or unpleasantness. Twenty nine college-aged healthy students participated in climate chamber experiments to determine their mean T_{pref} which was 0.6 °C cooler than previous finding by (de Dear et al., 1991). It can be concluded that T_{pref} gathered after a twenty two year gap using climate chamber experiment shows significant difference in participants' temperature preference suggesting change in how indoor ambient temperature is preferred. In addition, mean skin temperature and gender did not influence participants' T_{pref}.

Future research may investigate the relationship between experiment participant's thermal history and their preferred temperature when occupying air-conditioned buildings. It is also recommended that professional office workers would be considered as experiment participants in order to gather physical qualities different from university student volunteers thus verifying the current findings.

ACKNOWLEDGEMENTS

This research is the first part of the Thermal Alliesthesia Experiments in which all were funded under the Australian Discovery Project (Research Class: C2078, Project no.: A7675). The author would like to thank Professor Richard de Dear of Indoor Environmental Quality Lab, University of Sydney, Australia for his guidance throughout the experiment.

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Original Article

Indoor Air Quality and Symptoms of Sick Building Syndrome in Two Selected Building (New versus Old)

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ABSTRACT : *Poor IAQ would lead to the occurrence of Sick Building Syndrome (SBS) and other symptoms. This study aimed to investigate the IAQ and the symptoms of SBS among the office workers in the two selected buildings (old and new). A comparative cross sectional study was conducted among 90 office workers from an old building (26 years of age) and a new building (5 years of age). The SBS symptoms were assessed utilising the questionnaires adopted from Industry Code of Practice (ICOP) 2010 while IAQ parameters were monitored using the Handheld 3016 IAQ Particle Counter and Multi-Function Ventilation Meter. All the parameters studied were below the standard limit as set by the Department of Occupational Safety and Health (DOSH) and the United States of America's Environmental Protection Agency (US EPA) except for air velocity in the old building which was lower than the acceptable standard range. The levels of PM_{10} and total particulate matter (TPM) in the old building was significantly higher as compared to the new building (PM_{10}: $Z= -2.495$, $p = 0.013$ and TPM: $Z = -2.873$, $p = 0.014$). The SBS prevalence was 51.1% among respondents at the new building while 64.4% for old building. However, the difference was not statistically significant ($p > 0.05$). There was a significant association of drowsiness among respondents between old and new building ($\chi^2= 4.050$, $p = 0.044$). Therefore, in order to ensure a good IAQ, regular maintenance of ventilation and control measures should be conducted.*

Keywords - *Indoor air quality, sick building syndrome, air velocity, temperature, particulate matter*

1.0 INTRODUCTION

People spend 80% of their time indoors such in offices and in homes equipped with system such as heating, ventilation and air-conditioning (Yang & Heinsohn, 2007). Hence, indoor air quality (IAQ) of the building is a fundamental determinant of healthy living and well-being, comfort, and productivity of the human being. The interactions between climate (outdoor temperature and humidity), building design and ventilation systems, sources of contaminants (from outdoor such as fossil fuels emission or within indoor such as cooking combustion) and occupants are factors that may affect the IAQ.

Department of Occupational Safety and Health (DOSH), Malaysia in the Industrial Code of Practice on Indoor Air Quality (ICOP 2010) has proposed a list of selected indoor air quality parameters and their acceptable limits (DOSH, 2010). Such standard limits must be complied to maintain a good IAQ. For an ideal IAQ, the air inside the building should contain an

acceptable levels of contaminants of biological forms (molds or microorganisms), chemical forms (such as Carbon Dioxide (CO_2), Carbon Monoxide (CO), Volatile Organic Compound (VOC) which are vaporous and may be harmful when present in the breathing air at high concentration) or physical contaminants like dusts (particulate matters (PM): PM_{10}, $PM_{2.5}$ or ultrafine molecules). These contaminants could cause adverse health effect to human upon skin contact or when entering the respiratory system (Nur Fadilah & Juliana, 2012).

One of the well-known health effect related to poor IAQ is sick building syndrome (SBS). The SBS has been a major issue as many people are potentially at risk and it might affect job satisfaction, work stress, and productivity. The International Labour Organization (ILO) defines SBS as a phenomenon that occurs when 20% of respondents reported symptoms related to their respective places of work with a particular association with the IAQ (ILO, 2000). The SBS symptoms include itchy eyes, skin rash, nasal allergy, fatigue, body aches, sensitivity to odours and difficulty in concentration. Normally, SBS symptoms are present when the occupants were in the building and as they left the building, the symptoms will be absent; while the causes of the symptoms are unknown (Jones, 1999). The aetiology of SBS has always been a challenge due to its root cause has not yet discovered (Passarelli, 2009). The aim of this study was to investigate the level of indoor air quality (IAQ) parameters and the symptoms of SBS at two selected office buildings (new and old). Association of the reported health symptoms between the occupants of the new and old office buildings was established with the SBS.

2.0 METHODOLOGY

2.1 Study Design

A comparative cross-sectional study was conducted among 90 office workers who are registered staff, have worked at current building for at least four months, including males and females from both new and old buildings. The criteria for building selection were based on its age, using centralized air conditioning system and number of occupancies. The age of the old building is 26 years while the new building is 5 years. Both the new and old buildings have almost similar number of occupants (137 vs 132) and were completely depend on the centralized ventilation system to provide sufficient air.

2.2 Questionnaire Survey

A structured questionnaires adopted from the Industry Code of Practice (ICOP) 2010 were distributed to respondents. The questionnaires gathered information on socio demographic background, health status, time spent in the building weekly, the job position, the symptoms of SBS, and the perceived quality of the air inside the building. The respondents were defined as having SBS if they had at least one symptom of SBS and the symptoms appeared at least once a week. The respondents also must had reported the occurrence at least 1-3 days per week during the last four weeks and must had reported that the symptoms showed improvement when they were away from the place of work (Hodgson, 2002).

2.3 Indoor Air Quality Assessment

The assessment of IAQ at the selected buildings was conducted according to ICOP 2010 (DOSH, 2010). Following ICOP 2010, the numbers of sampling points were estimated based on the total volume of office floor area in each building. The sampling points were determined by considering the position of respondents and source of fresh air intake. The measurements of IAQ were conducted five days a week continuously from 8 am to 5 pm. Altogether, a total of four office areas were assessed within one month period. Lighthouse Portable Airborne Counter was used for measuring concentration of PM_{10}, $PM_{2.5}$, TPM, temperature and humidity, while Multi-Function Ventilation Meter was used to measure air velocity.

2.4 Statistical Analysis

Data was analyzed using Statistical Package for Social Sciences (SPSS) Version 22. The level of which $p<0.05$ was set as significance in the study. Kolmogorov-Smirnow statistic was used to test the normality of the data variables and the data was not normally distributed. The Mann-Whitney test was used to compare the IAQ parameters between the two buildings. The Chi Square test was used to associate the prevalence of health related symptoms among respondents as well as to determine the association of SBS with building category.

2.5 Ethical Considerations

The study protocol was explained to respondents and each individual has provided written informed consent prior to participation. This study was approved by the Human Research Ethics Committee USM (HREC) with the reference code USM/JEPeM/15110514 dated on 29th February 2016. All data were kept confidential throughout the study.

3.0 RESULTS

3.1 Building Characteristics

The characteristics of the two buildings were investigated. The old building was fully operated since 1990 while the new building was opened since 2011. Both buildings were located far from the main road and traffic light. They were built of concrete bricks with slanting tile roof. Fibre glass or rock wool was not detected within the rooms of any building. Both buildings were equipped with mechanical ventilation air conditioning systems. Smoking was prohibited in any of these buildings. The housekeeping chores include weekly mopping with water which contains detergent and daily removal of rubbish from dustbins.

3.2 Respondents Characteristic

There were 45 staffs recruited each from the old and new buildings. Majority of workers in both buildings were Malay females and non-smokers. With regards to their age, 44 percent (%) of the respondents in the old building were ranged from 20-29 years old while 37.7% respondents from the new building were ranged from 30-39 years old (Table 1).

Table 1: Characteristics of Respondents in the Old and New Buildings

Variables	N,%	
	Old Building (n=45)	New Building (n=45)
Gender		
Male	19 (42.2)	17 (37.8)
Female	26 (57.8)	28 (62.2)
Race		
Malay	45 (100.0)	44 (97.8)
Chinese	0 (0.0)	1(2.2)
Indian	0 (0.0)	0 (0.0)
Others	0 (0.0)	0 (0.0)
Age group		
20-29	20 (44.4)	4 (8.9)
30-39	13 (28.9)	17 (37.8)
40-49	8 (17.8)	15 (33.3)
50-55	4 (8.9)	9 (20.0)
Smoking Status		
Non-smoker	43 (95.6)	44 (97.8)
Smoker	2 (4.4)	1 (2.2)

3.3 Office Conditions between Building Categories

Both respondents (>50%) in old and new buildings were not satisfied with the room temperature and air dryness. In addition, they experienced stuffy bad air, unpleasant odour, and reported the presence of dust or dirt but reported less passive smoking in the office environment (Table 2).

Table 2: Comparison of Office Condition in the Old and New Buildings

Office Condition	Old Building		New Building	
	N = 45 (100%)		N = 45 (100%)	
	Yes	No	Yes	No
Room temperature was too high	32 (72.1)	13 (28.9)	29 (64.4)	16 (35.6)
Room temperature was too low	30 (66.7)	15 (33.3)	31 (68.9)	14 (31.1)
Varying room temperature	39 (86.7)	5 (11.1)	38 (80.0)	9 (20.0)
Stuffy bad air	15 (33.3)	30 (66.7)	26 (57.8)	19 (42.2)
Dry air	31 (68.9)	14 (31.1)	30 (66.7)	15 (33.3)
Unpleasant odour	32 (71.1)	13 (28.9)	28 (62.2)	17 (37.8)
Passive smoking	16 (35.6)	29 (64.4)	8 (17.8)	37 (82.2)
Dust and dirt	35 (77.8)	10(22.2)	29 (64.4)	16 (35.6)

3.4 Indoor Air Quality (IAQ) Assessment

The physical parameters of Indoor Air Quality (IAQ) studied were below the standard limit as set by the DOSH, Malaysia and the United States of Environmental Protection Agency (USEPA). Only the air velocity in the old building was found to be not within the acceptable range. There was higher humidity level reported in the new building compared to the old building. However both buildings were within the acceptable ranges of temperature and relative humidity inside the office environments of 23-26^{o}C and 40-70% respectively (DOSH, 2010).

Table 3: IAQ Assessment of Old and New Buildings

IAQ Parameter	US EPA Standard	DOSH Standard	Average	
			Old	**New**
$PM_{2.5}$ ($\mu g/m^3$)	35	-	11.77	7.44
PM_{10} ($\mu g/m^3$)	150	-	35.83	28.09
TPM ($\mu g/m^3$)	260	-	51.54	40.81
Temperature (^{0} C)	-	23 – 36	24.44	24.18
Relative Humidity(%RH)	-	40 – 70	48.64	54.26
Air Velocity (ms^{-1})	-	0.15 – 0.50	0.12	0.16

Table 4: Comparison of IAQ in Old and New Buildings

IAQ Parameter	Median (IQR)		Z Statistic	P value
	Old	New		
$PM_{2.5}$	9.10	6.99	-0.756	0.450
	(6.17 – 14.29)	(6.39 – 8.86)		
PM_{10}	38.79	28.06	-2.495	0.013*
	(32.03 –50.48)	(24.06 – 32.61)		
TPM	53.78	41.62	-2.837	0.014*
	(49.97 – 69.50)	(36.06 – 46.39)		
Temperature	24.37	24.43	0.000	1.000
	(23.89 – 25.13)	(22.90 – 25.35)		
Humidity	48.16	52.76	-1.436	0.151
	(41.83 – 54.23)	(49.94 – 58.84)		
Air Velocity	0.12	0.16	-0.757	0.449
	(0.03 – 0.21)	(0.11 – 0.202)		

* Significant at $p < 0.05$, Statistical test - Mann-Whitney

In contrast, the concentration of particulate matter (PM) was much higher in the old building as compared to the new building, but it was still within the acceptable level (Table 3). There were significant differences in PM_{10} and TPM between both buildings ($p<0.05$) while the trend were opposite (non significance) for $PM_{2.5}$, temperature, humidity and velocity (Table 4).

3.5 Health Related Symptoms among Respondents in Old and New Buildings

Drowsiness was the highest reported symptom (95.6%) in the old building while fatigue (86.7%) was the highest in the new building. Eye irritation was the least reported in the old and new buildings with 20.0% and 8.9% respectively. The occurrence of drowsiness was significantly different in both buildings ($\chi 2 = 4.050$, $p=0.04$) (Table 5). There was 64.4% of SBS prevalence in the old building as compared to 51.1% in the new building. However, no association was found between the prevalence of SBS with buildings' category ($p > 0.05$) (Table 6).

Table 5: Comparison of Health related Symptoms in Old and New Buildings

Health Related Symptoms	Old Building N=45		New Building N =45		$\chi 2$	P Value
	Yes	**No**	**Yes**	**No**		
Headache	35 (77.8)	10 (22.2)	34 (75.6)	11 (24.2)	0.062	0.803
Fatigue	40 (88.9)	5 (11.1)	39 (86.7)	6 (13.3)	0.104	0.743
Drowsiness	43 (95.6)	2 (4.4)	37 (82.2)	8 (17.8)	4.050	0.044*
Nausea	19 (42.2)	26 (57.8)	12 (26.7)	33 (73.3)	2.411	0.120
Cough	25 (55.6)	20 (44.4)	22 (48.9)	23 (51.1)	0.401	0.527
Stuffy Nose	28 (62.2)	17 (37.8)	27 (60.0)	18 (40.0)	0.407	0.829
Dry Throat	26 (57.8)	19 (42.2)	25 (55.6)	20 (40.44)	0.045	0.832
Skin Rash	23 (51.1)	22 (48.9)	19 (42.2)	26 (57.8)	0.403	0.525
Itching scalp/ears	22 (48.9)	23 (51.1)	18 (40.0)	27 (60.0)	0.720	0.396
Eyes Irritation	9 (20.0)	36 (80.0)	4 (8.9)	41 (91.1)	2.248	0.134

Table 6: Association of the Prevalence of SBS with Building Category

Building Category	Prevalence of SBS (N=90)		POR	95% CI	P Value
	Yes	No			
Old building	29 (64.4)	16 (35.6)	0.577	0.248 – 1.343	0.200
New building	23 (51.1)	22 (48.9)			

POR: Prevalence Odds Ratio, Statistical test - Chi-Square

4.0 DISCUSSION

4.1 The Indoor Air Quality (IAQ) Parameters

The IAQ parameters investigated in this study were acceptable (DOSH, 2010; USEPA, 1991). However, the air velocity in old building was lower than the acceptable standard range (0.15-0.50 ms^{-1}) which contradicted with the previous findings reported in old buildings (Ahmad & Mimi, 2015). Their results indicated that the old building has good IAQ level compared to the new buildings. Whereas, in this study, the PM_{10} and TPM concentrations was higher in the old building as compared to the new building. Similarly, Mohd Ezman *et al*. (2013) reported that the level of indoor air pollutants (CO_2, VOC, PM_{10} and $PM_{2.5}$) in old building was significantly higher as compared to new building. Sources of particulate matter in the office workplace could be from the laser printers, cleansers, photocopy activity, laminator, fragrant sprayers and even tobacco (Burr & Alderfer, 1991). Aerosolized toner powder particles with diameter >10 µm could be emitted from printers (Lee *et al*., 2001).

From the observation, the higher levels of PM_{10} and TPM in the old building could be due to the open-area for photocopy machines and fax-machines. In addition, those who work stations were positioned in close proximity to the

photocopy machine, painted wall, new carpeting had greater tendency to experience SBS than those who did not (Burr & Alderfer, 1991). In contrast, the major indoor air pollutant in the old building were particles produced from printers, as they were not isolated from the workspace area (Wang & Morawska, 2008). Even though smoking in the office was prohibited but some of the workers reported had smoked within the building area especially in toilet and car park.

The exact cause of the low velocity rate in the old building was unable to be identified and should be further investigated. The basis of suspicion that it might be caused by poor maintenance of the Heating, Ventilation, and Air Conditioning (HVAC) system cannot be established as it was not studied. Theoretically, the building would be placed under the negative pressure if the HVAC system was not functioning properly. In such cases, there might be infiltration of outdoor pollutants such as particulates, vehicle exhaust, and humid air. Consequently, the HVAC filter might be clogged and restricted the airflow, thus causing the system unable to circulate the air effectively (OSHA, 2011). Moreover, dust contained not only fine dirt but also human dander, microorganisms, and other particulates such as pollen, mould spores, fungi, and even rodent faeces. Hence, the HVAC system would be contaminated and becoming the breeding ground for bacteria, fungi, mites and other pests (WHO, 2009). Besides, it was known that fungal and bacteria exposure could increase the incidence of SBS (Zhang *et al*., 2011).

Both parameters, temperature and humidity in the old and new buildings were in the acceptable range. Temperature was known to be directly proportional to the relative humidity. The perception of comfort was related to one's metabolic heat production, heat transfer to environment, physiological adjustments, and body temperatures. Heat transfer from the body to the environment has been influenced by factors such as temperature, humidity, air movement, personal activities, and clothing (Burr & Alderfer, 1991).

To maintain a good indoor air quality inside the buildings, occupants should practice good housekeeping, isolation of the fax-machines and printers, and regular maintenance of the ventilation system. The most practical control measure for indoor air problems is by controlling the point source. The good indoor air quality was imperative for healthy workers.

4.2 Symptoms and Prevalence of SBS

Respondents felt drowsy as they work in the office, even though the room temperature was within the normal range. Lower room temperature was found to increase the percentage of drowsiness. Foo and Phoon (1987) reported that most of the occupants suggested that 27°C should be the most comfortable temperature. In addition, drowsiness might also be caused by the low level of artificial lighting. Human biological clock is controlled by melatonin, which is controlled by lighting. The intensity of indoor artificial lighting if lesser than the natural light, would affect the amount of hormone melatonin released by the body (Wright *et al*., 2013). Lack of light intensity will potentially reduce the production of melatonin, thus makes people to feel drowsy (Lazar *et al*., 2013).

Symptoms of SBS among respondents in the old building was significantly higher as compared to the respondents in the new building. Higher amount of particulate matter, low humidity, and slower air velocity were the factors contributing to SBS, while age and characteristics of the building were also important (Ahmad & Mimi 2015; Syazwan *et al*.,2009). The old ventilation system added with poor maintenance may reduce the ventilation rate. The increase of ventilation rate in office building would significantly reduce the prevalence of SBS (Mohd *et al*., 2013). Malfunctioning heating, ventilation, and air-conditioning systems (HVAC) and ineffective circulation of air was the main cause of SBS (Gupta *et al*., 2007).

No significant association was found between SBS and building category. The aetiology of SBS was influenced by the other stressors such as psychological, ergonomics of the work, stress level, job satisfaction, position in the organization, and other environmental conditions (Gupta *et al*., 2007). Both buildings occupants were considered to experience SBS if more than 20% of the occupants reported SBS symptoms during this study (Rosner, 2007). Most frequent irritants in the office were chemical "fumes' like adhesives, glues, and correction fluids. Other such sources might include wall paint, carpets, and other cleaners (Burr & Alderfer, 1991).

To reduce the prevalence of SBS symptoms, effective minimization of indoor air pollutants could be done by replacing building materials and furnishings of low emission potentials, locating the outdoor-air intakes away from unknown outdoor sources, and using special exhaust system to remove localized contamination sources (Shaw, 1997).

4.3 Limitation of Study

This study was only focused on certain environment factors, leaving out other potential environmental risk factors for sick building syndrome (SBS). Firstly, this study did not measure the presence of bioaerosols and chemicals. Increased relative humidity (RH) has been frequently associated with the presence of molds and fungi that was strongly associated with the occurrence of SBS (Engvali *et al*., 2001). This study also did not measure other specific environmental attributes, such as level of Carbon Dioxide (CO_2), Volatile Organic Compound (VOC), and formaldehyde. As a result, the study findings were only limited to the physical parameters measured. In addition, thorough assessment of ventilation system was not investigated in

this study. Hence further research on this should be conducted as it was found that air velocity in old building was lower than the acceptable range.

Furthermore, job stressors and psychological work environment were not assessed. Job strain, high psychological job demands, and low social support at work were found to be associated with SBS. Workstation factors such as noise, lighting, comfort, proximity of a window, and time spent at a video display terminal (VDT) were also associated with SBS symptoms (Azuma *et al*., 2006). On the other hand, since the data was collected in a short period and involved only short term of ambient sampling, therefore our findings might not represent the condition throughout the year.

5.0 CONCLUSION

All the physical parameters of indoor air quality measured in this study were within the acceptable limit as set by the DOSH and the USEPA except for air velocity in old building (which was lower than the acceptable range). However, PM_{10} and TPM were significantly different between old and new buildings. Headache, fatigue and drowsiness were highly prevalent in both buildings. However only drowsiness showed a significance different. Although no significant association was found between symptoms of SBS and the building category (old versus new), regular maintenance of ventilation and control measures should be conducted to ensure a good IAQ for building occupants.

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Original Article

Perceptions of Fire Safety Training among School Teachers in Kelantan, Malaysia

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ABSTRACT : *Recent fire accidents in schools have given rise to the safety issues. Training on fire safety is very important to help improve the safety aspect in schools while perceptions of fire safety training among school teachers are crucial in order to identify methods to prevent accidents from recurring. This study was conducted in order to analyze the perceptions of school teachers towards fire safety training in schools. Survey questionnaires were distributed among 400 school teachers from 111 schools randomly selected from ten District Education Offices (DEO) in Kelantan. The results were analyzed using Statistical Package for the Social Sciences (SPSS). They were based on 32% and 68% male and female respondents respectively. Descriptive analysis shows that most of the school teachers agreed with the need for fire safety training to be conducted in schools. This study suggests that school teachers require fire safety training in order for them to help improve fire safety in schools. Thus, teachers will be able to teach their students on the importance of fire safety, how to prevent fire and actions to be taken if an emergency happens in schools. It is hoped that the number of fire accidents in schools can be reduced with the school communities' commitment towards safety.*

Keywords - *Perception, Fire, Training, Teachers, School*

1.0 INTRODUCTION

Fire normally takes place without any warning. When it happens, building occupants are restricted in the amount of time they have to either extinguish the fire or to escape (Salleh & Ahmad, 2009). According to Spadaccini (2016), when fire is not effectively controlled, people may suffer injuries and at times, death. There is also destruction of properties, temporary or permanent closure of buildings, among other things. Fire can burst into flame anywhere or at any place including schools. Students, teachers and other staff spend most of their time in school. For example, in Turkey, a previous study reported that the period of teachers and students spend in school is about 180 days of a year or 6 hours daily (Erkan & Talha, 2009). A school is considered as a "place of work" and the term means premises where persons work, or premises used for the storage of plants and substances (NSKC, 2015). Thus, the probability of the risk and hazard to occur in schools could be higher than other places.

Gopalakrishnan (2012) clearly stated that in recent years, fire accidents have become one of the highlighted issues in educational institutions such as schools based on local newspaper reports. For example, on June 15, 2013, a student died while 2 others were injured in a fire at a private school, Maahad Tahfiz Al-Barakah (Mantab), Kampung Masjid, Tikam Batu, Kedah (Sinar Harian, 2013). On May 13, 2015, a similar tragedy occurred at Maahad Tahfiz Khairul Kalam, Shah Alam, Selangor at 7.38 am, destroying equipment and furniture such as mattresses and beds on the second floor of the building (Astro Awani, 2015). Another school, Tahfiz Ribat Assyafie's Islamic Studies Centre, Kijal, Terengganu experienced three fire incidents within two months. The first incident happened on 6 April, 2015 followed by the second one on April 25, which destroyed two blocks of dormitories that were occupied by 30 students and caused losses totalling RM200,000. The third incident that occurred at around 6 pm on 7 May, 2015 had destroyed the administrative building with estimated losses of more than RM100,000 (Harian Metro, 2015). Dozens of fire cases had occurred in educational institutions since 2007 as shown in Table 1 (New Straits Times, 2017).

Table 1: Chronology of Fire Incidents at Malaysian Religious and Tahfiz Schools from 2007 to 2017 (New Straits Times, 2017)

No	Cases	Date
	2017	
1.	A tahfiz student sustained injuries in a fire at the hostel of Pondok Nurul Iman in Kampung Tanjung Batu, Nenasi in Pekan, Pahang	13 January 2017
2.	The An-Nuur Islamic Education Centre, better known as Pondok an-Nuur in Pantai Sepat, Kuantan, Pahang, which housed 113 students, was razed in a fire. It was the second incident since 2006, when a blaze razed the students' hostel.	16 January 2017
3.	A total of 73 female religious school students in Maran, Pahang, were left with just the clothes on their back when a fire destroyed their hostel.	7 February, 2017
4.	Pondok Al-Baghdadi in Tumpat, Kelantan, which accommodated 100 students aged between 15 and 30, was destroyed in a fire. No casualties were reported.	28 February, 2017
5.	Ten residential buildings of Pondok Seri Permai in Pasir Puteh, Kelantan, were destroyed in a fire, leading to losses estimated at RM161,000.	17 April 2017
6.	Thirty students of Mahaad Tahfiz Al-Quran Al-Ismailiyah Mukim Lalang, Banggol Chicha, Pasir Mas, Kelantan, saw their hostel reduced to ashes in a blaze.	30 April 2017
7.	The store room of the Al-Islah residential religious school in Teluk Intan, Perak, which accommodated 68 students, was destroyed in a fire.	3 July 2017
8.	The Addiniah Al-Latifiah residential religious school in Pengkalan Hulu, Perak, which had 66 students, was destroyed in a fire.	4 July 2017
9.	Two hostel blocks of Maahad Tahfiz Al-Barakah in Sepang, Selangor, which housed 100 male students, were razed in a fire.	30 July 2017
10.	A total of 22 students and two teachers were killed in a fire at the Darul Quran Ittifaqiyah in the federal capital. The incident was believed to be caused by a short-circuit.	14 September 2017
	2016	
11.	A two-storey building which housed 30 students of Al-Redzuan residential religious school in Kampung Dato Ahmad Razali, Dengkil, Selangor, was razed in a fire.	18 January 2016
12.	A total of 60 students of Darul Itqan Al-Muhammadi residential religious school in Kampung Batu 40, Sabak Bernam, Selangor, lost their hostel to a fire.	7 March 2016
13.	The hostel of Maahad Tahfiz at-Tijarah at Jalan Bukit Idaman 8, Bukit Idaman in Selayang, Selangor, was among the premises destroyed in a fire.	3 March 2016
14.	Madrasah Tahfiz Al-Quran Raudhatul Ulum, Bagan Selat, in Butterworth, Penang, was destroyed in a fire. No casualties were reported.	11 May 2016
15.	The hostel of Madrasah Diniah Bakriah Pondok Pasir Tumboh, which housed more than 50 students, was razed in a fire. No casualties were reported.According to the Kelantan Fire and Rescue Department, this was the second fire-related incident at the school. The first one was in July 2016.	18 June 2016
16.	Maahad Tahfiz Daril Naim in Pangkal Kala, Melor, Kota Bharu, in Kelantan, was razed in a fire.	22 September 2016
	2015	
17.	The premises that housed the essential items of the students of Ribat Assyafie residential school in Taman Murni Perdana, Dungun, Terengganu, was destroyed in a fire.	6 May 2015
18.	The hostel of Tahfiz Khairul Kalam in Jalan Kebun, Shah Alam, Selangor, which had 26 students was destroyed in a fire.	13 May 2015
19.	Three students of Raudhatut Tahfiz residential religious school in Km2, Jalan Gunung Jerai, in Guar Cempedak, Kedah, suffered burns when a fire broke out at their hostel.	29 July 2015
20.	The hostel of Madrasah Tahfiz Al-Zahra in Kampung Ladang, Gelang Patah, in Johor Baharu, Johor, was razed in fire about 6am.	28 August 2015

21.	A fire destroyed 70 per cent of the Al Ummi religious school in Labuan; however, all of its students and teachers were safe.	21 October 2015
	2014	
22.	Seventeen students of Maahad Tahfiz Muhammadiah, Bukit Rangin, in Kuantan, were left without their two-storey school, no thanks to a blaze.	14 February 2014
	2013	
23.	A student of Maahad Tahfiz Al-Barakah (Mantab), Kampung Masjid, Tikam Batu, near Sungai Petani, Kedah, was found burnt to death, and two others injured when a fire destroyed their hostel.	15 June 2013
24.	A total of 81 students of the Kunak religious school in Sabah lost their belongings when their temporary hostel for male students was destroyed in a blaze.	4 July 2013
	2012	
25.	The second floor of the Assyifa residential religious school in Kampung Kolam, Kuala Ibai, in Terengganu, which housed 25 students, was destroyed in a fire while the students were performing Zohor prayers at a nearby surau.	9 September 2012
26.	A hostel for male students at the Sekolah Menengah Agama Nadzah, Bukit Besar, in Yan, Kedah, was destroyed in a fire believed to have been caused by short-circuit. Fires had also broken out in 1996 and 2005 at the same school.	25 January 2012
	2011	
27.	The top floor of the two-storey Maahad Qiraat Al-Azhar Amal Aimy Zdalifah at Km3, Jalan Sungai Korok, Sultan Abdul Halim Highway, in Alor Setar, Kedah, was destroyed in a fire.	16 January 2011
	2010	
28.	Sekolah Pondok Lubuk Tapah, Kelantan's oldest religious and educational centre, was destroyed in a fire.	22 January 2010
29.	An eight-year-old student of a private religious school in Hulu Langat, Selangor, was burnt to death in a fire.	25 July 2010
	2009	
30.	A fire which broke out at Sekolah Madrasah Darul Hikmah in Kota Kinabalu, Sabah, left damage estimated at about RM 200,000. However, no casualties were reported.	1 January 2009
	2007	
31.	Twelve students of Sekolah Menengah Agama Darul Makmur in Pekan, Pahang, were unable to sit for an examination after their school building was destroyed in a fire.	7 August 2007
32.	A fire destroyed Sekolah Pondok Bandar Hilir in Teloi, Sik, Kedah, However, there were no casualties as the incident happened during a school holiday.	22 September 2007
33.	A hostel block which housed 96 students of Sekolah Nurul Hidayah Al-Quran Maahad Tahfiz Pasir Puteh, Kelantan, was destroyed in a fire.	22 October 2007

March, Amaya-Jackson, Terry, & Costanzo, (1997) point out that fire accidents could lead to property loss, psychological distress, and sometimes loss of life. Fire accidents also show lack of awareness and fire safety knowledge in schools. One of the methods that can be used to help increase knowledge is through training and many studies showed that fire safety training is a recognized way of increasing the knowledge about fire safety among the public and improving their response with the aim of reducing the number of fire-related casualties (DiGuiseppi et al., 2002; Halpern & Hakel, 2003; Kennedy, 2003; National Fire Protection Association [NFPA], 2000; Proulx, 2003).

Fire safety education and training for teachers is imperative in order to prevent untoward incidents from happening in the case of an emergency, like fire (Urban Pro, 2010). This statement is also supported by the National Fire Protection Association (2017) regarding reported cases on U.S. fire department's response to approximately 5,690 fires at education buildings each year. Thus, it is very important to emphasize on fire safety education in Malaysian schools.

1.1 Fire Safety Training

Generally, training is present in many areas, such as military, aviation, management and others to obtain a specific set of skills needed for an explicit job. Training is used extensively in emergency preparations, which are rare events and need special attention. In the past as well as recently, many severe accidents have occurred in which people had lost their lives and property damaged, partly due to lack of training.

Human behavior in the field of fire safety has developed markedly since the late 50's when the first research was done by Bryan (1983). Obtaining deeper knowledge on why people behave the way they do could help fire safety engineers to change and design better evacuation process. Many research papers have mentioned that training is the key influence on successful evacuation of people from affected buildings. There is also a question about what kind of training, the period and content of such fire safety education that should be provided to the people in different

environments. People need to feel protected and safe in any time or occasion. With a special type of fire safety education on fire issues, an improvement can be made towards better and safer working environment (Andrej Cebela, 2012).

Besides that, according to Health Safety (2011), fire training is important because fires destroy property, cause injuries, and take lives. A fire in the workplace can also mean the termination of jobs, as many of the offices and factories destroyed by fire in Canada for example, are never rebuilt. One of the key strategies to maintain a safe workplace and prevent fires is fire safety training. With proper training, workers can eliminate fire hazards and respond quickly and efficiently if a fire breaks out. Without proper training, a small occurrence could quickly grow into a major incident with devastating outcomes. Everyone is at risk if there is fire and fire safety training could teach workers on how to recognize fire hazards, conduct fire risk assessment, prevent a workplace fire and respond if a fire occurs (Health Safety, 2011). The same rules also apply to teachers in school.

It is always advisable that proper fire safety measures are put in place to control the situation. Fire safety training has been studied by many researchers across the globe (Chen et al., 2012). This is because the fire safety community has recognized the importance of good fire management to reduce the vast increase in accidental fires (Woon & Suleiman, 2015). According to Nadzim and Taib (2001), fire safety management is the combination of or co-ordination of some activities or programs towards the prevention of damage from fire. Such programs include fire drill training, staff training, preventive measures, escape routes, etc. According to Della-Giustina (1999), when an effective fire safety management is properly and carefully developed, the end results can include reduced property insurance premiums, prevention of business interruptions, boosting customer services and public images, among others. Ramachandran (1999) asserts that safety is the complement of antithesis of risk. Safety will be increased if the risk is reduced.

Apart from that, safety training is to prepare oneself or come into a state of efficiency for a race and match (Hayward & Sparkes, 1982). Training is the process of learning the skills you need to do the job (Oxford Dictionary, 2010). It can also be the process of training or being trained, the education, instruction, or discipline of one who or that which trains (Webster's 1989). A response or an action of a person is the result of a behavioral or decision-making process. Occupants' response is determined by following processes which are awareness of the cues, interpretation of the situation and risks, deciding about action and action performance. A variety of factors will influence a decision-making process, such as experience with fire, familiarity with the environment, knowledge of language and many others including the training for fire safety emergencies (Kuligowski, 2009). Training should be designed for diverse types of occupancies in a form of theoretical practice, exercises, drills, and preparation for unexpected events. A study was done by Huseyin & Satyen (2006) to explore the importance of fire safety training in enhancing fire safety knowledge and response to the fire. The study assessed the current level of fire safety knowledge within general community. By providing fire safety training to all the participants, fire safety knowledge increases and the accuracy of response to a fire scenario increases too. Past studies argued that with proper fire safety training, a reduction in the rate of fire casualties could be suggested (Huseyin & Satyen, 2006).

Moreover, according to Nationwide (2017), educating and preparing students for a fire emergency should be a top priority. Some suggested programs that can be conducted are school fire drills which are done as expected and unexpected way and inspection on the exits to ensure stairways, doors and windows are unblocked and working properly. There should also be training programs for students on how to respond to fire alarm and locate fire protection system, fire alarm pull stations and sprinklers. They must also ensure every room has a map showing 2 exits, pair students with specific needs to an adult or classmate for extra assistance, have a predetermined assembly areas, a list to ensure every student is accounted for, encourage parents to practice home fire drills and prepare them in the event of a residential fire (Nationwide, 2017). However, all these activities for students should be conducted by teachers in school. Teachers should have adequate knowledge on fire safety in school and the aim of this study is to measure the perceptions of teachers towards fire safety training in school.

2.0 METHODOLOGY

This study was undertaken to assess the level of fire safety perceptions among school teachers in Kelantan, Malaysia by using a quantitative approach. Kelantan is a state located in the north east of peninsular Malaysia with a total number of 592 schools under ten District Education Offices. The questionnaires used in this study were adapted from Emergency Preparedness Questionnaire by City of Vancouver (2014), which focuses on the level of concern for various types of emergencies. Apart from that, the questionnaires are also based on the study conducted by Gail Sout (2000) regarding introduction to fire safety. The questionnaires were distributed among 400 teachers from 111 schools which were randomly selected from ten District Education Offices in Kelantan. The purpose of the questionnaires was to measure the level of perception among school teachers towards fire safety training in schools. The questionnaires were divided into two parts. Section A is for demographic background of the respondents. Section B is about their perceptions of fire safety training in school. The questions were constructed using closed-ended type of question with Likert scale. The respondents need to answer the questions whether they 1- Strongly Disagree, 2- Disagree, 3- Agree or 4- Strongly Agree. The questionnaire underwent expert-validation process in order to assess its suitability, language

used and clarity of the questions. Meanwhile, a pilot study was also completed in order to ensure the questionnaire was acceptable for the purpose of this study.

3.0 RESULTS AND DISCUSSION

This section presents the results obtained from the survey conducted after the questionnaire was validated by experts. The results were analyzed using Statistical Package for the Social Sciences (SPSS). Figure 1 shows the percentage of respondents by gender whereby 32 % are males and 68% are females.

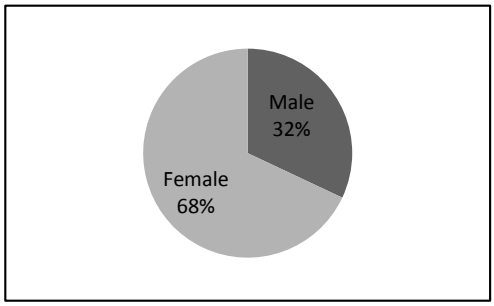

Figure 1: Percentage of Respondents by Gender

Meanwhile, Figure 2 shows the percentage of respondents by age whereby 3% of the teachers are 26-30 years old; 31-35 years old (13%), 36-40 years old (20%) and 41 years old and above (65%) . This indicates that most of the respondents have sufficient experience as school teachers in order to provide reliable responses to the questionnaire.

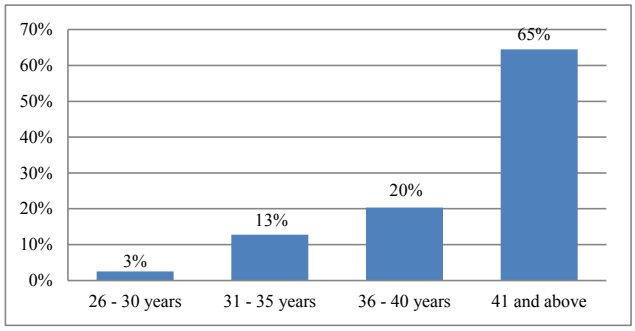

Figure 2: Percentage of Respondents by Age

Table 2 shows the reliability statistics for the questions used in this study. The result shows that Cronbach's Alpha is 0.947, which is considered reliable for the data (Bahaman Abu Samah, 2012). Meanwhile, this study also measures the validity of each question. The alpha value for total correlation is lower than the values for Cronbach's Alpha If Item Deleted, which means the questions used in this study are valid and accepted (Yusri, 2010).

Table 2: Reliability Statistics for the Questions

Cronbach's Alpha	No of Questions
0.947	10

In this study, all of the questions that had been asked are regarding perception of respondents about fire safety. Table 3 shows the descriptive statistics of the data gathered from the questionnaires survey.

Table 3: Descriptive Statistics of the Data Gathered from the Questionnaires Survey

No	Questions	Mean	Standard Deviation
Q1.	The importance of establishing a gathering place in case emergency happens should be disclosed in fire safety training	3.630	0.489
Q2.	Fire drill training should be carried out at school	3.618	0.492
Q3.	Instructions to teachers on safety measures should be provided	3.615	0.497
Q4.	Every person must be exposed and know regarding first step that should be taken in case if fire occur in work area immediately.	3.588	0.537
Q5.	Information on preparing an emergency route plan should be included in the training	3.570	0.506
Q6.	Information about tools that need to be have at schools such as fire alarm buttons, emergency door signage and fire extinguisher should be disclosed	3.568	0.511
Q7.	Exposure of fire prevention methods should be emphasized in fire safety training	3.568	0.512
Q8.	Everyone needs to know how to use the fire extinguisher	3.560	0.517
Q9.	Teachers needs to know where to put and place fire extinguishers in the school area	3.558	0.522
Q10.	Fire-extinguishing elements such as heat, fuel and oxygen need to be told to teachers	3.530	0.543

Based on the table, the mean score for each question is between 3 and 4, indicating that respondents agree with the statements given in terms of fire safety. The questions were sorted out based on the highest mean to the lowest mean. The highest perception was of Q1 which states the importance of establishing an emergency assembly area during fire safety training in schools. They agree that the assembly area is important as everyone can gather there during an emergency. According to the State of Connecticut Department of Developmental Services (2004), the first thing that must be done when fire occurs is the evacuation process. Evacuation means all occupants in the affected building must escape as quickly and as orderly as possible to a predesignated point of safety. This means that at schools, the teachers need to attend training on how to plan evacuation process which is smooth and safe. Training aims to improve performance and reduce stress for people by supporting the development of psychological flexibility at the jobsite. Psychological flexibility is the ability to be in mindfully aware of thoughts and emotions, and committed to achieve valued goals in school (State Of Connecticut Department Of Developmental Services, 2004).

Furthermore, most of the teachers also agree that fire drill should be carried out in schools. It is also important to conduct fire drill training program in schools because it can train and expose teachers to possible scenarios if fire occurs in school. According to Fire and Rescue Service (2016), it is the responsibility of teachers and the governing body of the premises to ensure that fire evacuation drills are carried out. The danger which may threaten children and staff if a fire breaks out depends on many different factors. Consequently, it is not possible to construct a model procedure for action in the event of fire which would be suitable for use in all premises. Each fire routine must be based upon a simple, efficient procedure which is specifically designed for the premises in which it has to operate. It is therefore important that the following points must be given prime consideration. Thus, several fire drill trainings should be conducted in a school in a year (Fire and Rescue Service, 2016).

Meanwhile, Q8, Q9 and Q10 respectively state that everyone needs to know how to use fire extinguisher, teachers need to know where to place fire extinguishers in the school area and fire-extinguishing elements such as heat, fuel and oxygen need to be communicated to teachers. The teachers also agree with all these statements. Fire extinguishers also play a critical role by controlling fires at their very early stage. According to Brendan Mccheffrey (2011), a leading sustainability on-line research organization, from a safety as well as from an environmental and carbon release perspective, the management of a fire with a fire extinguisher at the very early stage is the best case scenario. Besides that, the availability of accessible and working fire extinguishers assure that the highest possible percentage of fires will be controlled with the minimal environmental impact possible (Brendan Mcsheffrey, 2011). Thus, fire extinguisher training also needs to be provided to teachers so that they can improve and maintain fire safety in school.

4.0 CONCLUSION

The study has shown that most of the school teachers understood and agreed with the importance of fire safety training provision in schools. Many severe fire accidents that have occurred in the past should be an example of what

could go wrong and what could be done well. Technical disadvantages that led to untenable fire conditions are due to lack of fire safety training for teachers and other staff in schools. In many incidents, more often than not the victims only became aware of the fire too late and some even were not aware of it at all (Andrej Cebela, 2012). This could be due to lack of training for emergency response in case of fire. In spite of everyone's most conscientious efforts, fire and other emergency situations may still occur. Thus, it is important for schools and teachers to have appropriate planning, training and skills for them to be ready and able to react effectively. The training given and information shared could help prepare the teachers so that if a fire incident does occur, the response should be immediate, intelligent and most importantly, effective. Thus, knowledge regarding fire safety is very important to prevent or minimize accidents. It is hoped that the number of fire accidents in schools can also be reduced with the increasing commitment shown in the school communities.

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Original Article

The Strategic Role of Safety Advice towards Safety Participation in OSHMS in Malaysian Manufacturing Firms

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Abstract: *In order to have an effective preventive measures to reduce accidents at the workplace, organisations need to take a robust step to increase safety participation in Occupational Safety and Health Management System (OSHMS). Accidents will affect employees' morale for work and employers will bear the consequence of the direct and indirect recovery cost. Specifically, accidents will cost big company's good reputation. This study intends to examine the relationship of organizational safety factors (management safety commitment, safety training, extrinsic reward, intrinsic reward, employee involvement, safety communication and safety advice) towards safety participation in OSHMS using the resource-based view (RBV) and knowledge-based view (KBV) theories. A total of 100 responses were analysed from the Malaysian manufacturing firms with OHSAS 18001 or MS 1722 certifications. Data were analysed using the Smart Partial Least Square (SmartPLS). It is found that safety training and employee involvement have direct relationship towards safety participation in OSHMS. Specifically, the safety advice showed a significant moderating effect on the relationship between management safety commitment and safety participation in OSHMS. The findings of this study are useful to both OSH practitioners and organisation who wish to understand and apply safety capital towards safety participation in OSHMS with specific reference to the role of safety advice played by safety professionals.*

Keywords *- Malaysia, manufacturing, safety advice, OSHMS safety participation.*

1.0 INTRODUCTION

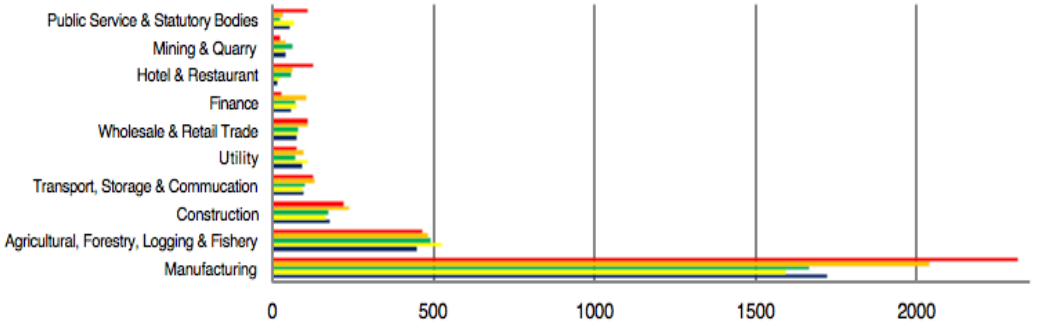
The manufacturing industry is the country's top 3 revenue generator. However, it has consistently recorded the highest number of occupational accident rate. Figure 1 showed the recent statistics of occupational accidents by sector from the year 2012 to 2016.

In order to reduce this alarming accident rate, the manufacturing sector needs to understand the reason behind the high accidents rate and improve their safety structures and processes proactively. Empirical studies has shown how the adoption of OSHMS not only reduces the rate of work accidents, can also be used as a strategic tool to improve business operations when it is compared side by side with organisations with and without OHSMS in place (Abad, Lafuente & Vilajosana, 2013; Hong, 2013; Vinodkumar & Bhasi, 2011). Furthermore, lower rates of workplace accidents and fewer interruption in the production process due to accidents offer a wide range of observable benefits derived from the adoption of OSHAS 18001 or OSHMS (Abad et al., 2013; Rzepecki, 2012).

As a result of the rapidly changing environment, certification of safety management system that is also known as OHSAS 18001 has become fundamental to achieving competitiveness for firms (Vinodkumar & Bhasi, 2011). Studies revealed that organisation that has OSHMS in place or has been certified with OHSAS 18001 does not only see the improvement of the firm's safety performance but provide an edge of competitiveness (Fernandez et al., 2012). Thus this long-term investment helps create and maintain a safe work environment and is seen as a cost-control tool (Abad et al., 2013).

Similarly, lack of employee participation has been identified as a major reason for the non-sustainability of an integrated management system (Lund, 2004). This has led to the interest of this study to further understand how organisation can sustain its competitiveness in the aspect of safety participation in OSHMS. This implies that safety participation in OSHMS is a critical element in order for an organisation to adopt OSHMS successfully and sustains its competitive advantage in the long run. Therefore, this study aims to investigate the impact of organisational factors toward safety participation in OSHMS. Specifically, this study has the following research questions.

1. Does human capital of management safety commitment and safety training, structural capital of reward system (extrinsic reward and intrinsic reward) and social capital of employee involvement and safety communication influenced safety participation in OSHMS?
2. How does safety advice moderates the relationship between management safety commitment and safety participation in OSHMS?



	Manufacturing	Agricultural, Forestry, Logging & Fishery	Construction	Transport, Storage & Commucation	Utility	Wholesale & Retail Trade	Finance	Hotel & Restaurant	Mining & Quarry	Public Service & Statutory Bodies
2016	2315	467	222	127	74	111	28	126	24	110
2015	2041	481	237	131	96	108	106	62	39	32
2014	1667	491	172	99	69	80	69	58	62	25
2013	1595	527	164	92	110	78	73	21	35	67
2012	1722	447	177	95	92	73	59	15	42	53

Source: Department of Occupational Safety and Health, 2017 (DOSH, 2017).

Figure 1: Statistics of Occupational Accidents by Sector from 2012 to 2016.

2.0 LITERATURE REVIEW

2.1 Management Safety Commitment

In order to achieve safer workplace, a manager plays an important role in promoting safety participation (Clarke & Ward, 2006). Employee's participation in an organisation is motivated when management is committed or involved in the improvement activities (Gallagher & Underhill, 2012; Raines, 2011; Subramaniam et al., 2016). Employer's participation in terms of commitment towards employees' welfare at work is viewed as a pivotal role to the success of a management system. This is because managers play a dual role in influencing employees' attitudes as well as behaviours in reducing occupational accident rates at the same time (Fernández-Muñiz et al., 2014).

Firstly, managers have a direct influence through their positive attitude to safety and through their behaviours. Secondly, the managers have an indirect influence through their support and funding for the implementation and development of the safety management system (Fernández-Muñiz et al., 2007). They can play the role to ensure that safety programs are able to run smoothly with adequate allocation of resources (specifically money & staff), active participation in safety meetings, investigating accidents, establishing correctives actions and encouraging all workers to be involved in such programs (Aksorn & Hadikusumo, 2008; Griffin & Hu, 2013; Hansen, 2006). Hence, this affirms that employees' behaviour and involvement in safety activities is positively influenced by the managers' safety commitment and by the safety management system implemented in the organisation.

2.2 Safety Training

Employees need to have the appropriate skill set to do their job effectively and able to identify hazards at the same time. A well designed and administered training program should emphasise safe work practices and be derived from a true assessment of need (Vredenburgh, 2002). In spite of that, safety training should be geared towards improving employees' knowledge and at the same time also increase self-efficacy and reduce anxiety and stress levels (da Cunha, Cipullo, Stedefeldt & de Rosso, 2015). According to Vinodkumar and Bhasi (2010), safety training plays a significant role in accident prevention programme and in any occupational safety and health programme. This is because safety training helps to improve behavioural skills, related knowledge and/or attitudes. Subsequently, this leads to a positive effect of safety training in improving behaviours which is related to our daily habitual routine (Ricci, Chiesi, Bisio, Panari & Pelosi, 2016).

2.3 Reward System

Reward system plays an important organisational role in motivating employees to perform their daily tasks (Burton, 2009). As suggested, for safety management system to influence safety behaviour, a reward system should be established to support the continuous improvement cycle in an organisation (Al-Refaie, 2013). Specifically, two main categories of rewards have been identified from the literature; the intrinsic reward and extrinsic reward.

2.3.1 Intrinsic Reward

Researchers have established that there are seven different types of intrinsic rewards (Allen & Kilmann, 2001; Ozutku, 2012). Firstly, a non-monetary form of recognition to acknowledge achievement. Second, creating a celebration to acknowledge an achievement. Thirdly, having regular appreciative expressions displayed by managers to employee to acknowledge their achievement. Fourthly, a 360-degree performance appraisal where feedbacks from co-workers and/or customers is incorporated into the performance appraisals. Fifth, providing a suggestion system available for individuals to make suggestions. Sixth, the use of developmental based performance appraisal. Finally, a continuous improvement based promotion wherein promotions are based primarily on the achievement of continuous improvement based goals (Allen & Kilmann, 2001; Ozutku, 2012).

2.3.2 Extrinsic Reward

On the other hand, researchers have listed six different types of extrinsic rewards (Allen & Kilmann, 2001; Ozutku, 2012). Firstly, individual based performance system refers to performance appraisals and pay increases that are based primarily on individual achievements. Secondly, profit sharing is a bonus plan that shares a portion of profits from the corporation with the employees. Thirdly, gain sharing refers to the portions of individual work unit gain in productivity, quality, cost effectiveness, or other performance improvements which are shared with employees in the form of bonuses based on a predetermined formula. Fourth and fifth, includes the employment security and overtime pay. Finally, quantity based performance appraisals become the six type.

2.4 Employee Involvement

Employee involvement is viewed as a behavioural oriented technique that involves individuals or groups in the upward communication flow and decision-making processes within the organization (Vinodkumar & Bhasi, 2010; Vinodkumar & Bhasi, 2011). The distinctiveness of employee involvement comes when employees are empowered to participate in managerial decision-making and improvement activities appropriate to their levels in the organisation by generating ideas for safety improvement in their workplace. When employees volunteer ideas and concerns, they feel that their opinions matter and their voices are heard. Subsequently, this will increase employee involvement (Raine, 2011). Moreover, employees who are involved in their work are excited about their job, thus this implies that they care about the future of their company and are willing to invest their discretionary effort (Gupta, 2015).

2.5 Safety Communication

Safety communication refers to regular communication about safety issues between managements, supervisors and workforce as an effective management practice to improve safety in workplace (Vinodkumar & Bhasi, 2010). This two-way communication can be conducted through regular meetings, trainings, briefing, regular personal contact by way of walk-about, publications in the form of newsletters, e-mails, memoranda and etc. In addition, sign posts, caution signs, and other indications of safety are also used as regular feedback to communicate to employees on their performance (Subramaniam et al., 2016). When communication that links between workers and management are kept open, this enable the flow of information especially in area pertaining to safety matters (Zohar, 1980). Another purpose of communication is to make sure that everyone understands their roles and responsibilities in pertaining to safety and health at the workplace.

2.6 Safety Advice

In this study, safety advice refers to the competency of the OSH officer to provide advice to support and assist management to meet their safety obligation (Hinde & Ager, 2003). Safety and health officers are regarded as a competent person if they have sufficient training and experience or knowledge and other qualities properly to undertake the necessary measures to comply with the OSH statutory requirements and prohibitions (Smith & Wadsworth,2009). OSH practitioners are considered an integral part of effective OSH management systems and have a significant role to play in improving health and safety at work. Their expert safety advice is recognised by the Institutional of Occupational Safety and Health (IOSH) in ensuring high standards are achieved and maintained (Smith & Wadsworth, 2009). Their major role is to setup and run the OSHMS. This includes preparation of policy, setting realistic objectives, establishing adequate systems, monitoring performance and reporting on this to senior management for review (Hinde & Ager, 2003).

2.7 Research Framework

The underpinning theories for this research are the resource-based view (RBV) theory (Barney, 1991) and knowledge-based view (KBV) theory (Grant, 1996). In this RBV context, competitive advantage can be sustained over time through the unique bundling of resources that is characterised as valuable, rare, costly to imitate and non-substitutable (Barney, 1991; Barney, Wright & Ketchen, 2001). The concept of safety capital is identified by analysing the creation and composition of the intellectual capital embedded in OSHMS. Accordingly, Nuñez and Villanueva (2011) proposed the safety capital model consisting of human, structural and social capital components. Based on the research framework, the following hypotheses were postulated:

H1: Management safety commitment has a positive significant relationship towards safety participation in OSHMS.

H2: Safety training has a positive significant relationship towards safety participation in OSHMS.

H3: Intrinsic reward has a positive significant relationship towards safety participation in OSHMS.

H4: Extrinsic reward has a positive significant relationship towards safety participation in OSHMS.

H5: Employee involvement has a positive significant relationship towards safety participation in OSHMS.

H6: Safety communication has a positive significant relationship towards safety participation in OSHMS.

H7: The positive relationship between management safety commitment and safety participation in OSHMS will be stronger when safety advice is high.

3.0 METHODOLOGY

The sample population is manufacturing firms in Malaysia already certified with MS 1722: 2011 or OHSAS 18001 certification. Podgorski (2006) recommended that a company that has implemented OSHMS for a minimum of 3-years based on the certification can provide reliable data required as it is in a stable functioning and improvement stage for OSHMS implementation. Based on the Malaysia Standard (2011), this means that the organisation had gone through the yearly audits and has been re-certified on the third year.

The list of the organisation was acquired from the Federation of Malaysian Manufacturers (FMM) 2015 directory and SIRIM QAS International Sdn. Bhd registration. Out of 366 surveys that were distributed, 125 were returned but only 100 were usable for further analysis.

The measurement items were adapted from tested and reliable sources. Specifically, safety participation in OSHMS items were adapted from Fernandez-Muniz et al., (2012), safety advice items were from Hinde and Ager, (2003)

and intrinsic and extrinsic reward items were adapted from Ozutku (2012). In addition, safety management commitment, safety training, employee involvement and safety communication were adapted from Vinodkumar and Bhasi (2010). All items were measured on a five-point Likert-scale, ranging from '1 = strongly disagree' to '5 = strongly agree'.

4.0 RESULTS

4.1 Descriptive Findings

The profile location of the manufacturing companies is depicted in Table 1. Of the 100 manufacturing companies that responded, 28% were from Penang, 22% from Selangor, and 13% from Johor where the main manufacturing locations in Malaysia. Table 2 showed the sizes of these companies and 32% of these manufacturing companies are large with more than 1000 employees. Furthermore, most of these companies are certified with OHSAS 18001 for the first time (Table 3). Table 4 showed the tenure of OSH officer who answered the survey in the selected companies. Majority of the OSH officers (74.0%) have been in the position for more than 3 years.

Table 1: Location of Company

Location	Frequency	Percentage (%)
Penang	28	28
Selangor	22	22
Johor	13	13
Kedah	9	9
Negeri Sembilan	6	6
Melaka	6	6
Sarawak	6	6
Perak	5	5
Pahang	5	5

Table 2: Size of Company

No. of Employees	Frequency	Percentage (%)
1-50	1	1.0
51-150	17	17.5
151-500	28	28.9
501-1000	20	20.6
Above 1000	34	32.0

Table 3: Years Certified with OSHAS 18001

Tenure of Certification	Frequency	Percentage (%)
3 years	43	43.0
4-6 years	22	22.0
7-9 years	15	15.0
10-12 years	11	11.0
Above 12 years	9	9.0

Table 4: Tenure as a Certified OSH Officer

Tenure as OSH Officer	Frequency	Percentage (%)
Less than 3 years	23	26.0
4-6 years	23	26.0
7-9 years	12	13.0
10-12 years	19	21.0
Above 12 years	23	14.0

4.2 Convergent Validity

Average Variance Extracted (AVE) is the mean variance extracted for the items loading on a construct and is a summary indicator of convergence (Fornell & Larcker, 1981). As reported in Table 5, factor loadings, Average Variance Extracted (AVE) and composite reliability (CR) can be assessed to confirm convergent validity. An AVE value of .50 or higher is the rule of thumb for a good convergence (Hair et al., 2010).

Next, composite reliability was assessed for reliability, which is a measure of convergent validity. The composite reliability value should be above .70 to conclude that we have generated an accurate scale (Gefen et al., 2000). Table 5 shows that the estimates ranged from .79 to .92, indicating good reliability results (Hair et al., 2010).

Table 5: Result of the Measurement Model

Constructs	Items	Loadings	AVE	CR
Safety Participation in OSHMS	SPR1	.84	.78	.92
	SPR2	.93		
	SPR3	.88		
Safety Advice	SAD1	.74	.59	.88
	SAD2	.78		
	SAD3	.79		
	SAD4	.78		
	SAD5	.76		
Management Safety Commitment	MSC1	.76	.64	.92
	MSC2	.87		
	MSC3	.82		
	MSC5	.63		
	MSC8	.87		
	MSC9	.84		
Safety Training	STR1	.78	.62	.87
	STR2	.81		
	STR5	.78		
	STR6	.78		
Intrinsic Reward	INR1	.66	.52	.87
	INR2	.79		
	INR3	.79		
	INR5	.71		
	INR6	.63		
	INR7	.73		
Extrinsic Reward	EXR2	.74	.56	.79
	EXR5	.86		
	EXR6	.64		
Employee Involvement	EI1	.74	.59	.81
	EI4	.85		
	EI5	.72		
Safety Communication	SCM2	.87	.67	.86
	SCM3	.75		
	SCM5	.83		

4.3 Discriminant Validity

Discriminant validity indicates the extent to which a construct is fully distinct from other constructs (Hair et al., 2010). Discriminant validity is analysed by comparing the square root of the Average Variance Extracted (AVE) with the correlations between the variables. All square root of the AVE extracted were higher than the correlations values in the rows and the columns, indicating adequate discriminant validity (Chin, 2010). In Table 6, the square root of the AVEs were reported diagonally and the correlation coefficients for each construct were less than the square root of the AVEs.

Thus, the measurement model demonstrated adequate convergent validity and discriminant validity, confirming the construct validity and conceding to proceed for hypotheses testing.

Table 6 Discriminant Validity of the Variables

Variables	*Mean (SD)*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
1.Safety Participation (SPR) in OSHMS	4.03(0.63)	**.88**	.54	.63	.47	.32	.61	.56	.50
2.Management Safety Commitment (MSC)	4.35(0.50)		**.80**	.78	.69	.50	.70	.78	.48
3. Safety Training (STR)	4.28(0.53)			**.79**	.63	.42	.59	.68	.47
4. Intrinsic Reward (INR)	3.81(0.58)				**.72**	.63	.62	.55	.43
5. Extrinsic Reward (EXR)	3.80(0.67)					**.75**	.46	.47	.48
6. Employee Involvement (EI)	4.33(0.47)						**.77**	.71	.47
7. Safety Communication (SCM)	4.19(0.49)							**.82**	.53
8. Safety Advice (SAD)	4.23(0.51)								**.77**

4.4 Hypotheses Results

In this study, seven hypotheses were postulated for the relationship between safety capital and safety participation in OSHMS. The results of the hypotheses testing showed that both safety training (STR) and employee involvement (EI) have positive significant relationships with safety participation in OSHMS (SPR). In addition, safety advice moderates the relationship between management safety commitment (MSC) and safety participation in OSHMS. Thus, hypotheses 2, 5 and 7 are supported. The results are reported in Table 7.

The significant interaction effect was plotted graphically as in Figure 2. The results showed that higher level of safety advice leads to higher safety participation in the organization as management commitment increases.

Table 7 Path Coefficient For Safety Capital and Safety Participation in OSHMS.

H	Direct Relationship	Path Coefficient (β)	*SE*	*t*-value	Results
H1	MSC → SPR	0.9	0.2	0.2	No
H2	STR → SPR	0.0	0.2	2.5***	Yes
H3	INR → SPR	0.7	0.1	0.4	No
H4	EXR→ SPR	0.3	0.1	1.0	No
H5	EI → SPR	0.0	0.1	2.3**	Yes
H6	SCM → SPR	0.8	0.2	0.3	No
H7	MSC*SAD → SPR	0.1	0.1	1.8**	Yes

Note. *p < .1(1.28). **p < .05 (1.65). ***p < .01 (2.33).

5.0 DISCUSSION

This study reveals that management safety commitment does not have any direct influence towards safety participation in OSHMS. The result is not consistent with the previous studies (Vinodkumar & Bhasi, 2011). Instead, management safety commitment was found to be significant towards safety compliance in the small medium size firm as reported in Hong et al. (2011). This implies that the direct relationship of management commitment in big firms is not obvious compared to small firms. It is possible that management commitment is diluted by the size of the firm and other factors may play a more vital role in driving safety participation. Surienty (2017) has also argued that management commitment play a significant role towards OSH implementation with the existence of a formal regulation such as a clear legislation emphasising compliance requirement.

In contrast, safety training and employee involvement are found to have direct significant relationships to safety participation in OSHMS. Specifically, safety training encourages safety participation in OSHMS. Similarly, when an employee is involved in the operation decision making process, it helps safety participation in OSHMS. For this reason, it is possible that active employee involvement can help the end process of OSHMS participation. This is consistent with the earlier findings of past studies (Vinodkumar & Bhasi, 2011; Fernández-Muñiz, et al., 2007).

Interestingly, this study discovered that both extrinsic and intrinsic rewards are not significantly influencing safety participation in OSHMS. It is possible that because the respondents are safety and health officers, it becomes their official job and duty to encourage safety participation in OSHMS. Thus, the insignificant relationship of the rewards system towards safety participation in OSHMS implies that the safety and health officers are dedicated to their work. They may not see the need for reward to be motivated to play their role. In addition, Surienty (2017) has also found that legislation that monitor compliance would enhance the impact of rewards for SMEs. Thus, when it comes to reward, it is possible that it is not the carrot popularly used by employers as it resulted an extra cost.

Safety communication is found to have no direct or indirect effects on safety participation in OSHMS. This is inconsistent with previous studies (Shantz et al., 2016; Vinodkumar & Bhasi, 2011; Fernández-Muñiz, et al., 2007). It is possible that since this is investigating the OSHMS, effective running of the processes and workflow are what important. As long as the system set up is in place and running successfully, the instructions can be delivered in many different ways and not necessarily in a formal structure as safety communication. Thus, future research may want to investigate the different type of communication instead such as verbal, or non-verbal type of communication.

Lastly, safety advice moderates the relationship between management safety commitment and safety participation in OSHMS. Specifically, there is a stronger positive relationship between management safety commitment and safety participation in OSHMS when safety advice is high. This is illustrated in the plotted interaction effect in Figure 2. As a big firm, the connection gap between the management and employees' activity is moderated by the presence of safety officers and their expert safety advice. Moreover, in companies that are certified with OSHAS 18001, safety and health officer play a very important role. The presence of a safety and health officer is necessary in a certified company and they play a significant role in overseeing the overall safety matters. It is observable and a requirement that for companies to acquire a certification, the appointment of a specific safety officer to oversee the safety matters in the organization becomes a key point. This result supports the earlier argument that the role of management in the safety practices in a bigger organization requires an additional support and this study found that safety officer's expert advice to support that relationship to ensure safety participation across the firms. Hence, this implies that the role of safety advice is critical for big organisations that have implemented OSHMS, whereby they may play the role to represent management commitment in smaller companies (Hong, 2011). Future studies may also want to examine the magnitude of safety advice in companies' compliance with safety practices.

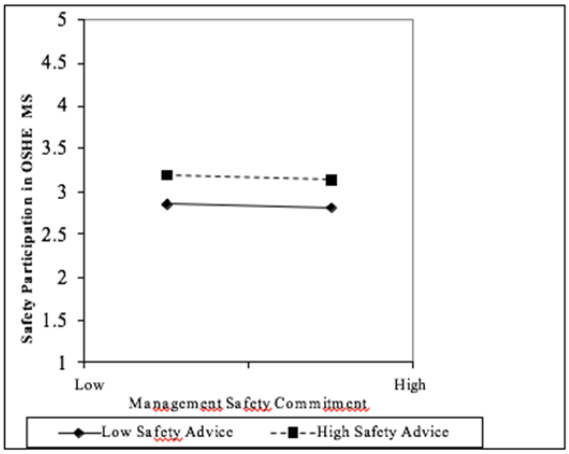


Figure 2: Moderation Effect of Safety Advice on the Relationship between Management Safety Commitment and Safety Participation in OSHMS.

6.0 CONCLUSION

Based on this research, the findings show that safety capital plays a crucial role to influence safety participation in OSHMS. Likewise, safety advice plays a very key role as a moderator between the relationship of management safety commitment and safety participation in Malaysia. The significant role of safety training and employee involvement also indicates the importance of training and knowledge held within those in the organisation itself that can help to sustain the recertification of OHSAS 18001. Future studies may want to look into the moderating effect of safety officer's tenure on safety participation in OSHMS.

In conclusion, safety participation in OSHMS is for big firms as studied in this study which may be different from a smaller firm. Thus, more studies in required to investigate the possible different effect the model may have on

different sizes of firms. Nevertheless, safety capital is a concept where knowledge about safety is the key components for organisations to influence safety participation in OSHMS. Successful implementation of OSHMS is important for the recertification of OHSAS 18001 that helps to sustain the competitive advantage and survival of organisation in long run.

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Review Article

Plantation Safety: A Conceptual Paper on Factors that Affect Safety and Health Risk Assessment in Oil Palm Plantation.

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ABSTRACT: *This is a conceptual paper to study the factors that affect the safety practitioner's perception towards safety and health risk assessment, namely HIRARC at oil palm plantation. Retrospective safety and health data were obtained and analysed. Factors identified were both confusions on hazard description and interpretation of risk assessment matrix. This paper will examine those factors and make recommendations for future research in Malaysia.*

Keywords *– Perception, Safety and Health, Risk Assessment, HIRARC*

1.0 INTRODUCTION

The agriculture or plantation industry plays a significant role as it contributes to the national economic development and employment opportunities. Apart from its positive impact, agriculture also is known as one of the high risks industries besides manufacturing and construction industries (International Labour Organization, 2017). Over the years, the agriculture industry faces a number of challenges such as climate change, high rate of biodiversity loss, pollution, rising production cost and workplace safety (Velten et al., 2015 and McCalla, 2001).

Safety and health issues are becoming the main problems faced by the agriculture sector nowadays due to the advanced use of technology and machines as well as chemical and biological products used in agriculture production processes. In today's context, the agriculture industry has become the one of the most hazardous occupation worldwide (ILO, 2000).

2.0 PROBLEM STATEMENT

The first problem to be addressed in this research is that most of the safety practitioner tend to make mistakes on issues related to risk assessment commonly known as Hazard Identification, Risk Assessment and Risk Control (HIRARC). In addition to the first problem, all type of industries specified in the First Schedule of Occupational Safety and Health Act, 1994, using the same general Guidelines of HIRARC without taking into consideration the likelihood operational definition in risk matrix. Nevertheless, most of the safety practitioners is uninformed on how to assess the level of workplace risks accurately.

3.0 PURPOSE AND SIGNIFICANCE OF THE INQUIRY

This conceptual paper is intended to identify and understand the factors that affect the risk management process in oil palm plantation. Therefore, the inquiry questions for this paper are: 1. What factors affect the safety practitioner's perception on describing the correct hazards? 2. How do the perceptions of safety practitioner influence the risks accuracy level? The answer to the inquiry questions is based on an extended documents review and interview. This conceptual paper is significant because it will explore a number of factors that affect the safety practitioner's perception towards HIRARC. Thus, this paper will examine those factors and make recommendations for future research in Malaysia.

4.0 SUMMARY OF THEORETICAL FRAMEWORK

This conceptual paper integrates workplace safety and health data and risk assessment matrices which make it necessary to give a theoretical framework on safety practitioner's perceptions towards risk assessment. The theoretical model that best explains how perceptions are formed is a risk formula. A risk is a combination of likelihood of an occurrence of a hazardous event and severity of injury or damage (DOSH, 2008).

5.0 DELIMITATIONS AND LIMITATIONS

This conceptual paper is delimited by several elements. First, this paper only reviews workplace safety and health data of oil palm plantation. This is delimiting because it excludes others agricultural based industries. Second, the theoretical framework uses risk assessment theories to explain and understand how a workplace risk is being assessed. This conceptual paper has its analytic restraints. For example, this paper relies on existing workplace safety and health historical data previously collected by the safety practitioners from selected palm oil plantation.

6.0 LITERATURE REVIEW

6.1 Oil palm plantation and workplace accidents

In oil palm industry, there are many activities involved, which include site clearing, ploughing, planting, manuring, pesticides spraying, pruning, harvesting, storage and transportation to the mills. These activities involved a lot of manual handling and the use of machinery. Among the new technologies used including palm harvesting equipment namely aluminium harvester, mechanical loader and e-cutter (Che Wan, 2017). There are many hazards, which can cause potential workplace accidents. Statistics have shown that agriculture workers are exposed to high risk of fatal accidents.

Highest frequency and fatality rates of injuries are mostly from the use of farm machinery and non-chemical occupational accidents (Au Yong, 2016). The major causes of injuries and fatalities in the agriculture industry are due to slip, trip and fall hazards, hit and struck by, crushing hazards and overturned agriculture tractors including all-terrain vehicles (Mohammed, Desa and Fatai, 2010). Insufficient workplace safety and health data due to poor data management is one of the key factor in incorrect risk analysis. Sunstein (2002), reported that understanding the nature and magnitude of the risks will helps the organisation to implement the right risks control measures.

6.2 Risk Management

Risk management is the process of assessing risks and taking steps to either eliminate or to reduce them by introducing control measures (Morgan, 1990). The process involves identification of the hazard, assess the risks and control the risk. The International Labour Organization (ILO, 2014), stated that the process of managing risk comprises of five steps:

Step 1: Identifying the hazard

Step 2: Identify who might be harmed and how the harm could occur

Step 3: Evaluate the risk (identify and decide risk control to be taken)

Step 4: Record on who is responsible for implementing the control measures

Step 5: Record, monitor, review and follow up the risk assessment

The whole idea of risk management is to prevent workers from an accident and to mitigate the adverse effects of loss as far as is reasonably practicable.

6.3 Hazard and risk

Hazard can be defined as any source, aspect of technology and activity that has the potential to harm in terms of human injury, ill health, property damage, environmental damage and combination of these (DOSH, 2008). Hazards identified can be divided into three main groups. The first group are the type of hazard which consists of the safety hazard, health hazard and environmental hazard. The second group is the classification of hazard. There are five classifications of hazard namely physical, chemical, biological, ergonomic and psychological. The third group is the category of hazard. There are four categories of hazards namely obvious, developing, transient and concealed. Issues arise when most of the safety and health practitioner wrongly identified the hazards according to their main characteristics of each group. On the other hand, describing the correct hazards could be challenging as well. Currently, there are four common ways to describe hazards. The hazard description can be based on activities, classification, outcome and the negative characteristics of an object or situation. Incorrect hazard description will further jeopardise the next process which is assessing the risks.

The Royal Society (1992) defines risk as the probability that a particular of adverse event occurs during a stated period of time or results from a particular challenge. Risk according to the Department of Occupational Safety and Health (DOSH) is a combination of likelihood of an occurrence of a hazardous event and severity of injury or damage caused by the unwanted event. Level of risk can be categorised by potential harm that the existing hazards may cause, the frequency a person are exposed and the number of persons exposed to the harm. Level of risk is a measurement of a risk which commonly classified into three broad categories which are high, medium and low. A high risk requires an immediate action to control the hazard, medium risk requires a planned approach to a hazard while low risk is considered as acceptable and further reduction may be not necessary. However, a control measure is needed when the risk can be resolved quickly and efficiently (DOSH, 2008).

6.4 Risk assessment matrix

Risk assessment matrices are very useful and widely being used as a decision tool in making and improving risk management decisions. In spite of this, the question of how well risk matrices should be constructed to improve risk management decisions is ongoing. A common method used for risk ranking utilises risk matrices; these are typically 3x3, 4x4 or 5x5 matrices (Altenbach & Brereton, 1998).

Guidelines on hazard identification, risk assessment and risk control (DOSH, 2008) provide a systematic and objective approach to assessing hazards and their associated risks that will provide an objective measure of an identified hazard as well as provide a method to control the risk. This guideline utilises 5x5 risk matrices. Likelihood levels range from most likely, possible, conceivable, remote and inconceivable. Severity is based upon an increasing level of severity to an individual's health, the environment, or to property. There are five severity levels ranging from negligible, minor, serious, fatal and catastrophic. Since this matrix provides the general application to all type of industries, there is a need to specify the appropriate conceptual and operational definition for both likelihood and severity focusing on oil palm industry.

7.0 METHODS FOR COLLECTING DATA

First, the study was conducted in selected oil palm plantation which uses HIRARC method to assess workplace risks. Historical safety and health data were obtained together with documents of HIRARC. Examples of data include both leading and lagging indicator. Leading indicators represents all prevention activities to avoid accidents. The examples are numbers of safety inspections, audits, meetings and trainings. On the hand, lagging indicators represents lost time injuries, accident rate, severity rate and fatality rate. Second, interview with safety personnel on the perceptions of HIRARC interpretation and accuracy of risks level were then identified.

8.0 FINDINGS

Inquiry question 1.

What factors affect the safety practitioner’s perception on describing the correct hazards?

There are two main factors affect the safety practitioner’s perception on describing the correct hazards.

8.1 Hazard definition.

They are different definitions of hazard based on the OHSAS 18001:2007 and MS 1722:2011. The OHSAS 18001 standard defines a hazard as a "source, situation, or act with a potential for harm in terms of human injury or ill health, or a combination of these. MS 1722:2011 defines a hazard as a source, situation, or act with a potential for harm in terms of human injury or ill health and damage to property. The different definition of hazard will affect the magnitude of risks being assessed.

8.2 Hazard description.

The hazard description can be based on activities, classification, outcome and the negative characteristics of an object or situation. Safety practitioner's confusion is on the proper description of the workplace hazards. Which of the following is the correct hazards description when performing pesticides spraying activities? Examples: pesticides hazard, chemical hazard, toxic chemical, pesticides aerosols within breathing zone or not wearing a proper personal protective equipment?

Inquiry question 2.

How do perceptions of safety practitioner's influence the risks accuracy level?
Most of the safety practitioners have different views on risk accuracy level. They often misunderstand the concept and interpretation of likelihood levels. Problems also found in choosing the right risk matrix for their workplace.

9.0 CONCLUSION

The findings led me to a conclude what are the factors affect risk assessment in the oil palm plantation. Understanding the exact criteria's in assessing workplace risks is an important factor for the top management to make the right decision using HIRARC. Oil palm plantation that carries out risk assessment should prioritise their risks so that appropriate control measures can be planned accordingly.

11.0 RECOMMENDATIONS FOR FUTURE RESEARCH

Based on the preliminary findings, the following recommendations for future research are as below:

Recommendation 1: Further research should be conducted to other different types of industries as listed in the First Schedule of OSHA 1994.

Recommendation 2: Further research should be conducted the effectiveness of control measures. An appropriate risk matrix for control measures needs to be developed.

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Short Communication

An Investigation of a Dental Laboratory Worker with Chronic Low Back Ache

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ABSTRACT : *The low back is usually associated with the lumbar spine which supports the entire weight of the upper body and significantly, is vital to the body mobility. Injury to the surrounding soft tissues can cause mild to debilitating symptoms due to muscle strain and ligament sprain. The causes of injury to the lower back are probably due to sudden twisting movement, poor posture position at work and manual handling of heavy objects or with twisting or bending movements while lifting. An Ergonomic Risk Assessment was carried out on a dental laboratory worker who complained of unresolved low back ache after a year on treatment and follow up at the outpatient department of a health clinic. From the various investigative methods used, it was found that the worker in question was placed in a situation that will over time encourage her to develop musculoskeletal disease. Our recommendations for change include immediate awareness and training in ergonomic principles of work and to report all cases so that appropriate action can be taken, reassess the workstation and environment of work, job enrichment, and creating a conducive environment for work. Once the changes have been implemented, a review will be necessary in three months time.*

Keywords: *dental laboratory, low back ache, RULA*

1.0 INTRODUCTION

The low back is usually associated with the lumbar spine which supports the entire weight of the upper body and significantly, is vital to the body's mobility. Injury to the surrounding soft tissues can cause mild to debilitating symptoms due to muscle strain and ligament sprain (Hayes, Cockrell, & Smith, 2009). The causes of injury to the lower back are probably due to sudden twisting movement, poor posture position at work and manual handling of heavy objects or with twisting or bending movements while lifting (Marklin, & Cherney, 2005). Among dentist and dental hygienist, prevalence of low back pain ranges from 36% to 60% (Hayes, Cockrell, & Smith, 2009) to 74% (Gopinadh, Devi, Chiramana, Manne, Sampath,

& Babu, 2013). An Ergonomic Risk Assessment (ERA) was carried out on a dental laboratory worker who complained of unresolved low back ache after a year on treatment and follow up at the outpatient department (OPD) of a health clinic.

2.0 CASE DESCRIPTION

The patient is a 39 year old female who work as a dental laboratory technician for 9 years at the same health clinic and was seen by an Out Patient Department (OPD) doctor in March 2014 with a differential diagnosis of Coccydynia or Sacrum Pain. She had a history of a fall when she was 16 years old involving her sacral area but recovered. The medical and surgical histories were unremarkable and there were no bladder or bowel symptoms. She was started on non steroidal anti-inflammatory drugs (NSAIDS) on a regular basis and thereafter on a need basis and regular physiotherapy was prescribed. There was not much improvement and so was referred to the Occupational Health Doctor (OHD) at the said clinic by the OPD doctor in April 2015 because her pain has increased so much so that it is present even at rest, interferes with her normal daily work and during sleep.

With her consent, her case was discussed with her superior and arrangement was made to conduct an ERA after she was referred to the Orthopaedic Surgeon for a complete evaluation of her current problem and an initial survey at her workplace was done to ascertain the work relatedness of her medical problem. Her diagnosis after her visit to the orthopaedics department was "L5S1 Grade 1 Spondylolisthesis (1 percent to 25 percent slip); Traumatic Degenerative Changes over L5S1". For light duty only – Not for heavy lifting – For proper ergonomic (proper back) support.

An ERA was carried out in the area of work that is the articulator zone of the dental laboratory. The assessment also included the safety and health aspects that could have contributed to her problems. The objectives of this survey were to carry out the ERA as per the Department of Occupational Safety and Health (DOSH) 2017 guidelines, identify the process in the workplace that could have contributed to the health problem, to evaluate the adequacy of existing control measures and to recommend appropriate control measures to reduce musculoskeletal diseases (MSDs) including other health and safety risks. Three main methods were used in this survey and they are walk through survey, job hazard analysis (JHA) and Rapid Upper Limb Assessment (RULA) which was modified from the DOSH guidelines.

The walk through survey covered the articulator zone of the dental lab which was located on the 1st floor of the two storey clinic building and assessable through stairs only. It measures 20.53 sq meters and accommodate 3 dental lab technicians working together in the room. About 1/3 of the room is occupied by 2 dental workstations and this leave little room for the third worker. All 3 workers have similar health complains comprising pain and aches at the shoulder, arm and wrist area including low back pain. They do not complain of respiratory, skin or hearing problems. Several ergonomic risk factors (ERFs) were noted and they include awkward position, repetition, static posture and vibration. There was low risk of exposure to dust in the workplace but respirators and other personal protective equipment was used as and when necessary. It was noted through the JHA that the process of setting of the denture was classified as high risk and will need to be managed to reduce the risk of developing MSDs because several ERFs were present. The third method used was RULA and a score of 7 was obtained, which indicated very high risk of developing MSDs and immediate change must be carried out.

3.0 DISCUSSION / CONCLUSION

From the various investigative methods used as discussed above, it was found that the worker in question was placed in a situation that will over time encourage her to develop MSDs. Our recommendations for change include immediate awareness and training in ergonomic principles of work and to report all cases so that appropriate action can be taken, reassess the workstation and environment of work, job enrichment, and creating a conducive environment for work. Specifics for change of high risk work process were given in the report to the head of department. Once the changes have been implemented, a review will be necessary in three months time. The DOSH guidelines for conducting ERA are a helpful tool in this regard. Similar problems faced by private dental laboratory workers assessed by the author and implemented by the private dental clinic revealed a score of 3 using the RULA method.

The patient's nature of work that is repetitive bending forward, sit and standing had reduced her symptoms paradoxically. As a result, her chronic low back ache was not recognized earlier as most doctors would have missed the relationship between her work and the ergonomic problems. This case highlighted the need for continued awareness and training in the recognition of MSDs in the workplace. Safety and health input at the planning stage of a similar workplace can help reduce such problems in the future.

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