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Noise Induced Hearing Loss (NIHL) Effect among Workers in Small Medium Enterprises (SME) in Malaysia

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A cross-sectional study of noise-induced hearing loss (NIHL) due to occupational noise exposure of greater than 90 dB (A) was conducted among Small Medium Enterprise (SMEs) workers throughout Malaysia. Area noise monitoring was carried out to determine the high risk area exposed to noise. Personal noise monitoring was conducted among the exposed workers. Questionnaire on demographic information including medical history was obtained. The secondary data on individual audiometric assessment was obtained from 18 SMEs. There are 5 out of 18 SMEs in this project with the measured area noise level greater than 90 dB(A) - this is not in compliance with the Factories and Machinery Act 1967 (Noise Regulation 1989). This study revealed that there was a significant correlation ($r = 0.469$, $p = 0.003$) between area noise monitoring and personal noise monitoring. Furthermore, there were complaints on sudden hearing loss, ear pain and ringing sound in ears received from the workers.

1. Introduction

Noise is derived from the Latin word 'nausea', defined as 'unwanted sound' or 'sound that is loud, unpleasant or unexpected' (Singh and Davar, 2004). According to Mohammadi (2008), noise generated above a certain level in various industries is associated with risk to safety and health of a person employed therein or of persons frequenting such areas. Noise is recognised as one of the occupational health hazards. Exposure to excessive noise could lead to hearing problem such as temporary hearing loss or permanent hearing loss and other diseases (Nor Saleha and Noor Hassim, 2006). Basically Noise-Induced Hearing Loss (NIHL) can be identified through audiometry assessment. Factory and Machinery (Noise Exposure) Regulation 1989 describes that hearing impairment means the arithmetic average of the permanent hearing threshold level of an employee is higher than his/her audiometric measurement level. Kiernan (1997) discovered that even a relatively low level of noise may affect human health adversely. His statement is supported by Singh and Davar (2004) who proved that there are many adverse effects such as hypertension and sleep disruption when a person is exposed to noise. Furthermore, several sources including medical studies have shown evidence indicating that noise problems have caused physical and psychological disorders e.g. stress (Mohammadi, 2007) and physiological effects e.g. increasing blood pressure and causing hypertension (Nadya et al., 2010).

According to ILO (2013), there are 2,113 occupational diseases in Malaysia in year 2012. This number had increased by 576 cases as compared to year 2011. From the total 2,113 cases reported, Noise-Induced Hearing Loss (NIHL) contributed to 11.21 % (237 cases). It can be seen that the number of the NIHL cases reported is increasing year by year. The Department of Occupational Safety and Health (DOSH) reported that in 2015, a total of 2,648 cases of occupational disease and poisoning have been reported to the Occupational Health Division as compared to 2,588 cases reported in year 2013. A total of 2,001 cases have been successfully investigated for the purpose of improving the workplace in terms of occupational health. Among the cases investigated, a total of 1,563 cases were related to noise induced hearing loss (NIHL). NIHL is the

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most common occupational disease experienced by workers in industries in Malaysia (78.1 %) as compared to the other type of diseases.
According to McDonald et al. (2009), 'safety is everyone's job', everyone has their responsibility to ensure safety in performing their work. Employees, employers and even visitors have their own role in ensuring safety. Safety control measure should be practiced such as wearing PPE e.g. wearing ear muff and ear plug when working in a workplace which is vulnerable to noise exposure.

2. Methodology

2.1 Study background

This study involves experimental work to measure the area noise, personal noise as well as noise-induced hearing loss (NIHL) among the small medium enterprise (SMEs) throughout Malaysia. A total of 18 SMEs have been selected for this study. These companies were chosen since they had relatively higher accident rates compared to the others, as reported to Social Security Organisation (SOCSO). This project was done together with SOCSO and with the cooperation of government agencies including the National Institute of Occupational Safety and Health (NIOSH) as well as the Department of Occupational Safety and Health (DOSH). This project is to assess the level of noise exposure in the working environment and within the individual hearing zone. On the other hand, audiometric readings were obtained to identify the effects towards hearing loss impairment among workers. This sampling was completed within 3 months starting from October 2015.

2.2 Noise Sampling devices

Four measurements were conducted for data collection in this study; i) area noise monitoring, ii) personal noise monitoring, and iii) audiometric testing. Several instruments were used for these measurements including sound level meter (SLM), dosimeter and audiometer. Questionnaire was distributed to ascertain information on background characteristics, risk factors and health symptoms. All equipment used is listed in Table 1.

Table 1: List of instruments used for measurement

Item	Parameter	Instrument
1	Area noise	Sound Level Meter (SLM) Model: SoundPro SE/DL Series
2	Personal noise	Noise Dosimeter Model: CASELLA dBadge CE-35X
3	Noise-induced hearing loss (NIHL)	Audiometric testing
4	Noise complaint (ear pain, sudden hearing loss)	Questionnaire

The results were analysed by using Statistical Package for Social Sciences (SPSS) software. Normality test was initially conducted using Kolmogorov-Smirnov of 1-tailed analysis to determine the data normality of continuous variables. The data is considered as normally distributed when the p-value of Kolmogorov-Smirnov was more than 0.5. There were two types of analysis that have been used in this study. The analyses are summarised in Table 2.

Table 2: List of SPSS test by to determine the parameter measured

Item	Parameter	SPSS Test
1	Relationship between area and personal noise monitoring	Pearson correlation
2	Relationship between noise, working hours and noise-induced hearing loss (NIHL)	ANOVA

3. Results and Discussion

3.1 Area Noise Monitoring

Area monitoring was conducted to assess the area noise level in various workstations of the SME companies under study. The nature of SMEs in this research includes manufacturing sectors, chemical sectors and other different types of working background SMEs. From Table 3, manufacturing based SME (plastic manufacturing) has the highest noise level (107.4 dBA) while packaging based SME has the lowest noise level noted as 66.3 dBA. This was because in most of the manufacturing based SMEs, noise-induced machines are used such as

grinders and other air-powered tools, which produce loud noise. According to Samir et al., (2001), the mechanisms of noise generation basically depend on the particular noisy operations and equipment including grinders, pneumatic equipment (air sander), pumps and compressors in industries.

Table 3: Noise level in every SME companies under study

Nature of the Company	Noise Range dB(A)	Average Noise Level dB(A)	Noise contour zone
Company A (wood working)	80.4 – 90.1	85.3	
Company B (paper manufacture)	78.1 – 97.8	88.0	
Company C (metal fabrication and engineering work)	84.5 – 99.8	92.2	
Company D (stainless steel)	71.2 – 107.3	89.3	
Company E (original equipment manufacturer, OEM for cosmetic)	66.3 – 79.5	72.9	
Company F (printing)	80.1 – 91.4	85.8	
Company G (plastic manufacturer)	81.0 – 107.4	94.2	
Company H (metal work, maintenance oil and gas equipment)	82.3 – 103.5	92.9	
Company I (steel fabrication)	78.0 – 85.8	81.9	
Company J (wire and chain-link fence making)	74.6 – 91.2	82.9	
Company K (food manufacturer)	84.3 – 100.7	92.5	
Company L (aluminium fabrication and assembly)	82.1 – 98.9	90.5	
Company M (car plat holder manufacturer)	72.4 – 84.3	78.4	
Company N (printing)	81.1 – 93.2	87.2	
Company O (furniture manufacturer)	78.7 – 96.7	87.7	
Company P (wood, PVC furniture manufacturer)	78.0 – 94.7	86.4	
Company Q (frozen food manufacturer)	73.5 – 84.1	78.8	
Company R (packaging)	68.5 – 74.3	71.4	

Remarks:

85 dB(A) – 90 dB(A)
< 85 dB(A)
> 90 dB(A)

3.2 Personal Noise Monitoring

A total number of 34 samples were chosen to be monitored on the personal noise exposure throughout their working period. Pearson correlation test was shown in Table 4.

Based on the statistical analysis from Table 4, the mean of all samples are 74.10 dB(A) with p-value of < 0.000 (which is smaller than 0.05, hence it showed a significant difference whereby personal noise in SMEs

is greater than 90 dB(A). According to Samir et al. (2001), the usage of grinders and pneumatic equipment (air sander) may produce extreme noise, hence increasing the level of personal noise exposure among workers.

Table 4: One sample t-test for personal noise monitoring

	Test Value = 90					
	T	Df (Degree of Freedom)	Sig. (2-tailed)	Mean Difference	95 % Confidence Interval of the Difference	
					Lower	Upper
personal noise	-6.772	33	0.000	-15.89706	-20.6729	-11.1212

3.3 Correlation between Area Noise Monitoring and Personal Noise Monitoring

Referring to Table 5, it shows that there was a significant correlation (r = 0.469, p = 0.003) between area noise monitoring and personal noise monitoring. These results agree with the findings by a similar previous study - according to Marjaneh (2012), extreme area noise can increase the personal noise level and hence contributes to premature hearing loss.

Table 5: Correlation between area noise level and personal noise level in 18 selected SMEs

		Area noise	Personal noise
Area noise	Pearson Correlation	1	0.469
	Sig. (1-tailed)		0.003
	N	34	34
Personal noise	Pearson Correlation	0.469**	1
	Sig. (1-tailed)	0.003	
	N	34	34

3.4 Audiometric Test

Table 6 shows that most of the workers (76.47 %) were suffering from abnormal hearing loss. Meanwhile, there were only eight workers (23.53 %) who have normal hearing status. Abnormal hearing loss can be classified into two categories, which are i) hearing loss and ii) hearing impairment. Among the 26 workers who suffered from abnormal hearing, 16 of them (61.54 %) are suffering from hearing loss while 10 out of 26 workers (38.46 %) are facing hearing impairment problem.

This result is supported by a study conducted by the NHS Choice (2015) - common cause of abnormal hearing loss is damage to the ear from repeated exposure to loud noises over time. This is known as noise-induced hearing loss, and it occurs when the sensitive hair cells inside the cochlea become damaged. The workers will have a higher risk of developing noise-induced hearing loss if they work with noisy equipment, such as pneumatic drills or compressed-air hammers (NHS Choice, 2015).

Table 6: Audiometric results for the exposed workers

Variable	Hearing Condition	Frequency (N)	Percentage (%)
Noise-Induced Hearing Loss (NIHL)	Normal	8	23.53
	Abnormal	26	76.47

N = 34 exposed respondents

3.5 Relationship between Factors Influencing Auditory Effects

There are several factors that can affect auditory effect. These factors include personal noise level, age and working experience (years) that might enhance the probability of getting auditory (NIHL) effect for an individual (Nizam et al., 2004). Table 7 shows the factors that influenced the auditory effect among the exposed group. Logistic regression analysis showed that noise-induced hearing loss (NIHL) was significantly associated to the personal noise (p = 0.012). Working experience (p = 0.516) and age (p = 0.545) do not show a well significant association between the cause of auditory effect and the employment period (p = 0.041).

The result obtained from Table 7 is somehow something cannot be directly justified. It is because most of the samples selected in this project have a very short working experience of not more than five years. Such short duration of noise exposure is not enough for the workers to suffer from auditory effects. According to Laura (2011), the risk for people to have hearing loss in the UK workplace increases with their employment experiences.

Table 7: The influencing predictors associated with the NIHL and noise stress among the exposed respondents

Model	Unstandardised Coefficients		Standardised Coefficients	t-value	Significance.
	B	Standard Error	Beta		
(Constant)	3.908	1.186		3.295	0.003
Personal noise	-0.034	0.013	-0.449	-2.674	0.012*
Working Exp	0.143	0.217	0.119	0.658	0.516
Age	0.073	0.119	0.106	0.612	0.545

a. Dependent Variable: hearing loss

[a] Logistic Regression analysis using ENTER method;

* Significant at $p < 0.05$

3.6 Recommendations to SMEs on solving the noise exposure

In order to maintain a good IAQ in an enclosed building, there are many aspects that need to be considered such as carrying out an appropriate engineering control, administrative control as well as personal protective equipment (PPE). Engineering control such as enclosure can be done in order to minimise the noise exposure. The wall of the enclosures should be massive and airtight to contain the noise emission. Absorbent lining on the interior surface of the enclosure will reduce the reverberant build-up of noise within it. The controls used in this element are by installing barriers, enclosures, silencer, vibration dampers and sound-absorbing material (Department of Labour, 2002). According to Brookhaven National Laboratory (2005), barriers (isolation) installation can help in reducing noise of at least 25 dB.

Administrative control is where the management carries the majority of responsibilities towards reducing the noise exposure. According to the Workplace Safety and Health Bulletin (2009), an industry management has to establish a noise management program to control and minimise the noise risk that might be faced by the workers. The management does need to conduct noise conservation training programme for employees if the Personnel Noise results were above of the action level. The training program should be repeated at least once in every two (2) years. Based on the Regulation 28 – Warning Sign in the Factories and Machinery (Noise Exposure) Regulation 1989, it is mandatory to post warning signs in the specific area (entrance and at production area). The warning signs should clearly indicate that hearing protection needs to be worn before entering the high noise area. As per Regulation 21 under the Factories and Machinery (Noise Exposure) Regulation 1989, a baseline audiometric test shall be established for every employee within six months from the day the employee commences work.

The most appropriate PPE used for reducing noise exposure is ear plugs and ear muffs. According to Brookhaven National Laboratory (2005), there are several types of hearing protection devices (HPD). The best HPD among the hearing protection device is ear muff as it can provide a noise reduction rate (NRR) of 20 - 30 dB.

4. Conclusion

A cross-sectional study design was applied to study the possible effects of occupational noise exposure on noise-induced hearing loss (NIHL) among selected workers in selected small medium enterprise (SMEs) in Malaysia. The area noise monitoring of 18 selected SMEs throughout Malaysia ranged from a minimum of 71.4 dB(A) to a maximum of 94.2 dB(A). The average of working hours in this plant was 8 h, and most of the SMEs were found to be exposed to the noise level greater to 90 dB(A) as well as 85 dB(A). There are 5 out of 18 SMEs in this project with the measured area noise level that is greater than 90 dB(A) - this is not in compliance with the FMA (Noise Regulation) 1989. Based on the findings of this study, there is a correlation between area noise monitoring and personal noise monitoring in SMEs. The study found that 26 out of 34 exposed samples are having abnormal hearing loss. Apart from that, from the complaints received, most of them are having ringing sound in ears (tinnitus). However, this conclusion can only be made as the baseline data and references for future researches because at the moment, there is no any previous baseline data that can be compared with in this project.

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