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The Association between Noise Exposure Level and Occupational Stress Level as a Non-Auditory Effects of Noise among Palm oil Mill Workers

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ABSTRACT: Palm Oil Mills are among the nosiest industrial workplaces, whereby excessive noise poses a threat to the health of organization and cause serious consequences. Excessive noise exposure gradually affects auditory and non-auditory aspects of health. The set symptoms are referred to as occupational stress, having a direct impact on concentration, thereby reducing the efficiency and productivity levels of organization. Therefore the objective of this study was to determine, in depth, the association between noise exposure and stress levels among Oil Palm Mill Workers. The study's scope was on the non-auditory effects of excessive noise. The participants were 62 workers of two selected Palm Oil mills. They were chosen through proportional stratified sampling based on the objective of this study the individual noise exposure level and environmental sound level were examined among samples while on the other hand O'Donnell inventory was utilized as a tool to determine the stress level and finally the relationship between stress levels. Evidence shows that Physiological and performance effects are the two most important body reflexes affected by high exposure risky noise levels. Noise as an occupational factor contributes to high occupational stress levels. Moreover subsequently, comprehensive solutions have been provided to this crisis.

Keywords: Noise Exposure, Non-Auditory Effects, Occupational Stress, Palm Oil Mill

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INTRODUCTION

The excessive noise, resulting from the operating machinery is a common problem that cannot be overlooked in industrial workplaces. According to the Malaysian's Factory and Machinery Act, Noise Exposure Regulation 1989 any sound level above 90 dB (A) is s considered as exceeding the Standard permitted by law. Continuously working at exposure to high levels of noise, after a period of time will cause variety of adverse effects to health namely auditory (hearing impairment) and non-auditory (entire organism, central and autonomic nervous system) effects(Juraj,2012). A significantly number of researches had investigated on the potential of noise-induced hearing loss in terms of auditory effects (Tung,2013;Russo,2013;Cruickshanks,2010). Thus the relationship between hearing impairment and excessive noise exposure has been well established (Hanidza,2013). In addition, some of the literatures attempt to find the relationship between intense noise exposure level and non-auditory effects (Chang,2009).The implication of the plethora epidemiological studies conducted over the years shows that noise impacts a wide range of health parameters. Whereby various negative non-auditory effects is often related to occupational noise exposure and has a significant association with a range of indicators of physical health. Observational and experimental studies have shown that environmental noise exposure leaded to annoyance, closely interrelated stress sleep disturbances and causes Fatigue during the day (Frei,2013), affects patient outcomes in hospital(Basner,2013)and staff performance in different workplaces, increases the occurrence of hypertension and cardiovascular disease, and impairs cognitive performance in schoolchildren(Ljungberg,2007). The package of adverse effects of long-term occupational noise exposure causes occupational stress that usually affects individuals' performance and Physical and mental health and has a negative impact upon job satisfaction. The relations between noise from aircraft or road traffic near airports and the risk of hypertension as an important risk factor for cardiovascular disease has been surveyed by Jarup in 2008 among residential neighbourhoods near Sydney Airport . He explored a significant association between a range of indicators of physical health and including cardiovascular problems (Black,2013) Evidence shows that the risk of ischemic heart disease increased among people living in noise exposure levels exceeding more than 65–70 dBA (Babisch,2000). On the other hand the direct effects of long term exposure to occupational noise on textile industry workers' lung functions were probed by António Paes and his co-workers. They obviously confirmed that long term noise exposure can increase the loss of ciliated cells and impairment of airways clearance . Insomnia is

one of the chronic adverse effects due to long term noise exposure that has strong relationship with the other non-auditory effects such as learning outcomes and cognitive performance (Evans,2007) .Exposure to occupational noise has also been linked with some other adverse effects such as self-reported fatigue , sickness-related absenteeism and symptoms of psychological distress Despite auditory and non-auditory effects of noise are quite separated issues but the direct relationship between them has been investigated by some of the researchers. For instance Rachiotis's research regarding the determinants of hearing loss prevalence among 93 noise exposed electro-production workers, concluded that NIHL causes communication interference and substantially affects social integration and gradually, the quality of life will be altered (Rachiotisa,2006). Furthermore, an increased risk of accidents has been reported in a retrospective study conducted among 52,982 male workers exposed to a minimum of 80 dBA on a daily basis in variety of noisy work environments in Quebec. Result of this study explores a significant direct association between occupational accident risk and worker's hearing sensitivity (Picard,2008). Losing concentration as a non-auditory effect of noise is directly linked to hearing impairment.

Palm oil industry in Malaysia: The world's second-largest oil palm plantation company, Felda Global Ventures Holdings (FELDA), is based in Malaysia. In 2012, the Malaysian palm oil industry produced18.79 million tons of crude palm oil and nominated Malaysia as one of the world's largest palm oil exporter. This industry employed an estimated 491,000 workers and created variety of job opportunities for local and foreign people. statistically all the evidences lead Malaysian government to feel more responsibility toward advance the production, procurement and use of sustainable oil palm products through the development, implementation and verification of credible global standards Palm oil mills are one of the plethora of industries where in several sections such as the engine room, boiler room, nut plant, sterilizing and press the sound level is above 85dB, and excessive noise is always considered as a key factor in creation of a series of Complaints. In fact one of the most important environmental stressors in palm oil mills is occupational noise that can develop job stress as a chronic disorder among palm oil mill workers. Nowadays occupational stress is the major occupational problem in palm oil industry. Stress as a physical, chemical or psychological hazard threaten the health of the workers and health of the organization subsequently. In fact Occupational stress is a psychosocial hazard that poses a threat to the health of organizations. Unfortunately there are a few studies that relate noise exposure levels and non-auditory effects especially stress levels in palm oil mill workers specifically. This study was undertaken to determine the correlation between stress level and the excessive occupational noise exposure level among palm oil mill workers.

MATERIAL AND METHODS

This cross sectional study took place in different sections such as Loading Ramp, Capstan Line, Sterilizing, Pressing, Nut Plant, Clarification, Boiler Room, Engine Room, Workshop and General Store of two palm oil mills located in Perak, North of Malaysia. The sample size of this study was calculated using the formula 1 by Lwanga and Lemeshow. A total of 32 workers from Mill A and 30 workers from Mill B with similar socio-Demographic background were chosen based on their respective section, their task and inclusive (Malaysian and non-Malaysian, currently working in selected section, Male) and exclusive (Diagnosed with Cushing disease, Diagnosed with cardio vascular disease, Diagnosed with Psychiatric disorder, Changing in sleeping pattern, below 18 and above 65 years old, Working less than a year, Addicted) criteria.

Formula 1: $\boldsymbol{n = \left(\frac{Z}{d}\right)^2 (P)(P-1)}$ n = Sample size, Z = Standard score for significant Leve,l P =estimation incident for population

Subjects, questionnaire and O'Donnell inventory: All respondents were required to answer two sets of validated Malay version of questionnaire; the first set of questionnaire includes socio-demographic background and health status. The second set of questionnaire, O'Donnell Personal Stress Inventory (PSI) used in order to determine stress level(s) approximately based on physiological and psychological symptoms of stress. PSI consist 11 psychological and physiological subscales adding up to 53 items. There were four musculoskeletal, six gastrointestinal, six physical system, six depression, eleven anxiety, three energy level, five diet, three activity, three relationship and three sleep categorized questions. The measurement of symptoms was based on using four point Likert scales and subsequently the items scores were summed up and dichotomized to stress (score of > 36) and No stress (score of <36) groups.

Environment Sound Level Monitoring and Recording: In each section of the palm oil mill, the environment sound level was identified individually using Lutron SL-4112 Sound Level Meter. Prior to environmental sound measurement, the SLM was calibrated using a sound-level calibrator (TES-1356, TES Electronic Corp., Taipei, Taiwan) based on SOP of the equipment? The results were used to classify the exposed and non-exposed sections. The work areas involved this measurement are Loading Ramp, Capstan Line, Sterilizing, Pressing, Nut Plant, Clarification, Boiler Room, Engine Room, Workshop, General Store. Figure 1 shows the location of each measurement.

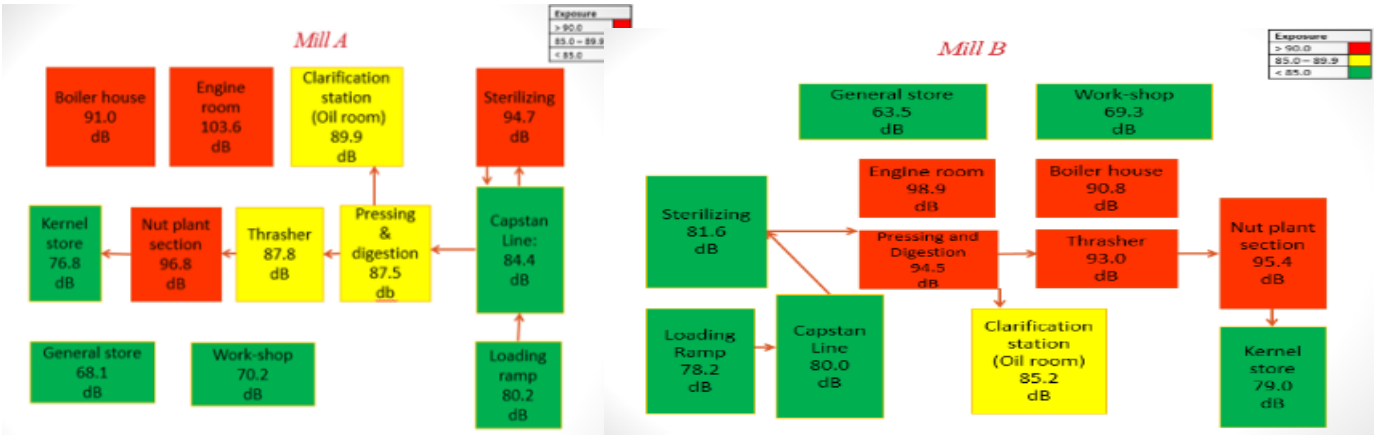

Figure 1. Environmental sound level monitoring

Personal Noise Exposure Monitoring and Recording: A Noise Dosimeter model Q-300 was used to measure the personal noise exposure upon each selected worker over 8 working hours and the personal 8-h TWA Leq with the range of 50–120 dB (A) was used to measure all subjects' noise exposure. Before and after measurements are taken, the noise dosimeters were calibrated at level of 114dB by the Noise Standard Calibrator and the measurement of dosimeter was based on SOP of the instrument. The noise dosimeter was attached on the belt of worker and the microphone was clipped on the shirt nearby his ear and then the dosimeter ran for 8 working hours. After 8 hours, the noise dosimeters were removed and the data was transferred in to the computer. The Leq data for the personal noise exposure level were calculated by using following formula based on the guideline of noise report writing from Department of Occupational Safety and Health (DOSH):

Formula 2: Leq=90+16.61 Log Dose/12.5xDuration: Statistical Analysis: To analyses the obtained data from the data collection sessions, SPSS version 20software was utilized. All of the independent variables including age, marital status, salary, environmental and personal noise levels, employment duration, as well as the dependent variable which was the Stress level inventory results were keyed into the SPSS version 20 software. The prevalence of stress level with considering total TWA noise exposure were calculated and analyses at both of the mills to clarify the association between contextual factors or independent variables and stress level. The analyses were carried out in two steps: in the first part, a descriptive statistical analysis pertain into the distribution of stress level and noise exposure dosage in all samples which are tabulated in the results part was conducted. And in the second step, the correlation between subjective stress level outcomes and noise exposure level during 8 working hours was analysed using Pearson correlation test. The statistical significance level was set at 0.05 in this study.

RESULTS

Demographic characteristics of the respondents were analyzed to give a clear picture of the type of respondents involved in the study. Among the analyzed variables was sex, age, marital status. Table 1 shows the frequency distribution of the respondents by their demographic characteristics The results show the level of noise exposure is not linked to the environmental sound level as in some of the noisy area the dosimeters did not record the expected higher level of absorbed noise. Table 6 shows the results from dosimeter during this research. Figure 4 shows the level of personal noise exposure and the environmental sound level in different sections. *The* Table 2 shows the results among 62 workers participated in this research. O'Donnell inventory results show that only 7 workers out of 62 workers experienced occupational stress in both of the mills with the scores above 36 (cut off line for stress detection). 4 workers in Mill An out of 32 workers, experienced stress while one of them was working in noisy working environment(sterilizer, 94.7 dB)and the other 2 of them were working in standard environment with sound level below 90 dB(Loading Ramp, 80.2 dB and Oil Room, 89.9). In Mill B, 3 out of 30 workers experienced occupational stress while two of them were working in workshop (69.3 dB) and one of them was working in boiler-room (90.8 dB).The prevalence of stress status in both of the mills have been shown in table 2. Environmental sound level and personal noise exposure as the independent variables have no significant relationship with stress level (P value>0.05, r<0.3). Tables 3 shows the relationship between stress level as the dependent variable on one hand with the six independent factors as below. The association between stress level and independent variables has been examined by using Multinomial Logistic Regression with the enter

method. The results in Table 4 show that the study did not find any statistically significant relationship between the independent variables and the dependent variable. (P value >0.05).

Table 1. Environmental sound level comparison between two mills

Sound Level	M (sd)	Min(section)	Max(section)	t (df)	P
Mill A	83.20±9.52	69.30 (store)	101 (engine room)	*0.657(59)*	*0.514*
Mill B	81.56±10.04	70.20 (workshop)	108 (engine room)		

Table2. correlation between Environmental sound level and Personal noise exposure

working area	Environmental sound level	Personal noise exposure	r	P	N
Boiler	90.1	99.4	0.240	0.430	13
Press	94.5	86.4			
Press	94.5	100.9			
Engine room	103.6	104.3			
Workshop	70.2	90.6			
Ramp	78.2	111.2			
Boiler	90.8	99.7			
Sterilizer	94.7	105.9			
Sterilizer	94.7	89.5			
Press	87.5	101.5			
Boiler	90.8	90.3			
Nut plant	96.8	102.1			
Oil room	85.2	104.1			

Table 3. Prevalence of stress

location	Stress status	No	%	Mean±sd	Range
Mill A	>36 <36	4 28	87.5 12.5	19.3±20.12	0-85
Mill B	>36 <36	3 27	90 10	16.36±15.59	0-72
Mills A and B	>36 <36	7 55	88.7 11.3	17.74±17.97	0-85

Table 4. Logistic Regression Model Examining the Association between Occupational Stress Status and Independent Variables

Variables	OR	df	P	95% CI	
				Lower	Upper
Noise exposure level	0.893	1	0.166	0.760	1.048
Environmental Sound Level	1.090	1	0.262	0.938	1.267
Age	0.963	1	0.503	0.864	1.075
Salary	1.000	1	0.246	0.999	1.004
Marital status	4.769	1	0.199	0.456	49.88
Education	0.855	1	0.813	0.234	3.122

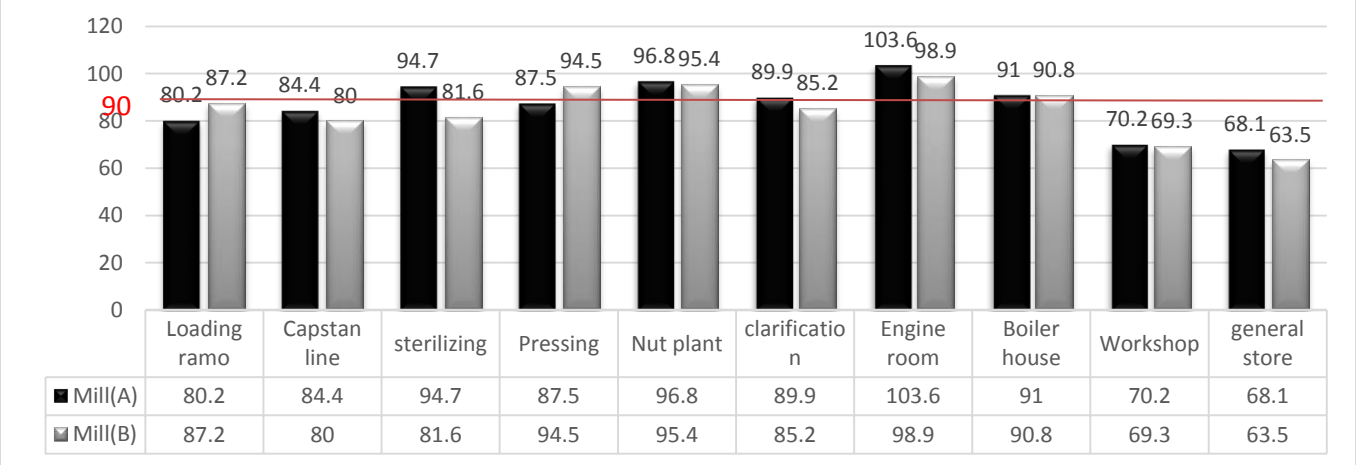

Fig 2. Environmental sound level status between the two mills

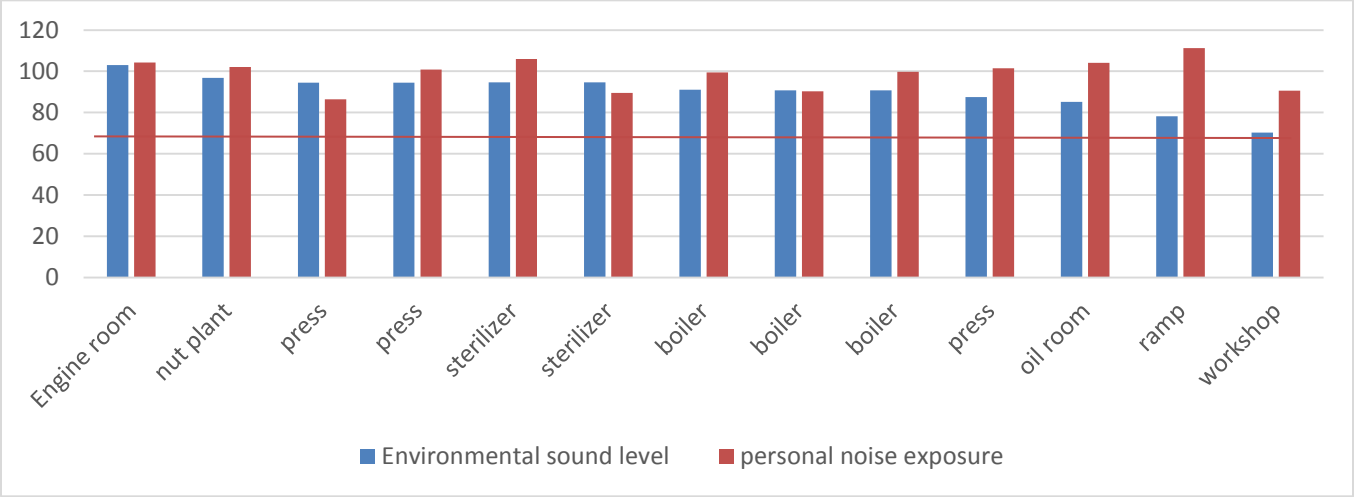

Fig 3.personal noise exposure and SLM results

DISCUSSION

62 Palm oil mill workers regardless their nationality, involved in this study. The socio-demography of respondents were asked to select the samples based on inclusive and exclusive criteria and also to determine the association between some of the socio-demographic factors and stress level. The age of the respondents ranged from 20 to 62. The wide range of age was because the variety of sections demand the workers with different skills and different experiences. Approximately most of the skilled workers were more experienced and older. The range of education in both of the mills were from non-registered to diploma. The high percentage of non-college-educated workers (90%) indicated that the occupational skills were achieved by working experience rather than education. High range of salary from RM 900 to RM 3422 shows that the length of employment, experience, skill as well as Level of education determine the income of workers who are involving in different position. One of the objective of this study was to determine the association between risk factors and stress level. As a conclusion there was no significant relationship between age, marital status, education level and salary with the occupational stress level among the workers. The finding of this study is supported by obtained results in study done by Syazani in 2012.The other main objective of this study was to determine the association between noise exposure level and occupational stress level among the workers. To minimize the uncertainty of outcome, this study suggests the simultaneous use of dosimeters and sound level meters. The environmental sound levels in different section of two mills were examined by Sound Level Meter. In both of the mills, nut plant, engine room and boiler house were considered as the noisy areas (ESL>90) while the workshop, general store, loading ramp and capstan line, were considered as the non-exceeded noisy area (ESL<90). Some of the reasons such as different types of sterilizer using in mill A, the short distance between sterilizer and engine room and oil-room, also operating the sterilizer with old components caused that the sound level in mill A is 13.1 dB higher than Mill B as the sterilizer section in mill A is noisy area and in mill B is non-exposed area. In previous research conducted by Syazani (2012) the environmental sound level has not been measured in sterilizer section and there is not any evidence show the type of sterilizer machinery. The obtained data have been analysed and the results showed that there were no significant relationship between the data of Personal noise dosimeter and Environmental sound level. The Observation of the workers during 8 working hours demonstrated that some of the workers do not working stationary in one section. For instance for the workers who were registered at workshop the Environmental sound level was considered 69.3 dB while they usually travelled to the other noisier section to fix the faulty machineries. On the other hand some of the workers did not stay in noisy sections such as engine room when they did not have any task to do. Hence the dosimeters recorded the higher or lower level of noise than expected level. In this research to determine the stress level and also to assign the casual pathway between noise exposure level and stress level, O'Donnell inventory was needed to conduct. Some of the basic influent factors have been controlled synchronously such as medicine usage,

addiction or some of the disease such as cardio vascular disease, psychiatric disorder and Cushing syndrome. The results show that 7 workers (11.3%) experienced occupational stress while only 2 of them were working in noisy area and the other 5, were working in non-exposed area. It means stress symptoms are not more frequently reported in high noise levels than elsewhere. Thus "noise level" is not the only significant influent factor to increase the stress level and probably these symptoms are dependent on the combination of noise with the other mentally stressful tasks or on the combination of noise with job-related communication. The findings of this study does not support by the previous study conducted by Syazani in 2012. In her study it has been proved that 88.6% of the workers who exposed to noise exceeding 85 dB experienced stress and also stress level has a significant association with noise exposure level, while this percentage is much lower in current study. Also the calculated results demonstrate that the correlation between stress and noise intensity in the environment is irregularly disproportional. The difference probably is due to different study design. Also stress symptoms develops over a long term period of time but in this study there was no accessible accurate information regarding workers' before their recruitment to participate or their personal effective factors that the workers are not willing to reveal them.. Regular usage of PPE by the workers and adaptation to the working condition due to long term contract membership also could probably reduce the adverse effects of noise. Statistically analyses result clearly states the lack of relationship between the noise exposure level and stress level in this research, hence it is concluded that the noise may not have a significant impact on the stress level of workers and that can be due to verity of reasons.

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