# Psychological impact of noise exposure among machine and non-machine operators in construction industry

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# Psychological impact of noise exposure among machine and non-machine operators in construction industry

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**Abstract.** Noise hazard is reported as a serious issue among the construction industry in Malaysia. The aim of the study is to determine the personal noise exposure level and the prevalence of psychological health effect symptoms among the machine and non-machine operators on construction site in Malaysia. Sixty-one (61) construction workers were participated as respondents and categorized into machine and non-machine operators group. All respondents were monitored for 8 hours working time using personal noise dosimeter for personal noise monitoring. Questionnaires and interviewed sessions were used to determine the prevalence of psychological health effect symptoms. The results obtained reveal that the construction workers have high personal noise exposure level where machine operators are significantly higher compared to non-machine operators. The prevalence of psychological health effect symptoms among machine operators is 89% higher than the non-machine operators. Lastly, there is a significant positive relationship between the personal noise exposure level and the prevalence of psychological health effect symptoms among the construction workers.

## 1. Introduction

Noise is one of the primary pollutants around the world that affects human working and living environment [1]. Noise is described as a common occupational hazard in most of the workplaces, especially in the construction industry [2]. The construction activity categorized as one of the sources of noise pollution which could lead to the occurrence of psychological and physical health effect such as stress towards the people work or live near the construction site [3].

The construction activities have led to several hazards, especially the noise hazard where it has become a common and serious source of environmental noise that harmed human's health [4]. According to the Social Security Organization (SOCSO) reports in 2016, there are 7338 accident cases occur in the Malaysian construction industry. It is the third-highest number of cases reported industry among all other sectors [5].

The Department of Occupational Safety and Health (DOSH) has shown a statistical report whereby the occupational noise-related hearing disorders are the highest occurrence occupational disease among the occupational diseases in Malaysia. The statistic of occupational disease among the occupational disease and poisoning by type of disease statistics for 1995–2009 from the DOSH, it shows that noise-induced hearing loss (NIHL) was the most commonly notified occupational disease. In year 2016, the analysis statistic shows the occupational noise-related hearing disorder consists of 2876 cases [6]. Ali [7] found that nearly 81% of the construction workers exposed to high noise exposure level that could

contribute to the hearing impairments and the psychological health effect symptoms. The psychological health effect symptoms indirectly contribute to the increase in the rate of accidents owing to interference with the sound signals and other non-hearing effects caused by noise.

Therefore, this study is to investigate the impact of noise exposure on the psychological health of the machine and non-machine operators in the construction industry.

## 2. Methodology

A walk-through observation conducted and guided by the supervisor. A noise exposure observation checklist from the Noise Hazard Identification Form by University of Melbourne [8] was used as a preliminary assessment to obtain deeper understanding regarding the safety practice and the exposure of noise among the construction workers. About 61 construction workers were selected randomly to participate in the study as respondents. The construction workers categorized into two (2) groups; machine operators group (n=31) and non-machine operators group (n=30).

Personal noise monitoring was conducted to obtain the personal noise exposure level among the respondents in the construction site. The Spark 706RC-ATEX personal noise dosimeter was used to measure the personnel noise exposure level among construction workers [9]. The data of 8 hours' time-weighted average (TWA) for every respondent obtained from the personal noise dosimeter for further analysis.

OSHA Recordable Questionnaire was used to measure the prevalence of psychological health effect symptoms among the construction workers [10]. The questionnaires distributed among the respondents during the interview sessions.

The data obtained were analyzed using Statistical Package of Social Science (SPSS) Version 20.0. Independent t-test was carried out to compare the personal noise exposure level between machine operators and non-machine operators. Independent Chi-square test was performed to compare the prevalence of psychological health effect symptoms on noise exposure between machine operators and non-machine operators. Binary Logistic Regression test performed for identifying the relationship between the personal noise exposure level and the prevalence of psychological health effect symptoms among the construction workers in the selected construction site.

## 3. Result and Discussion

Figure 1 and Figure 2 show the 8 hours time-weighted average (TWA) personal noise exposure monitoring for machine and non-machine operators. The personal noise exposure level among the construction workers was analyzed and compared with the exposure limit stated in regulations especially the Factories and Machinery (Noise Exposure) Regulations 1989 in Factories and Machinery Act (FMA) 1967 [11] and NIOSH [12]. The result shows that about 19.7% of construction workers identified expose to above the action levels as stated in Factories and Machinery (Noise Exposure) Regulations 1989 which is 85dBA. The construction industry generates noise from different types of heavy machines used in the construction site on a range between 80dBA until 120dBA where it puts the construction workers in the risks of over noise exposure [13].

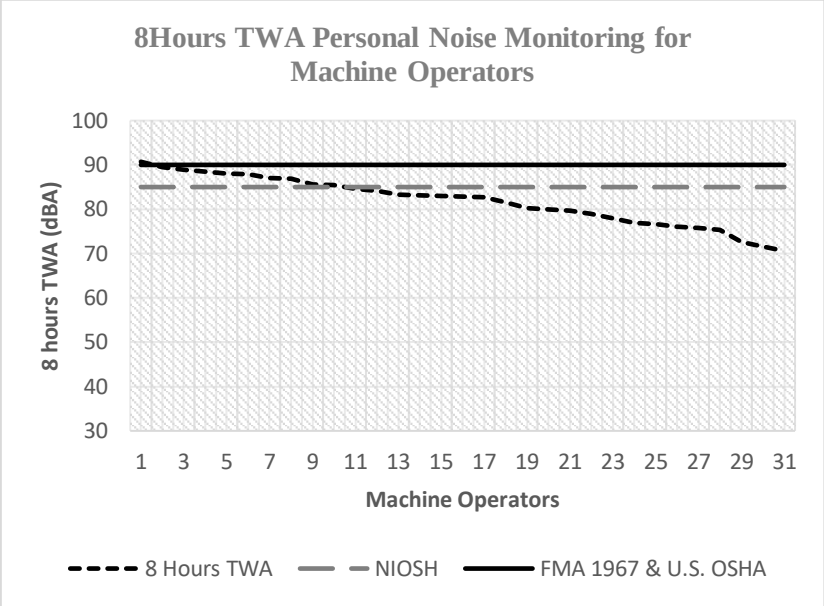


**Figure 1.** 8 Hours TWA Personal Noise Monitoring for Machine Operators

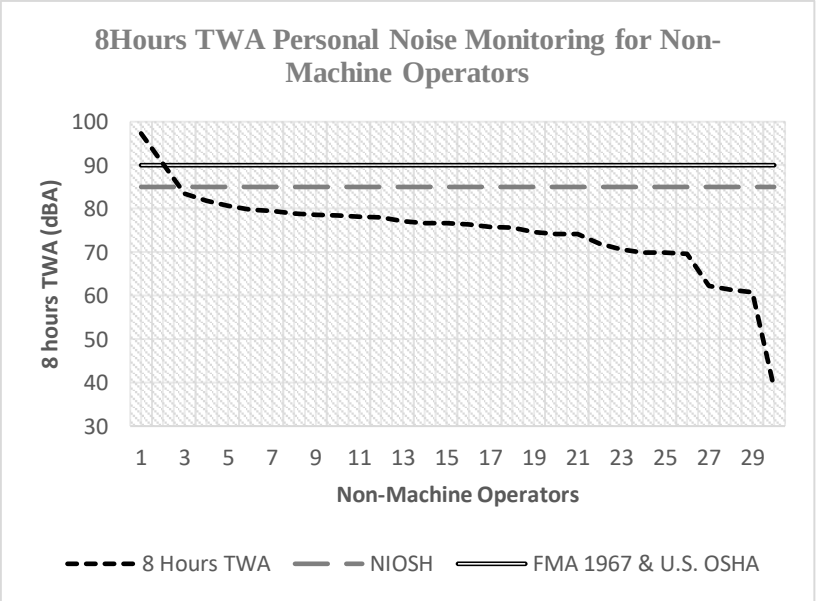


**Figure 2.** 8 Hours TWA Personal Noise Monitoring for Non-Machine Operators

Table 1 shows the minimum, maximum, means, and standard division of results for the personal noise monitoring among the machine operators and non-machine operators on the 8 hours time-weighted average (TWA). Based on the result, the mean value of TWA 8 hours (dBA) among machine operator recorded was 81.81 dBA while the non-machine recorded was 74.71 dBA. Besides, the results reveal that the maximum value of personal noise level of 90.7 dBA, which is above the permissible exposure limit (PEL). Main sources of noise at the construction site is the construction machines where most of the machines produce impacts such as devices for breaking of concrete, steel bar machines, electronic grinders, electronic mosaic cutters, pile drivers, and earth moving machines that produce unwanted sound [1]. These mechanisms considered as point or linear sources of noise based on the level of movement at the construction site in the studies of noise.

**Table 1.** Minimum, Maximum, Means and Standard Deviation of Personal Noise Monitoring

| Category | Time-Weighted Average TWA (8) (dBA) | | | |
|---|---|---|---|---|
| | Minimum | Maximum | Mean | Standard Deviation |
| Machine Operators | 70.6 | 90.7 | 81.81 | 5.54 |
| Non-Machine Operators | 38.7 | 97.3 | 74.71 | 10.13 |

N=61

Table 2 shows the independent t-test result that found significant differences (t=3.411, df=59, p=0.001) of personal noise exposure level between machine and non-machine operators group. The mean of personal noise exposure level for the machine operators (81.81dBA) was significantly (p=0.001, <0.05) higher compared to the mean of personal noise exposure level for non-machine operators (74.71dBA). The machine operators were exposed to loud noise most of the working hours compared to the non-machine operators at the construction site especially while handing the bar tying machine

**Table 2.** Comparison of Personal Noise Exposure Level between Machine Operators and Non-Machine Operators

| Variable | T-test Statistics[2] (df) | *P*-value |
|---|---|---|
| Personal Noise Exposure Level (dBA) | 3.411 (59) | ***0.001 |

N=61 *Independent T-Test ** Significant at p<0.05 *** Significant at p<0.001

Table 3 shows the prevalence of psychological health effect symptoms among the machine operators and non-machine operators. Tension in a noisy work environment identified as the highest prevalence of health effect symptom among machine operators (90.3%) and non-machine operators (43.3%). The tension issue could arise when they are unable to withstand the demand of work environment [14]. For the least prevalence of psychological health effect symptom among both machine operators (12.9%) and non-machine operators (3.3%) is the experience of any sleep disturbance.

**Table 3.** Prevalence of Psychological Health Effect Symptoms of Construction Workers

| Symptoms of Health Effect | Yes N (%) | |
|---|---|---|
| | Machine Operators | Non-Machine Operators |
| Ear pain | 17 (54.8) | 6 (20.0) |
| Sudden hearing loss | 5 (16.1) | 2 (6.7) |
| Tinnitus | 24 (77.4) | 5 (16.7) |
| Noticeable change in hearing | 13 (41.9) | 2 (6.7) |
| Anger and aggressiveness | 23 (74.2) | 10 (33.3) |
| Dizziness | 11 (35.5) | 6 (20.0) |
| Experience of any sleep disturbance | 4 (12.9) | 1 (3.3) |
| Stressful in noisy work environment | 28 (90.3) | 12 (40.0) |
| Tension in noisy work environment | 29 (93.5) | 13 (43.3) |
| Difficulty in concentrating or decision making | 16 (51.6) | 8 (26.7) |

N=61

The result also shows that there were significantly ($p<0.05$) differences between the machine and non-machine operators. The related prevalence of psychological health effect symptoms was ear pain, tinnitus, noticeable change in hearing, anger and aggressiveness, stressful in the noisy work environment, the tension in a noisy work environment and the difficulty in concentrating or decision making. While Table 4 shows that machine operators group has a significantly higher prevalence of all these health effect symptoms compare to non-machine operators group. Noise exposure is associated with the psychological health effect and could vary with the source of environmental noise exposure [15].

**Table 4.** Prevalence of Psychological Health Effect Symptoms Between Machine Operators and Non-Machine Operators

| Symptoms of Health Effects | Machine Operators | Non-Machine Operators | Statistics | |
|---|---|---|---|---|
| | Yes N (%) | Yes N (%) | Value[a] ($x^2$) (df) | *p*-value |
| Ear pain | 17 (73.9) | 6 (26.1) | 7.878 (1) | 0.005* |
| Sudden hearing loss | 5 (71.4) | 2 (28.6) | 1.344 (1) | 0.246 |
| Tinnitus | 24 (82.8) | 5 (17.2) | 22.563 (1) | 0.000* |
| Noticeable change in hearing | 13 (86.7) | 2 (13.3) | 10.227 (1) | 0.001* |
| Anger and aggressiveness | 23 (69.7) | 10 (30.3) | 10.250 (1) | 0.001* |
| Dizziness | 11 (64.7) | 6 (35.3) | 1.818 (1) | 0.178 |
| Experience of any sleep disturbance | 4 (80.0) | 1 (20.0) | 1.856 (1) | 0.173 |
| Stressful in noisy work environment | 28 (70.0) | 12 (30.0) | 17.102 (1) | 0.000* |
| Tension in noisy work environment | 29 (69.0) | 13 (31.0) | 17.926 (1) | 0.000* |
| Difficulty in concentrating or decision making | 16 (66.7) | 8 (33.3) | 3.976 (1) | 0.046* |

N=61 *Independent chi-square test * Significant at $p<0.05$

From the data obtained through the Binary Logistic Regression test shows that there is a significant relationship between the personal noise exposure level – 8 hours time-weighted average (TWA) and the prevalence of psychological health effect symptoms among the construction workers. The most strength and significant positive relationship among machine operators is the noticeable change in hearing (p-value=0.007). While the most strength and significant positive relationship among non-machine operators is anger and aggressiveness (p-value=0.027). The prevalence of anger and aggressiveness could increase as the people exposed to noise pollution and noise act as a stressor that causes unwanted expression of human such as anger [16-17].

**Table 5.** Relationship between Personal Noise Exposure Level and Prevalence of Psychological Health Effect Symptoms

| Variable | Personal noise exposure level (8 Hours TWA) (*p*-value) | |
|---|---|---|
| | M.O. | N.M.O. |
| Ear pain | 0.011* | 0.095 |
| Sudden hearing loss | 0.072 | 0.047* |
| Tinnitus | 0.809 | 0.055 |
| Noticeable change in hearing | 0.007* | 0.057 |
| Anger and aggressiveness | 0.062 | 0.027* |
| Dizziness | 0.016* | 0.050* |
| Experience of any sleep disturbance | 0.058 | 0.993 |
| Stressful in noisy work environment | 0.436 | 0.031* |
| Tension in noisy work environment | 0.767 | 0.028* |
| Difficulty in concentrating or decision making | 0.481 | 0.071 |

N = 61 * Binary Logistic Regression Test * Significant at $p<0.05$

## 4. Conclusion

The study had found the personal noise exposure level among machine and non-machine operators in construction industry. The machine operators group has significantly higher prevalence of psychological health effect symptoms compare to non-machine operators group where there were significant differences ($p<0.005$) between machine operators and non-machine operators for the prevalence of tinnitus, noticeable change in hearing, anger and aggressiveness, stressful, and tension in noisy work environment. The significant relationship between the personal noise exposure level and the prevalence of psychological health effect symptoms among the construction workers was identified in the study. The presented findings have important implications in industrial practice where the contractor should provide further safety training, required hearing protection devices and even implement the safety culture at the construction site to increase the safety awareness among the construction workers. The result presented here may facilitate improvement in determining the impact of noise exposure towards worker's health in construction industries.

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