Archives of Occupational Health | Volume 2 | Issue 1 | January 2018 | 43-7.

Original

Association between Noise Exposure and Noise Disturbance in Construction Workers

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Abstract

Background: Noise as one of the common hazardous factors in the work environments, causes adverse effects on the mental health of individuals in addition to physical problems. This study was conducted to measure the exposure of workers to noise in a construction workshop and assess its association with noise disturbance. **Methods:** A total of 96 employees of a construction workshop were considered in this study and were divided into four working groups: executive, administrative, supervisory and machinery. Noise exposure of workers assessed according to ISO 9612: 2009. The noise disturbance questionnaire was also completed by participants. **Results:** The results obtained from the noise exposure measurement showed that the mean of equivalent sound level in employees of administration section was 82.28, in administrative section was 66.52, in supervisory section was 76.43 and in machinery section was 78.45 dB. The results of noise disturbance showed that 25% of workers rated noise in the work environment as very disturbing. The results of regression analysis showed that the type of occupation associated with disturbance of subjects with correlation coefficient of 0.413. **Conclusion:** According to the results of dosimetry and self-reported disturbance, the noise exposure level and noise disturbance of work environment due to sound sources are high. Administrative solutions need to be provided to reduce the exposure of workers to noise.

Keywords: Noise exposure; Noise disturbance; Construction industry; Occupational exposure

Introduction

Theexposure of workers to noise is a common problem in working environments across the globe.1 About 10 million workers in the United States suffer hearing loss of more than 25 dB. In the entire world, 16% of hearing loss is due to exposure to noise in work environments.[2,3] An estimate of available data shows that about 2 million workers in Iran are exposed to harmful noise.[4]Exposure to noise can cause hearing loss in addition to a lot of other problems, including lack of concentration, loss of professional ability, distress and stress, and low productivity in workers.[5] Sound disturbance, as a measurable mental response, is one of the most important adverse effects of sound.[6] According to WHO (World Health Organization) findings, noise-induced distress has harmful and unpleasant effects on health-related quality of life.[7] In a research, the study of 4 occupations exposure in construction workshops was carried out. The results of the regression analysis showed that the type and characteristics of the work

Citation: Monazzam Esmailpour MR, Daneshvar A, Azam K. **Association between Noise Exposure and Noise Disturbance in Construction Workers.** Archives of Occupational Health. 2018; 2(1): 43-7.
Article History: Received: 25 August 2017; Revised: 10 October 2017; Accepted: 28 November 2017

were related to increase in sound exposure levels.[8] In a study on the effect of noise and shift work on worker fatigue as a function of age, it was shown that exposure to noise has a major impact on fatigue and as the duration of exposure increases, the level of weariness of workers also increases.[9]

The results of the correlation test in the study of the relationship between exposure to noise pollution caused by traffic and the quality and quantity of sleep among police officers of the city of Tehran showed significant correlations between the hours and the frequency of night sleep awakening, and the variables of age, noise and the sensitivity to traffic noise.[10] A study at the Bangkok power plant showed that although the sound was lower than the standard limit, noise annoyance was significant and based on evaluations, it was found that noise was higher than 55 dB over the environment, which can cause various health problems.[11]According to the mentioned studies, it can be concluded that there has been no research on the level of exposure and disturbance caused by noise in construction workshops.

Therefore, the present study aimed to investigate the association of noise disturbance among workers at the construction workshop.

Methods

This research was carried out in the spring and summer of 1395 at several construction workshops with the dominant construction activity in the city of Tehran during the construction of wall. In these construction workshops, different sources of sound including electricity generator, machines and hand tools were used. The population surveyed in this study was made up of all construction workers working in these workshops. All participants were male, and the protocol was reviewed and approved by the ethics committee of Tehran University of Medical Sciences and approved by number ***. Informed consent was obtained from all participants in this study. Entry criteria included working for at least 5 days a week at the construction workshop and not having hearing impairments. Also, people who did not complete the informed consent were excluded from the study. According to previous studies, 70 people were required to reach 80% power at the significant level of 5%. Considering the decrease of 20% and in order to compensate for the possible impact of this fall, a total number of 96 individuals from the workshops were randomly assigned.

In order to investigate the relationship between noise disturbance and exposure to noise in different occupational groups, the subjects were classified into four executive, administrative, supervisory and machinery groups. , A questionnaire and a sound meter were used to assess the exposure and outcome in this study. To determine the sound disturbance, the Sound Disturbance Questionnaire" Acoustic- sound disturbance assessment using social audit and socio-acoustic" was used. Validity of the Persian translation of this questionnaire was reviewed by Ali Mohammadi with specification of ISO/TS 15666. In order to determine the occupational exposure level of individuals, dosimetry in network A according to ISO 9612: 2009 standard was used for each individual. It was standardized to determine the exposure levels of occupational groups. The dosimeter used in this design is the CEL-272 model, which complies with the IEC 29, TC 29 / WG 4, IEC Draft Document ISO 1999.

The collected results were first studied for descriptive statistics including mean, range and standard deviation of observations. Compliance with normal distribution in data was studied to select either parametric or nonparametric tests. Non-parametric tests were used in case of violation of normal distribution. The difference in reported mean of audio disturbance in the occupational groups was assessed by one-way analysis of variance. The correlation between the exposure values and the reported disturbance score were analyzed by Pearson and Spearman correlation tests. Comparison of mean in abnormal cases was

done by Kruskal-Wallis test. The significance level was considered in all tests as 5%. All analyzes in this study were performed using SPSS21 software.

Results

In this study, the workers were classified into four groups: executive, administrative, supervisory and machinery groups. The 8-h equivalent sound level was calculated according to the formula of the measured dosimetry results for each person. First, Kolmogorov Smirnov and Shapiro Wilk tests were used to determine the normality of the data. The results showed that the data follows the normal distribution. Table 1 shows the descriptive statistics (average, standard deviation, mean, median, minimum and maximum) of audio exposure data divided by occupational groups. As shown in this table, the average noise exposure of the executive job group was 82.28, office group was 66.52, supervisory was 76.43, and machinerywas78.45, which indicates an increase in the average noise exposure of the executive job group. According to the results of ANOVA and Kruskal-Wallis test, there was a significant difference in noise exposure among occupational groups. Differences in noise exposure of executive, administrative, supervisory and machinery groups were significant, and the executive job group with the mean of 82.28 had the highest average exposure. Moreover, the administrative group had the lowest noise exposure level of 66.59 dB A. Scheffe test did not show any significant difference between the noise exposure of the supervisory group and the machinery group at the level of 0.05. Only executive group with administrative group and executive and supervisory groups had significant difference in the amount of exposure to noise.

The mean of sound disturbance in the executive, administrative, machinery and supervisory groups is 6.9, 4.7, 5.0, and 5.2, respectively.

The average noise exposure and disturbance in the executive job group was higher than the other occupational groups, and lowest amount of exposure to noise and sound discomfort was observed in the administrative occupation group. In order to study the normality of the variables of sound disturbance in occupational groups, age and work experience, Kolmogorov Smirnov and Shapiro-Wilk tests were used. The results indicated that sound disturbance in the executive and supervisory groups followed non-normal distributions and in the administrative and machinery groups followed normal distribution. Therefore, both parametric and non-parametric tests were performed. ANOVA and Kruskal Wallis tests of sound disturbance showed a significant sound disturbance among the occupational groups. The Scheffe and Pairwise tests showed a significant difference in sound disturbance between the executive and administrative groups, machinery and supervisory groups at a 5% error rate. However, no significant difference was found between the other groups.

The results of Pearson and Spearman correlations of noise exposure and disturbance showed high correlation. The value of R2determination coefficient in linear regression between 8-h noise exposure and disturbance indicates that noise exposure variable can justify 40.7% of the variations of the response variable, that is, sound disturbance. It can also be stated that at a 5% error level, with a change of 1 dB in 8-h noise exposure, 0.19 units was added to an individual's sound distraction score.

Table 1. Descriptive statistics of noise exposure divided by job group

		8-h noise exposure				
		Mean	Standard deviation	Median	Minimum	Maximum
Sound exposure	Executive	82.28	3.43	82.15	73.06	92.75
	Administrati ve	66.52	4.37	67.29	60.05	71.81
	Supervisory	76.43	2.87	76.71	70.56	81.94
	Machinery	78.45	5.04	79.77	70.05	84.73
	Total	80.21	5.44	80.95	60.95	92.75

		Sound disturbance					
		Mean	Standard deviation	Median	Mode	Minimum	Maximum
Construction workplace	Executive	6.88	1.48	7.00	7.00	3.00	10.00
	Administrative	4.67	0.82	4.50	4.00	4.00	6.00
	Supervisory	5.00	0.74	5.00	5.00	4.00	6.00
	Machinery	5.22	1.92	5.00	3.00	3.00	8.00

Discussion

Noise is one of the factors causing discomfort. It has been of great interest to several researchers, considering the increase and improvement of construction industry and the need for housing due to the increasing population of Iran, especially in the ages that require housing. Therefore, the human resources needed for this industry are increasing. Noise pollution is one of the most important pollutants in the work environment and so far, extensive studies have been carried out on the effects of noise on people's sound disturbance. But so far, there has been no study on the workers of this industry. Therefore, the present study aimed to investigate the relationship between noise exposure and sound disturbance at a construction workshop. The results showed that the average noise exposure at the studied workshop was 80.21. Meanwhile, the executive team with an average noise exposure of 82.28 dB had the highest average noise exposure. According to these results, it can be stated that the highest exposure is in the executive group, followed by the machinery and supervision dimension, and finally in the administrative group. These findings are in line with the results obtained at the study on the work groups of Manjil wind plant.[12] According to Abbasi,[12]each occupational group that was more involved in the implementation had more exposure.

Based on the findings of this study, the mean sound disturbance in the statistical population was 6.35 and its standard deviation was 1.65. In this community, 25% of people reported disturbance of 8 and above, indicating high disturbance. In other studies, sound disturbance rates were reported as 8 and 32%.[12,13] The reasons for the difference in results can be due to the measured sound characteristic, the difference in the studied population and tool and the method used. According to the findings of this study, there was a positive and significant correlation between noise exposure and sound disturbance, and a linear relationship between them. Also, there was a positive and significant correlation between the degree of exposure to noise and sound discomfort among employed people in the occupational groups, indicating a significant difference in the degree of hearing loss between different groups. As a result, the executive group had the highest amount of exposure and therefore the highest average of noise disturbance, while the administrative group had the lowest exposure level and as such, had the lowest average sound disturbance. These findings are consistent with those of other studies.[12,13] The range of the present study was 60 to 93 dB, while the range in studies by other study was 70 to 100 and 60 to 83 dB, respectively both of which are in the same range as the current study, where increase in exposure, increases the percentage of people who suffer from excessive hearing impairment. Although there are many differences, such as the type of studied occupations, different sound sources and different working conditions, and differences in individual characteristics in all three studies, but increasing the amount of exposure to noise increases the amount of noise disturbance. Therefore, the high level of irritation in the executive work group can be assigned to the high level of exposure to noise, which in this study also had a linear relationship between noise exposure and distress. Another study has also shown that there is a linear relationship between noise exposure and distress, and stated that the effect of low frequency sound is greater than the effect of high-frequency noise on disturbance. The scope of

the study was 60 to 85 dB, which was common in our study area.

Conflict of interest

The authors declare no conflict of interest.

Acknowledgement

Due to the privacy policy in the construction workshop, the name of the construction workshop cannot be used; however, the author is very grateful to all the managers and staff of the workshop for their assistance during this research.

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