



# Effect of Chronic Noise Exposure on Aggressive Behavior of Automotive Industry Workers

Iraj Alimohammadi<sup>1</sup>, Fakhradin Ahmadi Kanrash<sup>1</sup>,  
Jamileh Abolghasemi<sup>2</sup>, Hanieh Afrazandeh<sup>3</sup>,  
Kazem Rahmani<sup>2</sup>

## Abstract

<sup>1</sup>Department of Occupational Health Engineering, School of Public Health, Iran University of Medical Sciences, Tehran, Iran

<sup>2</sup>Department of Epidemiology and Biostatistics, School of Public Health, Iran University of Medical Sciences, Tehran, Iran

<sup>3</sup>Department of Internal Medicine, Mashhad University of Medical Sciences, Mashhad, Iran



**Background:** Noise pollution is one of the important harmful physical factors in work environment in developed and developing countries. It not only causes a variety of physiological effects, but also accounts for psychological disorders.

**Objective:** To investigate the effects of chronic exposure to noise on aggression in automotive industry workers.

**Methods:** In a cross-sectional study conducted in an Iranian automotive industry, a group of workers were randomly selected from different parts of the paint shop. The workers' aggression level was measured using the Buss and Perry's questionnaire. The noise level was also measured at the workplace. Using linear regression analysis, the relationship between the level of aggression and noise level was evaluated.

**Results:** 250 workers with a mean age of 36.1 (SD 3.7) years were studied. There was a significant ( $p < 0.05$ ) correlation between the measured noise intensity and the aggression level of the studied workers.

**Conclusion:** Exposure to noise in work environment increases the incidence of tension and inappropriate behavior associated with aggression. Controlling noise through use of protective equipment might reduce the deleterious effects of noise on workers.

**Keywords:** Aggression; Noise; Occupational medicine; Mental health

## Introduction

Noise pollution is one of the important harmful physical factors in work environment in developed and developing countries.<sup>1</sup> In recent years, noise pollution has been recognized as one of the factors affecting quality of life across the globe.<sup>2</sup> Noise may cause psychological disorders too.<sup>3</sup> The deleterious effects of noise on humans do not usually appear

in short-term. Chronic exposure to noise, however, has a significant impact on humans and their surroundings after years. As personal characteristics and sensitivity to noise differ from person to person, mental effects of noise are not directly related to noise intensity; sometimes, the slightest noise may cause a severe reaction in one person, whereas a loud noise may have no effect on another one. In general, it has been shown that noisy environments

Correspondence to  
Fakhradin Ahmadi  
Kanrash, Department  
of Occupational Health  
Engineering, School  
of Public Health, Iran  
University of Medical  
Sciences, Tehran, Iran  
E-mail: F\_ahma-  
di1367@yahoo.com  
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may impair speech and understanding, decrease brain activity, and cause a disharmony in physical work.<sup>4</sup>

The physiological and psychological effects of noise exposure on humans often appear gradually; the negative psychological outcomes, appearing in the long-term, include aggressive behavior, physical and mental exhaustion, stress and anxiety, dizziness, headache, anger, lack of concentration, sleep disorder, and reduced efficiency.<sup>4-6</sup>

Aggression is a very important factor in occupational health and has an adverse effect on life of people in their work and social environments. Long-term exposure to high-level noise may cause tensions and aggression in individuals; even different frequencies may act differently and cause impairment in cognitive functions, increase human errors, may cause adverse consequences, and most importantly, increase psychological reactions in social and family settings. These issues are of great importance in terms of health and safety in work environments.<sup>7</sup>

Working in automotive industry is one of the hardest jobs associated with various physical and chemical risk factors for the workers.<sup>8,9</sup> One of the most important harmful factors in this industry is noise, due to the presence of high-speed machinery and mechanical movements of the machines. According to few studies so far conducted on aggression caused by long-term exposure to noise in industrial environments and its adverse consequences such as extensive psychological and functional disorders, this study was conducted to investigate the relationship between workers' aggression level and chronic exposure to noise in industrial environments.

## Materials and Methods

An analytical cross-sectional study was carried out on workers working in an Ira-

nian automotive industry. Two-hundred and fifty workers selected at random from 600 workers working in the company were participated in this study. The participants gave written informed consent before entering the study. To minimize the effects of confounding variables such as the effects of chemicals used in the painting station and other similar parts, attempts were made not to select individuals from these stations.

The volume and intensity of the received noise by the studied workers at different work stations during specified work shifts were measured based on ISO 9612:2009 standard, using a Testo CEL-815 device with a precision of 0.5 dB; the device has the ability to measure noise intensity balance in the A network and under calibration with a calibrator, model Testo IEC942/90 CLASS2 with an intensity of 114 dB at the frequency of 1 kHz.

To assess an estimation of the mean received dose of noise for each subject, the measurement was made during an 8-hour work shift at each station. Similarly, the mean time for each activity during the 8-hour work shift was calculated for each worker using the following equation:

$$LEPd = 10 \times \log \left( \frac{\sum_{i=1}^n t_i 10^{SPL/10}}{8} \right)$$

where *SPL* represents sound pressure level (dB). To determine the level of aggression for each individual, the Buss and Perry's questionnaire was used (Aggression Questionnaire-AQ). The questionnaire consists of 29 questions the answer to each of which is based on a Likert scale. The questionnaire evaluates four types of aggression—physical aggression, verbal aggression, anger, and hostility. The reliability of the English version of the questionnaire was examined through test-retest method;

For more information on blood pressure among a group of Jordanian workers chronically exposed to noise see <http://www.thejoem.com/ijoem/index.php/ijoem/article/view/1134>



**Table 1:** Pearson's correlation coefficient (*r*) between aggression scales and the noise intensity dose received by studied workers

Scale	Verbal aggression	Physical aggression	Anger	Hostility	Aggression
LEPd	0.131*	0.160*	0.226*	0.139*	0.189*
Age	0.467**	0.417**	0.288**	0.264**	0.401**
Job tenure	0.416**	0.392**	0.174**	0.393**	0.394**

\*p<0.05, \*\*p<0.01

the Cronbach's  $\alpha$  were 0.80, 0.76, 0.72, and 0.72, for physical aggression, verbal aggression, anger, and hostility, respectively.<sup>10</sup> The Persian version of the questionnaire used in the current study had a Cronbach's  $\alpha$  of 0.78.<sup>11,12</sup>

### Statistical Analysis

Stata ver 12 (Corp LP) software was used for data analysis. Pearson correlation coefficient was used to assess the relationship between noise exposure level and level of aggression. Multiple linear regression analysis was also used. Those variables with a p value >0.2 in univariate analysis were included the regression analysis. A p value <0.05 was considered statistically significant.

### Results

A total of 250 workers with a mean age of 36.1 (SD 3.7) years was studied. The studied workers had a mean job tenure of 14.9 (SD 2.0) years. Most (92.0%) of the studied workers were married. More than half (50.8%) of the workers had a high school diploma; about 20% had higher education.

The mean noise dose received by the workers was 86.00 (SD 1.55) dB. There was a positive correlation between the daily dose of noise received by the workers and the aggressive scales such as verbal aggression, physical aggression, hostility and anger (p<0.05). The highest correlation was observed with the anger dimension (r=0.226). There was also significant (p<0.01) correlations between the age and participants aggression levels (*ie*, hostility, anger, *etc*) (Table 1). Work experience is known as a factor that increases the level of aggression. Those with higher work experience had higher scores of aggression subscales with stronger correlation in the subscales of verbal aggression and hostility (p<0.01). There was also a positive (p<0.05) linear relationship between the job tenure and aggression components.

There was a significant linear relationship between aggression components and noise intensity in workplace (Fig 1). An increase of 1 dB in workplace noise intensity was associated with an increase of 0.191, 0.156, 0.236, and 0.120 units in physical aggression, verbal aggression, anger, and hostility scores, respectively.

### TAKE-HOME MESSAGE

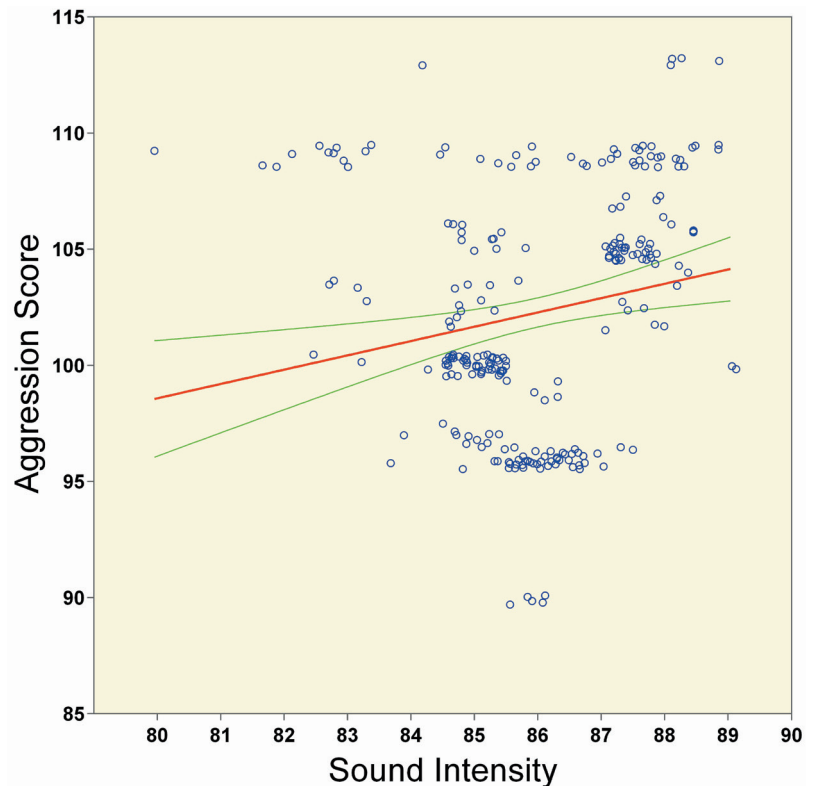
- Noise pollution is an important harmful physical factors in work environment. It has been recognized as one of the factors affecting quality of life across the globe.
- The relationship between workers' aggression level and chronic exposure to noise in industrial environments is an important issue.
- There is a linear relationship between the level of noise received by a group of workers in an automotive industry and the level of aggression they expressed.
- Increased job tenure and age had a direct relationship with psychological status and aggression.

## Discussion

We found a linear relationship between the level of noise received by a group of workers in an automotive industry and the level of aggression they expressed. Those with higher job tenure had higher aggression levels. This could be due to the impact of noise and physical stressors in the workplace. The interactive effects of noise intensity and job tenure could also lead to mental stress and destructive aggression in work environment, which is of paramount importance from the safety and health point of view.

Violence and aggression are closely related to individuals' health outcomes and undesirable behaviors, so that the World Health Organization (WHO) has considered anger and aggression among the 20 main causes of years-life-lost due to disability (YLD).<sup>13,14</sup> Aggression is expressed in various ways such as physical, verbal, and non-verbal forms. The destructive and violent behaviors prevalent around the world are now considered a social problem; noise is one of the factors that can increase the aggression level in workers. There are a number of conceptual models of natural factors that can be used for controlling noise levels and preventing aggression.<sup>15</sup>

Psychological effects of noise vary from person to person, in various locations, and different time. However, in general, environments with noise pollution would bring about an increase in speech impairment and reduce brain activity; it may also cause disturbed physical work. Results of our study were somehow in line with the results of other studies about the effects of noise on individuals' performance and also its psychological effects.<sup>16,17</sup> Studies carried out in administrative centers in Germany show that noise levels >55 dB are considered a mental stressor and may even cause irritability and aggression in people. To



**Figure 1:** The linear relationship between noise intensity and aggression score in studied worker. The data points are presented after jittering. The green lines represent the 95% CI of the regression line.

prevent these problems, the level of noise tolerable by people was set to <55 dB. Disturbing or excessive noise might damage individuals' daily activities or life balance; it would often cause disturbed social relationships by causing aggression.<sup>18</sup>

Noise at high and low frequencies is considered an important mental and psychological stimulus for brain activities and will increase human errors, reduce accuracy, and also increase psychological responses such as aggression, so that the person exposed to noise may eventually develop visual and auditory impairment with physical consequences at the workplace.<sup>6</sup> In addition to harmful effects of noise on mental status, it reduces the quality of life of the exposed people and their relatives.<sup>19</sup> Older people who are exposed

to chronic noise are more sensitive and violent than unexposed young people; the highest frequency of behavioral tension caused by noise occurs between the age of 30 and 49 years; younger people (<30 years) and those over the age of 49 can also be affected depending on their personality traits that are mainly rooted in their family and work responsibilities.<sup>8,20</sup>

Consistent with the findings of these studies and confirming them, our results also showed that increased job tenure and age had a direct relationship with psychological status and aggression.<sup>8</sup> Correlations between the effects of noise and psychological status has long been described.<sup>21</sup> Exposure to intense noise can cause personality changes and violent reactions.<sup>22,23</sup> Psychological effects of noise on two music bands were examined; the results showed that the group that were chronically exposed to loud noise suffered more aggression compared with another group.<sup>24</sup>

Psychological effects of noise include depression and anxiety that can lead to physical harm, reduced self-care, lower work tolerance, and increased isolation.<sup>25</sup> Studies on exposure to noise and its relationship with aggression showed that of the exposed individuals, 18.5% and 23.3% suffered from depression and aggression, respectively.

Environmental and air pollutants, such as carbon monoxide, have an interfering role in the effects of noise on aggression.<sup>8,26</sup> Based on the models provided for the pattern and effects of noise on mental disorders, such as noise-induced aggression, one can mention the factors such as personality factors, attitudinal factors in the use of personal protective equipment for controlling noise and consequently, prevention of noise-induced aggression, psychological characteristics, and auditory factors.<sup>27</sup> Several studies indicate that verbal anger is related to the level of exposure to noise, which is consistent to the

results of our study.<sup>8,28</sup> About 63% of people exposed to noise suffer from degrees of noise-induced anger whereas only 40% of healthy non-exposed individuals have such a problem.<sup>8</sup>

One of the limitations of this study was the lack of investigating the effects of other factors influencing aggression caused by exposure to noise. Furthermore, due to not having female workers in the studied automotive industry, it was not possible to study the observed association among different sexes.

**Conflicts of Interest:** None declared.

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