Investigation of the impact of noise exposure on blood pressure in tire manufacturing workers

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Abstract

BACKGROUND: Noise can cause serious health problems. Regular use of personal health equipments can reduce such problems. This study has been designed to compare the blood pressure of tire manufacturing workers, who were exposed to noise (> 85 db) and used personal health equipment, with a control group without noise exposure.

METHODS: In this case-control study, 70 workers who were exposed to noise (case group) and 220 workers who were not (control group) were recruited. Regular use of personal health equipment was compulsory. LEQ was calculated for both groups. To analyse the data, chi-square test and t-test were implemented. Finally multivariate regression model was developed.

RESULTS: No difference was seen between the groups in terms of basic characteristics (age, years of working, and BMI). Mean systolic blood pressure in case and control groups was 116.6 and 117.5, respectively; giving a P-value of 0.50. Mean diastolic blood pressure in case and control groups was 76.7 and 77.4, respectively; giving a P-value of 0.47. Results indicate no significant difference between blood pressure of cases and control groups.

CONCLUSION: We did not see any significant difference between the blood pressure of those exposed to noise, and regularly using personal health equipment, and those in the control group without noise exposure. Therefore, we strongly recommend use of such equipments.

Keywords: Tires Factory, Blood Pressure, Noise Exposure

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Introduction

Noise is considered a health risk factor for workers in various occupations. Noise or unwanted sound may cause hearing loss, conversation interference, sleep disturbance, annoyance, reduction of functionality of workers, and chronic physiological effects such as hypertension.[1-3] The biological effects of noise are, generally, divided into the two categories of hearing and non-hearing effects.[4,5] The most important and conclusive disorder rendered by noise is hearing loss.[6] Non-hearing effects of noise include physiological effects, functionality interference, and psychological difficulties. All levels of noise cause the blood vessels to constrict.[7] Exposure to noise influences the heart rate, reduces the heart's efficiency, and accelerates respiration.[8] Many studies show systolic and diastolic blood pressures of higher than 85 db when exposed to sounds.[9-11]

Acute exposure to noise stimulates hormonal and neural systems and as a result induces temporary changes such as hypertension, high heart rate, and cardiovascular disorders, long-term continuation of which may render these effects permanent.[12] Zhao et al., in their study, showed that after familial background and salt consumption, exposure to noise plays an important role in causing hypertension.[13]

Noise-induced effects on different cardiovascular parameters are diverse and non-conclusive. A study by Knutsson et al. in 2000 showed that mean systolic and diastolic blood pressures were significantly higher in airport employees exposed to higher than 85-db noise compared to that of the control group.[14] However, in other studies, such as a study on 276 factory workers in Brazil in 1992, no significant difference was observed in systolic and diastolic blood pressures of the two exposed and non-exposed groups.[15] Noise-induced effects on the hearing of workers with different occupations have been investigated by many studies, while, other effects of noise have been overlooked. According to revised scientific resources, more than forty epidemiological studies have been conducted concerning the effect of noise from industry and traffic on the cardiovascular system since 1981. Results from most studies did not

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absolutely approve nor deny long-term effects of exposure to loud noise on the cardiovascular system. Therefore, more studies and analyses are required to be carried out in this regard.[16-19]

Application of personal protective devices, such as earplugs, reduces the noise intensity by 15-30 db. Placing cotton balls into ears decreases noise intensity by 5-7 db.[20] The present semi-empirical study, thus, attempted to investigate the effects of exposure to occupational noise on hypertension in a tire manufacturing factory (section A) and to compare the blood pressure of the workers, who constantly used protective devices and were exposed to noise, with that of those not exposed to noise.

Materials and Methods

The present case study was conducted on 70 employees of one of the stations at a tire manufacturing factory with non-standard noise level (85 db), referred to as 'section A' briefly, as the noise-exposed group, and 222 employees at other sections of the factory, as the non-exposed group. The control group was similar to the experiment group in the type of labor, but was not exposed to noise.

In this regard, the employees were provided with earplugs, connected via a special strip to facilitate removal. The main issues were maintaining personal hygiene and application know-how of the earplugs which were obviated by annual trainings. It should be mentioned that the earplugs were selected by adopting technical specifications pertinent to the range of frequency and the degree of noise reduction.

The class random sampling was conducted proportionate to the volume of each class. The studied population comprised of men. The demographic information namely, age and years of work experience were retrieved via the questionnaire extant in the periodical examinations of the workers. Furthermore, height and weight were recorded with tape measure and scale followed by BMI calculation, using the formula of weight divided by height squared on the basis of kilograms on square meters. Subsequent to initial examinations, filling out the questionnaire, and collecting demographic information, individuals with records of blood pressure-related diseases even in their families, and individuals with less than three years of service were eliminated from the study. Blood pressure of the two groups was measured using an ALPK2 mercury sphygmomanometer by an experienced nurse twice with 10-minute intervals at break time while seated, in order to minimize external factors such as stress and physical activity (for instance the walk from the entrance to the location) prior to measuring blood pressure. The reason was that the blood pressure taken during physical activities is normally higher than that of during resting; hence, it is not the true blood pressure. As a result, the blood pressure of the samples was measured at a time other than their physical activity period (i.e. the duration of exposure to noise).An approximate amount of 15-30 minutes was dedicated to each individual.

The mean blood pressures in the above-mentioned two measurements were later analyzed. The samples were informed of the objectives of the study prior to measurements to prevent them from being stressful and to avoid possible defective results. As shown in table 1, arterial blood pressure was divided into four separate groups according to their systolic and diastolic nature.[21]

Table 1. Arterial Blood Pressure

Blood pressure	Systolic	Diastolic
Normal	< 120	< 80
Mild	140-159	90-99
Moderate	160-179	100-109
Severe	> 180	> 110

Noise measurement and evaluation was conducted utilizing Casella cel-450 audiometer by an experienced occupational health expert. The audiometer was calibrated by cel-110.2 calibrator. A point to be mentioned is that the personnel under study did not spend the entire time of their 8-hour work shift in working stations and that they took tea and lunch breaks; thus, an 8-hour equivalent level (leq) was calculated to exactly determine exposure degree. Sound pressure level was measured in 'A' and 'C' weight networks, in which A network was adopted for worker's exposure and C network for noise analysis. Velocity setting of the device was set to 'slow'.[22]

95% of the analysis was conducted through SPSS statistical software was at a significant level. Chi-square and t-test were employed for comparing the demographic specifications of the two groups. In order to determine the difference between systolic and diastolic blood pressures between the two groups t-test was adopted. Multi-variable regression model was utilized to diminish the effects of background variables. Blood pressure was considered as a dependent variable in the mentioned model. Variables of age, height, weight, years of service, body mass index, and exposure and non-exposure to noise were regarded as independent variables.

Results

The results showed that the two groups under study were similar concerning demographic specifications such as age, height, weight, BMI, and years of service, as the statistical test did not indicate any significant difference (Table 2).

Considering the measurement results, maximum and minimum noise pressure levels in different working stations were 96.5 and 87.2 db, while noise pressure level in the working environment of the control group was less than 53 db. On the other hand, mean systolic blood pressures of workers in experiment and control groups were 116.6 and 117.5, respectively. Moreover, the diastolic blood pressures of experiment and control groups were 76.7 and 77.4 mm/Hg, respectively. Both systolic and diastolic blood pressures were within normal blood pressure range, considering the mentioned categorization in table 1.

Table 3 portrays the results of blood pressure measurement in experiment and control groups. As observable, the difference between mean systolic and diastolic blood pressures is not statistically meaningful.

Having eventually analyzed systolic and diastolic blood pressures of the two groups with the regression model with background variables (Table 2) incorporated into the model, no difference was observed (P systole = 0.54, P diastole = 0.38).

Discussion

Results of the present study showed that mean systolic and diastolic blood pressures (table 3) in the exposed group were not more than those in non-exposed to noise group. The results of the present study were not in agreement with those obtained by Kempen et al., who investigated and analyzed the results of 43 epidemiological studies in different fields, including air traffic, occupational noise, and road traffic in the past thirty years.[23]

Kempen et al., in the mentioned meta-analytical study, analyzed the studies conducted between 1970 to 1999 in Germany and England pertaining to the investigation of the effect of noise on hypertension and cardiovascular diseases. According to the results of the above-named study, the relative risk of cardiovascular diseases, for every 5 db increase in noise intensity, were 1.14 (1.01–1.29) and 1.26 (1.14–1.39). However, as mentioned earlier, due to limitations such as the study type, blood pressure measurement methods, lack of identical definitions (for instance blood pressure and permissible noise level), and etcetera, the relationship between noise intensity and incidence of cardiovascular diseases is not yet decisively proven.[23] The results of a study by Thompson showed that the degree of blood pressure prevalence between the two groups exposed to high and low noise ranged from 0.3–1; portraying results contradictory with those of the present study.[22] The results of the study by Babisch on diastolic blood pressure were in agreement with the present study; however, the mentioned study did not consider personal protective devices.[24] Abbate et al. in another study concluded that systolic and diastolic blood pressures tend to increase with age and years of service.[12]

Table 2. Demographic characteristics of case and control groups

Variable	Case		Control		
	Average	**SD**	**Average**	**SD**	**P Values**
Age	33.7	5.04	32.5	6.34	0.15
Height (cm)	175.55	6.13	175.61	6.46	0.92
Weight (kg)	76.05	10.73	77.8	11.79	0.26
Experience (year)	9./95	4.86	9.45	4.72	0.44
Body Mass Index	24.37	3.83	24.78	3.77	0.43

Table 3. Average systolic and diastolic blood pressures in case and control groups (mm/Hg)

Blood pressure	Case		Control		P Value (t-test)
	Avg	**Sd**	**Avg**	**Sd**	
Systolic	116.6	8.83	117.5	9.92	0.5
diastolic	76.7	6.59	77.4	6.63	0.47

Considering different industrial environmental conditions in different countries or even in different regions of a country, types of employed equipments, types and manner of using personal protective devices, study type, blood pressure measurement methods, and disparate definitions of terms (such as blood pressure and permissible noise level), the exact comparison of the present study with other studies was impossible. As a result, a comprehensive interpretation will not be free from limitations and complications. Interfering factors such as stress, and status of the workers regarding physical activity, social and economical class, which is effective on the consumption of high calorie foodstuff, were also different from the study conducted by Zare et al., in which the effect of noise on the blood pressure of airport employees was investigated.[15]

With regard to the similarity of the two groups under study concerning age, sex, height, weight, and BMI, it can be concluded that exposure to noise cannot be considered as a risk factor for incidence of hypertension in the workers studied. This is in contradiction to the results of other studies conducted in this field, namely, studies by Motamedzade and Ghazaiee, and Zare et al. Regular use of personal protective devices, such as earplugs, by the personnel of section A may be among the reasons of this contradiction.[15,19] It should be reminded that the evidence for existence of a relationship between noise and hypertension is not significant yet; not only resulting from the complexity of noise, but also due to limitations in determining properties of exposure, accuracy and authenticity of methods of blood pressures measurement, and controlling interfering factors. Therefore, further and more comprehensive studies are suggested in which the foregone factors are incorporated.

Conflict of Interests

Authors have no conflict of interests.

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