

Effects of occupational noise exposure on changes in blood pressure of workers

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Abstract

BACKGROUND: In most industries, workers are exposed to loud noise. Noise is considered as a nonspecific biological stressor that have adverse effects on human physiology. It is associated with hypertension which is in turn one of the most important preventable risk factors of cardiovascular disorders. This study aimed to evaluate the effects of noise on changes of workers' blood pressure.

METHODS: This cross-sectional study was performed on 90 individuals who were exposed to noise at one of the industries in Isfahan, Iran. Noise levels (in dBA) were measured by means of a sound level meter. Data was collected using a demographic questionnaire and physical examination. Blood pressure was measured by a sphygmomanometer at workplace. The collected data was analyzed by t-tests.

RESULTS: The workers aged 31.5 ± 5.2 years and were exposed to mean noise level of 97.5 ± 10.1 dBA which was significantly above the standard level (85 dBA). The relationships between blood pressure, heart rate, and noise level were not significant. However, Pearson's correlation indicated systolic blood pressure to have significant correlations with age (correlation coefficient = 0.302) and work experience (correlation coefficient = 0.299).

CONCLUSION: Workers exposed to noise levels above the standard, especially in the metal industry but their blood pressures haven't any associated with noise. It mentions that any changes in blood pressure resulting from occupational noise are likely to be small, careful controls, large sample sizes, and long time exposure to noise would be taken to identify significant effects.

Keywords: Noise Exposure, Blood Pressure, Young Workers, Cardiovascular Disease, Metal Industries

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Introduction

In most industries, workers are exposed to loud noise which adversely affects human physiology. Noise is considered as a nonspecific biological stressor. It can be associated with hypertension which is one of the most important preventable risk factors of cardiovascular diseases. Loud noise is a major stressor in the workplace whose effects on human body include hearing loss. In fact, sound waves can be absorbed by the body and cause physical and psychological symptoms.¹

The effects of noise on humans are categorized as hearing loss and non-auditory effects such as physical and mental effects and interruption in daily activities.² According to available literature, workers exposed to high levels of noise suffer from not only hearing loss but also hypertension. The strongest evidence comes from studies of blood pressure in occupational settings.³

Since hypertension is a multifactorial disease, contradictory results have been obtained in the study

of external factors such as noise on different races and people. Some studies have reported the absence of a relationship between noise and hypertension.⁴ Numerous other studies however, suggested that noise is significantly associated with hypertension.^{5,6} Therefore, noise has been considered as a risk factor for cardiovascular diseases.^{7,8}

Apparently, the stress caused by high levels of noise increases the release of adrenaline, constricts peripheral veins, and finally causes hypertension. Loud sounds may also increase heart rate, reduce cardiac output, and speed up breathing.^{4,9,10} An occupational study showed the prevalence of hypertension among textile workers exposed to noise (A-weighted sound pressure levels of 100 dBA) to be 1.34 times more than the control group.¹¹

Workers in metal industries are exposed to loud noise (110 dBA). Their blood pressure before and during work are significantly different. Moreover, working in different parts of the plant with various

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sound pressure levels was found to be related with blood pressure.^{12,13}

In a study on airport staff, a significant difference in blood pressure was found between ramp workers exposed to noise levels of 101 dBA and administrative staff. The results showed that chronic exposure to high levels of aircraft noise can be considered as a risk factor of hypertension.^{14,15}

In another study, the mean systolic and diastolic blood pressure of workers exposed to loud noise (sound pressure level ≥ 90 dBA) during eight-hour work operation was significantly higher than control groups.¹⁶

In an automobile assembling company, 24-hour blood pressure screening of workers who were exposed to high levels of noise for 16 continuous hours showed 1-mmHg increase in systolic blood pressure for every 1-dB increase in noise level.¹⁷

Findings of previous studies on workers exposed to noise indicated that noise did not change heart rate and increased diastolic blood pressure more than systolic blood pressure.¹¹ In addition, increased age and work experience were associated with higher heart rate and systolic and diastolic blood pressure.¹¹ Therefore, while blood pressure can be an indicator of noise exposure, heart rate is not a reliable indicator.¹⁸

Studies designed to investigate the effects of noise exposure and shift work on workers of a plastic company showed that noise was more effective than shift work on systolic and diastolic blood pressure.^{6,17}

Systolic and diastolic blood pressure of textile workers exposed to noise was directly related with age and inversely related with body mass index (BMI). In addition, after adjustments for age, sex and BMI, diastolic blood pressure of the workers had a direct correlation with noise.^{11,18,19}

Higher levels of noise have greater destructive effects. In fact, in noise levels beyond the standard (85 dBA), every 10-dB increase in sound pressure level will raise blood pressure for 9 mmHg.^{19,20}

Workers and employers have not yet believed the serious side effects of high levels of noise on health. Noise can be a risk factor of cardiovascular diseases that are in turn the leading cause of death worldwide. Noise is a health hazard and has relations with high blood pressure.^{18,19,21,22} On the other hand, hypertension is a preventable risk factor of cardiovascular diseases.²³⁻²⁵ This study aimed to evaluate the effects of noise on changes of workers' blood pressure.

Materials and Methods

In a cross-sectional study, census sampling was used

to select 90 workers who were exposed to noise at a factory in Isfahan, Iran. The information was collected through a demographic questionnaire and physical examination.

A sound level meter (CEL 440, CASELLA CEL USA) was used to measure noise at workplace in term of dBA. The standard method recommended by ISO1996 was followed in measurements. According to the American Conference of Governmental Industrial Hygienists (ACGIH 2011), the standard sound level limit is 85 dBA.²⁰

Physical examination of the exposed group (production line) was performed at workplace in standard conditions at mid-shift work hours (9-11 a.m.). The room temperature was normal. We recorded the average of two blood pressure measurements on the right arm taken after a five-min rest using a sphygmomanometer (ALPK2, Japan). Hypertension was defined as systolic blood pressure ≥ 140 mmHg or diastolic blood pressure ≥ 90 mmHg.²³

The collected data was analyzed with independent t-test and Pearson's correlation test in SPSS for Windows 16.0 (SPSS Inc., Chicago, IL, USA). P values less than 0.05 were considered significant.

Results

The mean age and work experience of the workers were 31.5 ± 5.2 and 6.7 ± 3.7 years, respectively. Their mean BMI was 24.6 ± 3.5 kg/m². They were exposed to mean noise level of 95.2 ± 10.1 dBA which was significantly above the standard level (85 dBA).

The relationships between blood pressure, heart rate and noise level were not significant. However, Pearson's correlation indicated systolic blood pressure to be significantly correlated with age (correlation coefficient = 0.302) and work experience (correlation coefficient = 0.299) ($P < 0.01$). Moreover, mean BMI was significantly correlated with systolic blood pressure (correlation coefficient = 0.422; $P < 0.01$).

The difference between mean systolic blood pressure (142.2 ± 20.3 mmHg) and the normal range was statistically significant ($P < 0.01$). No such significance was observed in case of diastolic blood pressure (90.3 ± 13.5 mmHg).

Discussion

In this study, the workers were young men with normal BMI. Therefore, they were expected not to have cardiovascular diseases or hypertension. They had been exposed to high levels of noise long enough to experience its side effects.^{2,20} Their mean BMI (23.4 ± 4.3 kg/m²) was close to the average BMI of the whole community (24.8 ± 3.8 kg/m²).^{2,25} The

incidence of overweight in the studied population was 25%. Similar to previous studies,^{4,12,14} we found positive weak correlations between systolic blood pressure and mean BMI, work experience, and age ($P < 0.01$). While the mean systolic blood pressure of our participants was significantly different from the normal range, the same was not true in case of diastolic blood pressure ($P < 0.01$).

Not only is noise associated with the risk of occupational deafness, it can also act as a stressor which induces medical problems such as hypertension. As a primary or contributing cause of death, hypertension usually has no warning signs or symptoms. Therefore, many hypertensive individuals are not aware of their disease. This lack of knowledge puts them at risk of heart disease and stroke, add to costs in health care services, medications, and missed days of work.^{2,3,22-24}

As U.S. Preventive Services states, "Studies have identified blood pressure control as a cost-effective method to reduce premature cardiovascular morbidity and mortality. A 12- to 13-point reduction in blood pressure can reduce the number of heart attacks by 21%, strokes by 37%, and all deaths from cardiovascular diseases by 25%".^{26,27} Therefore, training and blood pressure control programs for workers, preventive measures for noise exposure at workplace, and special care for workers with a history of hypertension are recommended.

Preventive measures in workplace should first control the noise source, then limit sound propagation, and ultimately protect the recipient. Engineering techniques such as isolating the source, using sound-absorbing walls, acoustic waves aberrant, and designing low-noise machines are the best ways to protect workers. The last resort however, is the use of personal protective equipment.²⁸

Conclusion

Workers, especially those in metal industries, are exposed to noise levels above the standard. Although the effects of noise on blood pressure and ischemic heart disease did not appear to be as strong as indicated by earlier studies, further research in this field is warranted. Since changes in blood pressure resulting from occupational noise are likely to be small, careful controls, large sample sizes, and at least five years of exposure to noise are necessary in further evaluations.

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Conflict of Interests

Authors have no conflict of interests.

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