

# ARTERIAL HYPERTENSION MORBIDITY IN THE WORKERS EXPOSED TO INTENSE NOISE

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## Keywords:

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**Abstract:** Noise exposure contributes to the increased prevalence of cardiovascular disease; there is an obvious relation between this exposure and ischemic heart disease. This article aims at demonstrating that arterial hypertension in a workplace with noise exposure higher than 87 db is an occupational disease. Due to the fact that the relative risk is higher than 1 and that FEP is higher than 20%, we can state with 95% probability that there is an epidemiological association between a noise higher than 87 db and arterial hypertension.

## Cuvinte

**cheie:** hipertensiunea arterială, boală legată de profesiune, zgomotul peste 87 dB

**Rezumat:** Expunerea la zgomot contribuie la creșterea prevalenței bolilor cardio-vasculare, existând o evidentă relație între această expunere și bolile cardiace ischemice. Acest articol își propune să demonstreze că hipertensiunea arterială la un loc de muncă cu expunere la zgomot de peste 87 dB este o boală legată de profesie. Datorită faptului că riscul relativ este mai mare ca 1 iar FEP este mai mare de 20%, se poate afirma cu probabilitate de 95% că există o asociație epidemiologică între zgomot mai mare de 87 dB și prezența HTA.

## INTRODUCTION

The noise from the environment (interior and exterior) has increased both in intensity and in the number of sources, at the same time with the development of civilization. In the 19<sup>th</sup> century, along with the strong industrial development of society, new machines and equipments have occurred, whose functioning disseminate increasingly stronger sounds in the environment.

The World Health Organization pointed out that, in our age, the noise has exceeded the occupational disease character, becoming a public threat to the physical and mental health. At the beginning of this century, the great bacteriologist Robert Koch said: "one day the fight against noise will be led in the same manner as in the past, for the plague and cholera".

In Europe, it is estimated that one-third of workers (more than 60 million people) are exposed to noisy working conditions for more than a quarter of their working time. About 40 million workers are exposed to noise at least half of the working time. As a result of this, a series of measures have been taken worldwide aiming at reducing the level of noise in the environment, as well as at the workplace. At the same time with the accession to the EU, our country has been required to align to the legal provisions in the field covered by a series of measures to limit the noise level. For workplaces too, maximum limits of the noise level have been established. These limits are set according to the neuro-psychical and psycho-sensorial strain and are in accordance with the provisions of the European Directive 2003/10/EC on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (noise).

Occupational noise causes two types of effects on the human body:

1. otic effects, specific due to the injury of cochlea, represented by hypoacusis and deafness. In these conditions, the occupational character is certain, and their reporting and declaration is required;
2. extraotic effects, nonspecific represented by changes in the function of the various devices and systems of the body, due to the noise. These diseases do not have an occupational character, but noise may interfere negatively in their evolution.(3)

According to the occupational health legislation in force, high blood pressure (HTA) is framed as a work-related disease (2), in the conditions of occupational exposure to noise, vibration, temperature and heat radiation increased over the maximum allowed limits. Nonspecific effects are caused, first of all, by the existing connections between the auditory areas, other areas on the cortex and subcortical centres and can cause the excitation of the neighbouring centres which have a role in regulating blood pressure (vasomotor centres, heart centres).(1) In the second place, the effect of noise on the auditory system is transmitted to the ascendant activator reticular system and hypothalamus, and the hypothalamic-pituitary-adrenal axis is stimulated.

The cardiovascular effects are the most important and are put into practice by raising blood pressure or modification of certain biological parameters. Numerous experimental studies have shown that exposure to noise intensity between 85-90 dB (A) was followed by increasing blood pressure without retuning to the initial levels after the cessation of the exposure.(2)

## PURPOSE

This article aims at demonstrating that high blood pressure to a workplace with exposure to noise exceeding 85 dB is a work-related disease. The study was carried out on workers

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of a factory producing chemical equipment, exposed daily at a noise level of 87 dB (A).

**METHODS**

The research was carried out on 200 patients who were divided into two groups:

- 1) Study group, with exposure to intense noise, was made up of 150 subjects, employees of the following factory departments and sections: the heating system (Heavy and Light), Preparation department, Tooling department, Smithy department;
- 2) Control group without exposure to noise was made up of 50 personal subjects working in the administrative and financial accounting departments, without occupational exposure to intense noise or other professional factors.

Both groups are made up only of men and there are no statistically significant differences in the following parameters: age, retirement, seniority in terms of exposure to noise (at least 10 years), area origin (U/R). The average noise exposure was of 20 years (10-35 years).

In order to assess as accurately as possible HTA causality in the subjects occupationally exposed to noise exceeding the maximum limits, we followed the two groups during the years 2011 and 2012. Thus, we were able to accomplish two studies: a retrospective study using the data from the year 2011 and a prospective study using the data from 2012.

Regarding the source of the data, this one was made of individual medical records existing in the Medical Office Enterprise. For each individual, the following were recorded in a standard form: identification data (age, total work experience, length of exposure to noise, weight, height), lifestyle (alcohol and tobacco consumption), personal medical history (diseases of hearing), type of noise - the impulsive noise reach the inner ear without triggering the stapelial reflex and therefore, they have a particularly harmful effect. Also, uniform, prolonged noise, leads to the stapelial muscle fatigue, resulting in a weak protection; frequency of the sounds - high frequency sounds seem to be more harmful than low frequency, simultaneous exposure to ototoxic substances, the results of the clinical investigations and the clinical laboratory tests performed during the periodic check-ups at unit level (tonal liminal audiometry).

The diagnosis of hypertension was determined on the basis of the systolic and diastolic blood pressure. World Health Organisation recommendations have been observed regarding the measuring technique (in sitting position and in physical and psychological comfort conditions of the employees). Blood pressure values were measured at the entrance and exit of the work shift.

**RESULTS**

Many surveys on the occupational and background noise have investigated the hypothesis that exposure to noise exceeding 85 dB could be a risk factor for cardiovascular disease, especially hypertension, arrhythmias and ischemic diseases of the myocardium.

Epidemiological research has shown that in certain parts of the active population (the employed), high blood pressure has a higher frequency compared to the rest of the population.

The assessment of the causal relation between the occupational risk factors (noise) and high blood pressure can be done through several methods. In both studies (prospective and retrospective), we have calculated the incidence (number of new cases of hypertension) and the prevalence (number of cases of hypertension (all cases of hypertension)). Then we established: the relative risk (RR) and the etiologic fraction of occupational

exposures (FOE), calculated according to the formulae:  $RR = \frac{AXB}{CXD}$ , where A = number of subjects with noise exposure and HTA within the study batch; B = number of subjects with other chronic diseases within the study batch; C = number of subjects without noise exposure and HTA within the witness batch; D = number of subjects with other chronic diseases within the witness batch;  $FOE = \frac{(RR-1)}{RR} \times 100$ .

We determined the level of noise in the study departments, in all work stations, at the level of the workers; ear and at different distances from the working devices, with the help of the sound-digital set top box type Quest model 2900, with weighting networks A, C and LIN.

The maximum permissible noise intensity in workplaces with reduced neuro-psychical and psycho-sensorial strain is of 87 dB. A shift lasts for 8 hours, the weekly exposure to noise being of 40 hours.

In the Boiler section (heavy and light), Tooling section, Preparing and Engineering Section and in the Workshop Section, values above the maximum allowable limit (Leq) have been registered, values between 87.6 and 97.9, and noise spectral analysis reveals elevated values in the "conversational" area. The technological processes generating noise values above the maximum limits are polishing and grinding operations. Hall walls are not sound-deadening properties.

Security individual equipments, although there are for each worker, such as headphones and earplugs, are used only by 60%, justifying the "awkward" sensation and the inability to perceive changes in sound to the occurrence of defects or the lack of interest regarding the consequences of noise exposure. So, only 60% of workers are aware of the risks of occupational illness and always wear protective equipment, without being summoned.

**Table no. 1. Comparative analysis of the structure of the two batches in the year 2010**

	Patients with HTA	Patients with other chronic diseases
Study group	65	85
Control group	5	45

In the retrospective study, in 2011, hypertension occurs in 65 of the workers exposed to occupational noise, compared to 5 of the employees who are not exposed to this contaminant in a professional environment.

The relative risk is of 6.88, so the risk of hypertension is 6.88 times higher in those exposed to intense noise. Professional etiologic fraction is 85%, so it can be assumed that hypertension is an occupational-related disease (> 20%) in the study group.

The relative risk and the etiologic fraction have shown a causal link between noise and hypertension. So, we can say that noise not only acts on hearing, but also on the body as a whole, the activity of all assessed employees requires continuous monitoring of health.

In cases with hypertension, we also analyzed the cardiovascular risk according to BMI (body mass index) - obese: BMI > 30 kg/m.

**Table no. 2. Risk factors associated in HTA occurrence**

Risk factors	HTA patients in the study batch (65 persons)		HTA patients in the witness batch (5 persons)	
	no.	%	no.	%
<b>Obesity</b>	44	67,69	3	6
<b>Ischemic changes</b>	15	23,07	1	2

<b>Diabetes</b>	10	15,38	2	4
<b>I degree relative with HTA</b>	21	32,30	7	14

From table no. 2, it shows that of the 65 subjects with hypertension in the study group, 44 are obese, while 15 show ischemic changes on ECG, compared with the controls, where, of the 5 subjects with hypertension, only 3 are obese and one with ischemic changes on ECG.

The professional environment with noise seems to positively influence the emergence and the development of hypertension, especially when associated with coronary heart disease and/or family history of hypertension.

Diabetes is another important disease whose occurrence and development is compounded by the presence of various stress factors of the working environment.

Adding in the people exposed to noise of other cardiovascular risk factors, concurrently create a high or very high cardiovascular risk. The retrospective evaluation of the incidence and prevalence of hypertension in the study group is useful for implementing a comprehensive programme of continuous medical supervision and secondary prophylaxis to prevent complications that may occur over time, due to the underlying disease and occupational exposure to noise above the maximum limits.

**Table no. 3. Comparative analysis of the structure of the two batches in the year 2012**

	<b>HTA patients</b>	<b>Patients with other chronic diseases</b>
Study batch	5	145
Control batch	1	49

In the prospective study, in 2012, in the study group five new cases of hypertension appeared, and in the control group, only one case, so a medical prophylaxis of cardiovascular disease is needed in the workers exposed to noise by reducing, both the cardiovascular risk factors and the occupational exposure to noise (staff turnover, quiet room breaks, training and briefing the employees).

The relative risk is of 1.7, so that the risk of hypertension is 1.7 times higher in those exposed to intense noise.

The professional etiological fraction is of 41%, so it can be assumed that hypertension is an occupational-related disease (> 20%) in the study group.

In the present study, it has been demonstrated that the noise above 87 dB is involved in the development of hypertension in the study group.

**Incidence**

Incidence measures the frequency of new cases and reflects the implication of the etiologic factors.

Hypertension incidence in the study group is of 3.33% and of 2% in the control group. So, noise at work can be a factor that causes new cases of hypertension. This causal relation emphasizes the need of applying innovative and effective measures to prevent the occurrence of new cases of hypertension.

**Prevalence**

Prevalence measures the frequency of existing cases (new and old). Hypertension prevalence in the study group is of 43.33% and of 10% in the control group. It is noted that the prevalence of hypertension is higher in the study group compared with the controls, so it is necessary to implement a programme for hearing protection, so that to be able to intervene in real time to reduce or eliminate the negative effects of noise,

especially by raising awareness of the occupational health risks due to not wearing the hearing protection equipment.

**CONCLUSIONS**

Under intense exposures to noise, including the effects of the disability plan in deafness or hypo auditory hearing professional, the frequency of high blood pressure is significantly increased.(4)

Due to the fact that the relative risk is greater than 1 and the FOE is more than 20%, one can say with 95% probability that there are epidemiological associations between noise in excess of 85 dB and the presence of the HTA.

Workers exposed to noise of more than 85 dB (A) for a long period of time (5,6) or at a high level over 95 dB (A) for periods of a few years ago (7) have elevated blood pressure, on the periodic checks.

Recognition of risks and their reduction by technical and organizational measures:

- given the fact that the technological process cannot be changed in order to decrease the noise level, the permanent use of the hearing protectors is imperative by all those exposed, as well as monitoring their correct usage;
- mitigating the spread of airborne noise by using acoustic enclosures and screens;
- isolating the procedures involving noise emission and restricting the access to noisy areas;
- control of noise and vibrations that propagate through the ground, using damping measures;
- organizing the work activity so that the time spent in noisy areas to be limited;
- in workplaces, where the noise exposure exceeds 87 dB, there should be signs marking the obligation to wear earplugs;
- auditory rest is recommended (rest for 5-10 minutes at a time) in quiet rooms.

There are absolute and relative contraindications for noise exposure (chronic diseases of the middle and internal ear, psychopathy, including manifested neurosis, hypertension, moderate to severe form, associated with other cardiovascular risk factors), which must be taken into account in employment, to reduce occupational diseases and accidents.

Other effects of the chronic exposure to noise described by workers were: altered perception of sound signals and verbal communication, impaired speech intelligibility, difficulties in maintaining vigilance and attention, sometimes euphoria, headache, mild anxiety, malaise, tension, restlessness and discomfort, mild depression, violent behavior (due to the use of alcohol and family problems), low capacity of learning a new working methods.

It is necessary to raise the workers' awareness in case of occupational diseases as a result of not wearing the protective equipment and hence, of eliminating the working incapacity of these workers.

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