

EVALUATION OF THE NONSPECIFIC EFFECTS INDUCED IN WORKERS BY OCCUPATIONAL NOISE

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Abstract: Occupational noise is directly related to decreased work ability, and non-specific pathology induced by prolonged exposure continues to be a topical issue in the scientific debate. This paper deals with noise from the psycho-physiological hazard perspective, using as assessment tool a symptoms questionnaire with 24 items in a case-control study (N = 100). The results show statistical significance for 10 items (of which 5 items at $p < 0.01$), especially for lower work ability, poor memory, fatigue and depression. Subjects exposed to noise are 1.6 times higher risk to develop nonspecific effects, often neglected in favour of effects on the auditory analyzer. We propose this questionnaire to be applied routinely by occupational health services in order to manage the workers' health, along with other means of workplace health promotion.

Cuvinte cheie: zgomot, efecte nespecifice, capacitate de muncă

Rezumat: Zgomotul ocupațional este în relație directă cu scăderea capacității de muncă, iar patologia nespecifică pe care o induce expunerea îndelungată continuă să reprezinte un subiect de actualitate în dezbaterile științifice. Lucrarea de față abordează zgomotul din perspectiva noxei psiho-fiziologice, utilizând ca instrument de evaluare un chestionar de simptome cu 24 itemi într-un studiu de tip caz-martor (N=100). Rezultatele arată o semnificație statistică pentru 10 itemi (din care 5 itemi la $p < 0,01$), în special pentru scăderea capacității de muncă, tulburări de memorie, oboseală și depresie. Subiecții expuși la zgomot au un risc de 1,6 ori mai mare pentru a dezvolta efecte nespecifice, acestea fiind deseori neglijate în favoarea efectelor asupra analizatorului auditiv. Propunem acest chestionar pentru a fi aplicat în mod curent de către serviciile de medicina muncii care gestionează sănătatea lucrătorilor, alături de alte mijloace de promovare a sănătății la locul de muncă.

INTRODUCTION

One of the important risk factors that affect health and work ability is the noise, which includes a complex of sounds with varying intensities and heights, with different characteristics (impulse, pure, audible), rhythmic or arrhythmic, continuous or discontinuous produced by machines, tools, appliances, vehicles, and human voice during the professional activity.(1) Modern technology has greatly reduced the human physical effort, but it remains a source of risk factors on the neuropsychological demands per sé, as well as a secondary exposure to noise from the automated machines. Noise directly reduces work ability through decreasing the possibility of intellectual concentration, decreasing movement accuracy and efficiency, decreasing or distracting attention, and increasing energy expenditure required to perform a given task. Noise generates additional fatigue, not only through difficult related efforts in collecting verbal information or voice overuse, but especially by brain overload, because noise is a perceptible stimulus which conveys no information, but requires from the receiving nervous cells in the cortex an activity necessary to verify this lack of information. It should be noted that occupational noise often extends to a considerable number of workers who perform non-noisy work, but they work close to sources without sound insulation.(2-5)

If specific conditions are located at auditory level, extra-auditory pathology is nonspecific and can be explained by many nerve connections between the following structures: the four neurons of the acoustic path and various neighbouring

nerve centres (vasomotor, respiratory); 41 and 42 cortical acoustic areas; cortical areas and other subcortical centres, the hypothalamus, pituitary, endocrine glands, nervous vegetative system. The hypothalamic-pituitary-adrenal axis is considered the stress axis.(6)

Prolonged exposure to noise causes fatigue, headache, irritability, and depression. It also maintains/aggravates pre-existing pathology such as neurasthenia (exaggerated irritability and instability of character); favours the anxious obsessions; emphasizes depression. Noise, especially the unexpected, may cause seizures and hysteria major, aggravates gastroduodenal conditions and functional pathology of the colon. These effects and changes must be taken into account while performing medical examination in view of employment, adaptation or periodic checks.(7,8) If exposure continues or is repeated systematically, permanent alterations in the neuro-sensory system, circulatory, endocrine, digestive system, etc may appear.(9-13)

European statistics register every year over 7.5 million accidents at work. Although it is difficult to quantify the role of noise in the production of these accidents, logic and data indicate that this role is significant.(14) Just think about the adverse effects they may have: disruption of verbal communication between workers, masking warning signals or the sound of a dangerous event; distracting attention in workers (drivers, in particular); increasing stress at work. In the US, it was estimated that only office work efficiency reduction due to noise costs 1.2 billion dollars annually.

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PURPOSE

The study aims at evaluating the direct or derivative effects of occupational exposure to noise.

METHODS

Study Material:

We have selected two groups (a total of 100 subjects), as follows:

- Group of cases (c): 50 subjects exposed to noise in a wood processing enterprise (furniture), with primary processing, and mechanized sections;
- The control group (m): 50 subjects from the section "Finishing-Packaging" of the same company, without noise exposure (table no. 1)

Table no. 1. Main characteristics of the studied groups

Group	Mean age (years)	Mean length of service in the same job (years)	Gender	Profession / occupation
Cases (50)	37.52±8.51	15.34±6.11	10 females (20%) 40 males (80%)	25 carpenters 15 processors 10 unskilled
Controls (50)	35.29±6.81	12.43±7.75	15 females (30%) 35 males (70%)	31 packers 19 unskilled

Note: "±" signifies standard deviation

Occupational noise assessment

Noise intensity was measured with the digital sound level meter with integrated sound system type Quest 2800, appropriate to the quality standards of the European Union. The principle of the method is to turn the device's microphone captured sounds into electrical signals and display them on screen, directly in decibels, in the weighting circuit A.

Questionnaire of symptoms (for nonspecific effects of noise)

We used a questionnaire of symptoms (subjective complaints) consisted of 24 items, of which specific effects of noise (2 items), and especially non-specific effects such as fatigue, anxiety, attention, memory impairment, palpitations, irritability, sleep disorders etc. grouped into short-term effects (6 items), and long term effects (16 items).

Creating a database and statistical analysis

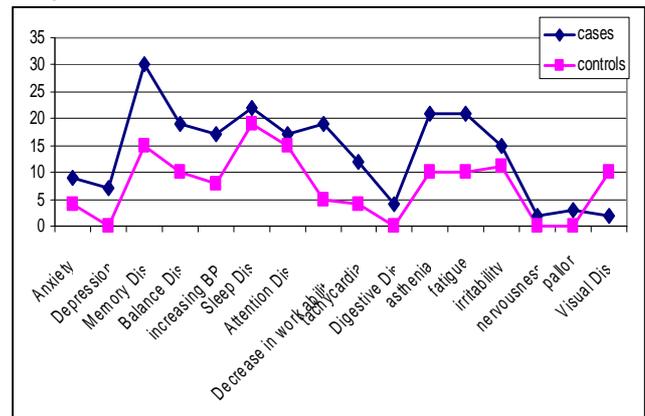
We used data from the following sources: medical records (pathological outcomes PO), psychological examinations, electrocardiogram (ECG), and clinical examination with measuring blood pressure (BP). Statistical analysis was performed using Microsoft Office Excel 2003 and Chi-Square Test ($p < 0.01$).

RESULTS

The recorded sound level measurements were above the allowed values of intensity noise (L_{eq}) in machining and mechanical polishing industrial section, average of 89.45 ± 1.67 dB(A).

An integrated data analysis from medical records, BP values, and frequency of responses to the symptoms questionnaire is shown in table no. 2. We believe that the most statistically significant are the differences between the 2 groups on symptoms questionnaire (figure no. 1 and table no. 3). The share of the subjective complaints in the cases group entitles us to relate the nonspecific effects to industrial intense noise.

Figure no. 1. Comparison of responses in the case-control study



DISCUSSIONS

Most studies on extra-auditory effects of industrial noise, at least one national survey, are based on the analysis of data from medical records and information provided from regular check-ups of the workers, first with reference to cardiovascular diseases (hypertension) with a share between 20-30%. (15-10) Our research included a very helpful tool in assessing the extra-auditory effects of noise, namely the symptoms questionnaire, which was statistically significant ($p < 0.01$) for the following complaints: poor memory, visual disturbances, depression, decreased work capacity and fatigue. A certain statistical significance ($p < 0.05$) was found for the following complaints: fatigue, digestive disorders, tachycardia, hypertension, and pallor. These data are consistent with those of the previous epidemiological studies proving the extra-auditory effects of the occupational noise, and underlining the particularity that noise is a psycho-physiological hazard. (21)

The discomfort caused by noise exposure is sensed long ago, but it is very difficult to quantify. Some researchers have proposed an integrated assessment of the exposure by calculating the integrated exposure index - IEL, as a useful tool in studies of impact. (22). Currently, there is still no consensus on short or long term physiological disorders induced by exposure to noise. It is very difficult to establish a dose-response relation showing a strong appearance of a distinct adverse effect from other stressors or conditions. Instead, the types of noise and protective measures are intuitive and well known. For example, intense and short-term noise induces changes whose picture is common to those generated by any feeling of fear. (23)

CONCLUSIONS

In conclusion, the direct or derivative effects of occupational exposure to noise include hearing loss sensitivity, physiological and/or mental disorders, difficulties in communication, and impaired professional performance. Symptoms questionnaire applied in both groups of subjects shows a significantly higher proportion of subjective complaints in the group of cases, these subjects standing at a 1.6 times higher risk of developing non-specific effects related to noise exposure. General nonspecific noise effects on the human body are often neglected in favour of specific effects (hearing loss, deafness), so more studies are required in this respect. Surveillance of cases with pathological changes is recommended, as well as measures to reduce the risk of noise exposure.

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Table no. 2. Integrated quantitative analysis of survey results

Group	PO		Frequency of responses	ECG		Psychological exam (low attention)	Measured BP values (mmHg)	
	Hyper-tension	Duodenal ulcer		normal	modified		normal	increased
Cases	16	4	228	34	16	4	30	20
Controls	8	0	141	41	9	0	45	5

Table no. 3. Statistically significant results of the questionnaire by Chi-Square Test

Variable		Count	group			p Likelihood ratio
			c	m	Total	
Pallor	1	Count	3	0	3	0.039*
		% of Total	3.9%	.0%	3.9%	
	2	Count	35	38	73	
		% of Total	46.1%	50.0%	96.1%	
	Total	Count	38	38	76	
		% of Total	50.0%	50.0%	100.0%	
Visual disorders	1	Count	2	10	12	0.009**
		% of Total	2.6%	13.2%	15.8%	
	2	Count	36	28	64	
		% of Total	47.4%	36.8%	84.2%	
	Total	Count	38	38	76	
		% of Total	50.0%	50.0%	100.0%	
Depression	1	Count	7	0	7	0.001**
		% of Total	9.2%	.0%	9.2%	
	2	Count	31	38	69	
		% of Total	40.8%	50.0%	90.8%	
	Total	Count	38	38	76	
		% of Total	50.0%	50.0%	100.0%	
Memory disorders	1	Count	30	15	45	0.000**
		% of Total	39.5%	19.7%	59.2%	
	2	Count	8	23	31	
		% of Total	10.5%	30.3%	40.8%	
	Total	Count	38	38	76	
		% of Total	50.0%	50.0%	100.0%	
Hypertension	1	Count	17	8	25	0.027*
		% of Total	22.4%	10.5%	32.9%	
	2	Count	21	30	51	
		% of Total	27.6%	39.5%	67.1%	
	Total	Count	38	38	76	
		% of Total	50.0%	50.0%	100.0%	
Decrease in work ability	1	Count	19	5	24	0.000**
		% of Total	25.0%	6.6%	31.6%	
	2	Count	19	33	52	
		% of Total	25.0%	43.4%	68.4%	
	Total	Count	38	38	76	
		% of Total	50.0%	50.0%	100.0%	
Tachycardia	1	Count	12	4	16	0.022*
		% of Total	15.8%	5.3%	21.1%	
	2	Count	26	34	60	
		% of Total	34.2%	44.7%	78.9%	
	Total	Count	38	38	76	

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Variable			group			p Likelihood ratio
			c	m	Total	
		% of Total	50.0%	50.0%	100.0%	
Digestive disorders	1	Count	4	0	4	0.016*
		% of Total	5.3%	.0%	5.3%	
	2	Count	34	38	72	
		% of Total	44.7%	50.0%	94.7%	
	Total	Count	38	38	76	
		% of Total	50.0%	50.0%	100.0%	
Asthenia	1	Count	21	10	31	0.010*
		% of Total	27.6%	13.2%	40.8%	
	2	Count	17	28	45	
		% of Total	22.4%	36.8%	59.2%	
	Total	Count	38	38	76	
		% of Total	50.0%	50.0%	100.0%	
Fatigue	1	Count	20	9	29	0.009**
		% of Total	26.3%	11.8%	38.2%	
	2	Count	18	29	47	
		% of Total	23.7%	38.2%	61.8%	
	Total	Count	38	38	76	
		% of Total	50.0%	50.0%	100.0%	

** Strong statistical significance ($p < 0.01$) * There is a statistically significance ($p < 0.05$), with a probability of 90%.

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