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EFFECT OF LOW-FREQUENCY NOISE AT LOW LEVELS ON HUMAN HEALTH IN LIGHT OF QUESTIONNAIRE INVESTIGATION

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ABSTRACT

The paper presents results of investigation performed by the Department of Epidemiology of the Medical Academy in Warsaw jointly with the Department of Acoustics of the Building Research Institute. The study concerned the dwellers exposed to a low-frequency noise in their residential area. The noise was coming from the appliances installed inside the building or service workshops. Based on the questionnaire investigation and interviews it was made the evaluation of a long-lasting effect of the low-frequency noise on health of dwellers.

1 - INTRODUCTION

It results from the analysis of complaints about noise in dwellings that most of them concerns the low-frequency noise (LFN) coming from appliances like pumps, transformers, fans, refrigerator units installed inside or outside the building. In many cases the noise at very low levels to be generally regarded as acceptable, was subject of complaints. So, in order to develop the new criteria for the assessment of the LFN and define its acceptable levels, it was performed the epidemiological investigation among dwellers exposed to the LFN in residential environment.

The aim of the study was to evaluate subjectively the noise and determine if a long-lasting exposure to the LFN at low levels is potentially decisive of the health risk for the dwellers.

2 - INVESTIGATION METHODOLOGY

The investigation was performed jointly by the Department of Epidemiology of the Medical Academy in Warsaw and the Department of Acoustics of the Building Research Institute. The Department of Acoustics made the acoustical measurements in dwellings tested, determined a source of the noise and its acoustical parameters. The Department of Epidemiology determined the perception and health consequences of the LFN.

A method of the questionnaire investigation (inquiries) was applied to evaluate the state of health and subjective noise nuisance. The tests referred to adults (over 18) living in dwellings where occurred the LFN from appliances installed in the building and at least one person from that flat complained about the noise nuisance (group tested, designated Group T). By means of the matching method each individual of the Group T was matched with a person of the same gender, at the similar age, living in the same block of flats in a dwelling with a comparable level of background noise but without the LFN control group, designated Group C. Table 1 presents the sources of the annoying LFN, the sound levels in flats during the noise operation and a percentage of the individuals, from the Group T, exposed to the noise coming from the given source.

No	Source of noise	L _A (dB)	Percentage of individuals exposed	Kind of exposure
1	Fans	26-31	33%	daytime, intermittent
2	Central heating pumps	23-33	18%	night and day, intermittent
3	Transformers	20-23	30%	continuous, night and day
4.	Refrigerating units	21-32	19%	day and night, intermittent

Table 1: A list of LFN sources, sound levels in dwellings during source operation and a percentage of individuals from Group T exposed to each noise source.

In most of flats (81%) in Group T a sound level did not exceed the permissible values (25 dBA at night, 35 dBA-in daytime), but the noise was audible and perceived as annoying due to the low-frequency components.

The LFN did not occur in dwellings of the Group C. There were acoustical conditions typical for urban area. The flats were penetrated by traffic noise (from cars mainly) and random residential (*everyday*) noise at unstable levels. The background noise levels were comparable in the dwellings of the both groups.

The evaluation of the state of health and noise nuisance was performed based on the questionnaire to be specially prepared. The inquiry form included the topics as follows:

- personal details (age, gender, education, profession, exposure to noise in a workplace),
- living conditions,
- exposure to noise in daytime and at night,
- subjective evaluation of audible noise nuisance,
- subjective and objective characteristics of noise sources,
- the present state of health of the individual tested.

Data about the possible changes in a state of health, in result of the day-night exposure to the LFN, were gathered based on the responses obtained. To evaluate the noise nuisance there were taken into account particulars about a getting accustomed to existing noise, desire to exchange a flat, taking up the action with a purpose of recognition and elimination of noise sources, search for help at kith and kin. The individuals were asked about time of day when the noise usually occurred, its kind (continuous, intermittent), duration, taking up the action to mask the noise (e.g. – turn on the radio, TV or open a window).

In questions concerning the subjective evaluation of noise hazard they were asked about noise loudness, its nuisance, a disturbance of the fundamental living functions: work, rest, sleep.

Internal sources of residential noise and external sources whose energy penetrated into dwellings were identified with objective methods. It was determined a type of noise, its nature and acoustical parameters. Information was gathered about a subjective feeling of noise source and time of its operation. To evaluate a state of health there were used: a test of cardiovascular disease, the Questionnaire for Assessment Behaviour Models [2], the Beck's depression test [1] as well as responses to the questions including a self-evaluation of the state of health, ailments from heart, stomach, liver, the appearance of chronic fatigue symptoms, a chronic insomnia. The individuals were also asked about appearance of diseases of the long-lasting course based on the earlier prepared list of chronic diseases. Since a deviation in the state of health mostly depends on many reasons it is very difficult to prove the effect of LFN.

3 - RESULTS OF THE QUESTIONNAIRE STUDY

A group of 49 individuals, living in Warsaw, was examined. 27 of them were qualified to the group tested (Group **T**) and the others to the control group (Group **C**). There was a close resemblance between the both groups regarding age, gender, education, employment and living conditions. Moreover, the both groups were equally exposed to the traffic noise and the residential noise. The main distinctive feature for Group **T** was the LFN coming from the appliances installed inside or outside the building (it was confirmed by the acoustical measurements). Table 2 illustrates the mostly mentioned sources of noise

audible in the dwellings under investigation. In Table 3 is given a subjective assessment of the audible noise in dwellings carried out by the dwellers. Health consequences of noise effect – morbid symptoms most frequently declared by the individuals examined are given in Table 4.

No.	Noise source	Group tested	Control group
1	traffic	93%	95%
2	backyard	52%	48%
3	residential (from neighbouring flats)	15%	52%
4	appliances installed in the building	67%	14%
5	appliances of services workshops in the building	44%	19%
6	ventilation in neighbouring building	19%	0%
7	loud music	4%	33%
8	others	11%	38%

Table 2: The mostly indicated sources of noise audible in dwellings examined.

No	Noise assessment	Group tested	Control group
1	annoying, very annoying	93%	45%
2	loud or very loud	70%	68%
3	I got accustomed	15%	83%
4	I did not get accustomed and noise is getting more annoying	83%	30%
5	it makes falling asleep difficult	84%	35%
6	it makes the work, that requires concentration, difficult	78%	45%
7	awakening at night, it makes the refalling asleep difficult	82%	36%
8	it irritates and gets on nerves	93%	59%

Table 3: Subjective assessment of noise in a flat in dwellers' opinion.

It was moreover stated that the individuals exposed to LFN more frequently were sad, cried, had difficulties with making decisions. Mood depression characteristic of the individuals from Group **T** was also confirmed by Wrzesniewski's test for Investigating Behaviour Models. The individuals exposed to LFN were characterized by the decreased need of success, lack of inclination to aggressive behaviour, lower dynamics of activity and lack of reasonable impatience. The lack of mental balance among the individuals exposed to LFN was expressed by the occurrence of moderately severe and severe depression states at 30% of Group **T**. It shows that LFN affecting the central nervous system may accelerate the occurrence of the first symptoms of mental disease at the individuals with hidden disease until now. The Beck's depression test indicated to:

- chronic irritation – 31%(T) vs 5%(C)
- worse estimation of one's own appearance – 33%(T) vs 5%(C)
- inferior quality of sleep – 89%(T) vs 45%(C)

No.	Symptoms	Group tested	Control group
1.	chronic fatigue	59%	38%
2.	heart ailments (anxiety, stitch, beating, palpitation)	81%	54%
3.	chronic insomnia	41%	9%
4.	headaches repeated	89%	59%
5.	repeated feeling of ear pulsation, pains of neck, backaches	70%	40%
6.	frequent feeling of vibration in ears, pressure on eyeballs or other parts of body	55%	5%
7.	frequent feeling of shortness of breath, shallow breathing, "trembling" in chest	58%	10%
8.	frequent irritation, nervousness, anxiety	93%	59%
9.	frequent frustration, mood depression, making decisions with difficulty	85%	19%
10	depression (inclusive severe one)	30 (11)%	5 (0)%

Table 4: Symptoms most often declared by dwellers.

4 - CONCLUSIONS

The epidemiological investigation was performed in order to estimate if LFN at very low levels near the detection thresholds, to be generally recognized as non-arduous and harmless, creates a potential health hazard for the dwellers. In spite of the preliminary character of the study and relatively small group of the individuals examined it explicitly results from the investigation that:

- LFN even at levels approximating the detection thresholds and not exceeding the acceptable values of A-weighted sound levels is perceived as annoying or very annoying and creates the potential health hazard for the dwellers.
- Among the individuals exposed to LFN there were stated the following symptoms to testify a worse state of health:
 - they more often defined their state of health as bad,
 - they really more often declared the heart ailments
 - chronic insomnia more frequently occurred at them.
- Objective psychological tests among the individuals exposed to LFN revealed:
 - occurrence of features predistinating towards the so-called A type i.e. increased risk of heart infarct (Wrzesniewski's test to examine a complex of behaviours and attitudes),
 - essential reduction in mood which may be both a cause and a result of sickness process (Beck's test to measure the state of possible depression).
- The exposure to low-frequency noise may create the depression states or intensify a degree of depression already existing but of which the person is unaware (the moderately serious and serious depression occurred among some individuals exposed to LFN).

REFERENCES

1. **P.J.Lustman, L.L.Griffith, M.S.W. Ray, E.Clouse**, Depression in Adults with Diabetes. Results of 5-yr Follow-up Study. *Diabetes Care*, Vol. 11 (8), pp. 605-612, 1988
2. **K.Wrzesniewski**, Polish Questionnaire for the Assessment type A Behaviour Pattern. (in Polish), *Medical Review (in Polish)*, Vol. 7, pp. 538-542, 1990