Psychophysiological Changes of the Organism Caused by Amplified Music

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The noise of music is a great problem in Lithuania and all over the world. It acts together with other non-beneficial factors of the environment, thus it is difficult to evaluate its harmful impact. The problem of the noise of music arose during the last decade, and it increases with time. In this study, data on the noise of music in clubs and restaurants of Vilnius are presented. 965 persons answered a questionnaire about the influence of the noise of music upon their health. Psychophysiological changes of the organism such as heart rate, blood pressure, reaction speed of the central nervous system, hearing and vision (simple and complex reaction), volume and concentration of attention under the influence of the noise of music were evaluated in 422 individuals.

Key words: noise of music, psychophysiological changes, organism reaction, questionnaire studies

INTRODUCTION

From the beginnings of the humankind, various noises caused many problems for people. Julius Caesar banned traffic of wagons during the night time, as their noise was disturbing his sleep. In Mediaeval times, work of blacksmiths and use of carts with iron tires in certain places of cities was limited by legal acts. American B. Franklin was forced to move from one place of Philadelphia to another as, according to his words, "noise of the market disturbs me more and more, and I do find myself more and more often that some things I must repeat twice".

Recently the problem of the noise of music has become actual for professionals of various fields. According to the data of J. D. Mansfield and others, inside the cars with powerful stereo equipment sound is intensified up to the extreme level of 140 dB, and during sessions of aerobics and figure skating the level of music is the same as in disco clubs (1). J. Schneider points out that a prolonged action of the noise of music causes changes of hearing (2). In Oslo, Norway, analysis of hearing of young people using portable music players was performed. This analysis revealed that the risk of hearing damage is low only in the case of normal intensity (80 dB) of sound. In Germany, survey of 589 teenagers aged 10–17 years regularly using portable music players and attending disco clubs revealed a decrease of hearing by 5 percent comparing with initial levels (4). Studies performed in Singapore disco clubs proved a harmful effect of music on the hearing of employees of these clubs (5). Audiologic screening revealed hearing damage in 41.9 percent of employees *versus* 13.5 percent in control group.

French studies proved that the risk of hearing damage from loud music is the same as from industrial noise (6). Hearing loss was statistically significantly higher among young people who were listening to partable audioplayers for more than 7 hours a day in comparison with the control group.

According to literature, noise provokes changes in homeostasis followed by changes in heart rate, blood pressure, muscle tonus, brain electric activity and emotional tension [7, 8]. Noise causes impairment of sleep, decrease of working capacity, speed of psychomotor reactions and provokes development of neuroses (9, 10). Noise as a stressor via neurohumoral pathways causes changes in cardiovascular system, increases hypertension, facilitates development of ischemic heart disease and inhibits immune system (11). The amount of changes caused by noise depends on the character of noise, time and duration of action during the daytime, general duration, and on other environmental factors. Individual sensitivity, health, age often predetermine the effects and sleep disturbances (12). Epidemiological data point to causal relations between the impact of noise and arterial hypertension (13, 14). It has been established that noise increases the arterial blood

pressure by 5 to 15 mmHg and is a risk factor of arterial hypertension (15).

Taking into account contemporary scientific achievements, noise of music should be evaluated in the context of the general theory of stress (16). Long-lasting sound of high intensity is disharmonic and is considered as noise. Long-lasting noise as a stressor exerts an influence on the central nervous system, causes biochemical changes and increases the concentration of adrenaline in blood, resulting in a psychological stress which is related to the increase of the number of ischemic heart disease factors (17).

MATERIALS AND METHODS

The noise of music in the places studied and at home was measured with a Bruel and Kjer 2203 measuring device. Data on noise measurements in bars, restaurants, discos, etc. performed due to public complaints by the Vilnius Public Health Centre were also used. The level of noise was measured in living compartments located close to disco bars and restaurants. Over 30 measurements were taken. Using a questionnaire, 965 persons frequently exposed to the noise of music were questioned. Psychophysiological studies were performed on 422 persons with the age range from 15 to 52 years.

The reaction speed of the central nervous system was measured with a universal chronoreflexometer. Red and green lights were used as the irritants, and their combination as a complex irritant. A certain latent period passes between the moment of irritation and the onset of the effect. It is very short and is measured in milliseconds. The irritant also provokes corresponding chemical reactions in the brain cortex and induces visible motor reactions. Three measurements of the reaction speed of the central nervous system were taken at intervals of 5–10 seconds and the averages were calculated. For evaluation of the functional status of the central nervous system, tests of vision and hearing were used. For analysis of attention amount and transmission, tables of Shulte-Platonov and other systems were used.

RESULTS AND DISCUSSION

The noise of music according to public complaints was measured in bars, restaurants and discotheques. The level of noise was measured in living compartments located close to disco bars and restaurants. Data of the measurements are presented in Table. It shows that the equivalent level of sound in bars, restaurants, discotheques and living compartments in some places exceeded the Lithuanian norms of hygiene HN 33–1993 even four times.

In many of the restaurants, cafés and bars the maximal level of noise exceeds the allowed norms by 5 to 13 dB. For example, in the entertainment centre “Elguva” in the dancing hall the maximal level of noise reached 98 dB and exceeded the upper limit by 5 dB. Analogous data were obtained in other restaurants and bars, but in some of them the noise was extremely high; e.g., in the café-bar “Amerika” the maximal level of noise in the dancing hall reached 102 dB and exceeded the allowed limit by 7 dB. With loud music in restaurants, elevated levels of noise were determined in the neighbourhood courtyards and flats. Excessive noise of music had negative effects on psychics and physiology.

The majority of persons questioned were aged 19–25 years, and they were affected by the noise of music in entertainment places and at home. None of them stated that he/she had no headaches whatever. One of the first effects of the noise of music is headache of various character and duration. About 67 percent of the questioned people pointed out that they got tired faster and had a lower working capability. As many as 57 percent stated that they slept 6 hours per day on average, and this could be a direct effect of the noise of music. Only 43 percent told that they slept 8 hours per day on average. During questioning people were asked what kind of music they liked. About 72 percent preferred banging music; 36 percent liked constantly repeating music. Only 8 percent listened to music they didn’t like. Definite data were obtained on the reaction of the respondents to the duration, character and effects of music.

After psychophysiological tests of the reaction of the central nervous system of young people affected by the noise of music it was established that persons who had been exposed to the noise for 5 and more years (bar attendants, waiters, DJs and others) had slower reactions to sound and light irritants that ordinary amateurs of music. For example, their, reaction speed in chronoreflexometry to red light irritant was 0.623 ± 0.002 ms with the other group (0.231 ± 0.002 ms, $P < 0.001$). The reaction speed in chronoreflexometry to a simple sound irritant among bar attendants was 0.561 ± 0.008 ms *versus* 0.297 ± 0.007 ms. The psychological test was best performed by young people who listened to loud music irregularly (28 s), while in bar attendants this index was lower (57 s). Data on the cardiovascular system in both groups were similar. Thus, persons who had been exposed to the noise of music for five and more years had slower reactions to sound and colour irritants, slower performance of psychological tests, and they made more mistakes than young people who visited discotheques on certain days of the week.

Table. **Data of measurements of noise of music**

No. of object	Name of object	Number of measurements	Equivalent noise dB [averages]	Maximal noise dB [averages]
1.	Entertainment centre "Elguva"	6	46	70
	Flat No.3	4	35	57
	Flat No.12	3	42	62
	Dancing hall	8	83	98
2.	Restaurant "Bočiai"	5	86	94
	Flat No. 5	3	52	49
	Flat No. 7	2	46	46
	Bar	3	58	72
3.	Bar "Prie Universiteto"	4	72	78
	Big hall	3	78	82
	Small hall	2	71	75
4.	Entertainment centre "Muzikinis Angaras"	6	78	80
	End of hall	5	79	96
	Middle of hall	8	82	102
5.	Club "Indigo"	4	86	98
	Dancing hall	9	93	106
	Striptease club	7	89	102
6.	Restaurant "Amatininkų užeiga"	4	80	93
	Central hall	8	80	98
	Cellar hall	5	78	96
7.	Café-bar "Amerika"	8	86	95
	Yard at windows of inhabitants	3	79	88
	Dancing hall	5	92	102
	Pool room	2	79	86
8.	Café at Jaunimo teatras			
	courtyard during concert	7	86	103
	Courtyard of inhabitants	4	80	89
9.	Café "Relax"	5	89	97
	At the living house	5	85	88
	At entrance to cafe	3	87	95
10.	Café "Gardus kąsnelis"	6	69	96
	Flat No. 4	5	52	79
	Flat No. 6	5	58	70
11.	"Gero viskio" bar	7	76	93
	Dancing hall	9	87	97
	Courtyard	5	89	99
12.	Restaurant "Pekino antis"			
	In hall while quiet music	6	78	90
	In hall while usual music	7	86	98
	Flat No. 64	4	78	88

CONCLUSIONS

1. Musical noise in the majority of Vilnius restaurants, cafés and entertainment centres exceeded the allowed limits by 5 to 13 dB and maximally reached 95–103 dB.

2. The individuals who had been exposed to loud music for more than 5 years (bar attendants, waiters, DJs) had slower reactions to external sound and colour irritants and took more time to perform a psychological test, made more mistakes, and their cardiovascular system was more labile than of young people who visited discotheques on certain days of the week.

3. As an effect of amplified music, about 67 percent of respondents were complaining of faster fatigue, decrease of working capability, 57 percent had sleep disturbances and 20 percent impaired hearing.

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ORGANIZMO PSICHOFIZIOLOGINIAI POKYČIAI MUZIKINIO TRIUKŠMO METU

S a n t r a u k a

Straipsnyje aptariami žmonių organizmo psichofiziologiniai pakitimai veikiant muzikiniam triukšmui, analizuojami literatūros duomenys apie šio triukšmo poveikį sveikatai. Anketiniu būdu apklausėme 965 žmones apie muzikinio triukšmo įtaką jų sveikatai. Ištyrėme 422 asmenų psichofiziologinius organizmo pokyčius veikiant muzikiniam triukšmui: pulsą, arterinį kraujospūdį, centrinės nervų sistemos reakcijos greitį, dėmesio greitį ir jo apimtį. Tyrimo rezultatai parodė, kad daugelyje Vilniaus kavinių ir restoranų maksimalus triukšmo lygis viršija leistinus dydžius nuo 5 iki 13 dB. Anketinės apklausos ir organizmo psichofiziologinių tyrimų duomenys atskleidė nemažus pakitimus ir neigiamą poveikį žmonių sveikatai.

Raktažodžiai: muzikinis triukšmas, psichofiziologiniai pokyčiai, organizmo reakcijos anketinis tyrimas