SHORT COMMUNICATION

Community noise annoyance assessment in an urban agglomeration

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Abstract

In urban areas community noise is one of the important factors in producing deterioration of both well-being and the quality of life. The aim of the study was to compare two noise annoyance surveys and two noise annoyance scales in the period of 15 years in selected areas of Slovak capital Bratislava, to calculate risks of community noise annoyance and disturbance in the observed samples. Noise annoyance risks were calculated by bivariate and stratified analysis in the form of odds ratio and Mantel–Haenszel weighted odds ratio from 2x2 and 2xn tables. The use of validated five-grade scale of noise annoyance assessment gives higher possibilities for more detailed analysis, allows to calculate the indicator – percentage of highly annoyed subjects (% HA), the rate of highly annoyed individuals. The percentage of highly annoyed subjects was 18 % in the year 2004, which is comparable with recently published studies. The percentage of respondents that were not at all annoyed by road traffic noise has been decreased during the 15 year period by 10 % (42% vs 32%). The increase of subjective community noise annoyance risks has been observed after 15 years as well. The sample from the year 2004 has been more annoyed by road traffic noise, neighbourhood noise, noise from entertainment facilities, noise from industry and railway noise. The highest risk increase has been observed in the entertainment facilities noise annoyance (OR_{MH}=1.51; 95 % CI = 0.90–2.52 vs OR_{MH} = 4.47; 95 % CI = 2.75–7.33). Using of standard five-grade noise annoyance questionnaire gives higher possibilities for data analysis in the studies investigating the influence of environmental noise annoyance on selected population groups *(Tab. 3, Ref. 7)*.

Key words: community noise, urban area, noise annoyance scale, risk assessment.

In urban areas community noise is one of the important factors in producing deterioration of both well-being and the quality of life. Community noise (also called environmental noise, residential or domestic noise) is defined as the noise emitted from all noise sources except for industrial workplaces. Main sources of community noise include road, railway and neighbourhood activity.

It was estimated in 1994 that in the European Union (EU) approximately 77 million people (i.e., 22 % of the total population of the EU) were exposed to a transportation noise level (L_{Aeq}) exceeding 65 dB during the day, which many countries consider to be unacceptable (Miedema and Oudshoorn, 2001).

It has been demonstrated that community noise may have a number of direct adverse effects other than hearing damage. These include adverse effects on communication, performance, and behaviour; nonauditory physiological effects; noise induced disturbance of sleep; and community annoyance. Noise annoyance may be defined as a feeling of discomfort evoked by noise, it is a psychic status, that arises from unintended perception of influence or at subordination to circumstances with the negative attitude of an individual, because they disturb his privacy, interfere with performed activities or they influence the rest qualities. The level of annoyance together with noise sensitivity is often used

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Acknowledgements. This work was supported in part by Grant No. 1/0533/03 from the Scientific Grant Agency of Ministry of Education of Slovak Republic and Slovak Academy of Sciences.
This work was presented on the meeting of the Slovak Medical Society on the 2005, December 5.

Tab. 1. Subjective community noise annoyance evaluation (distribution in five grade scale, year 2004).

Type of noise	Category in five grade scale Annoys				
	Not at all	Slightly	Moderately	Very	Extremely
Road traffic noise	32 %	28 %	22 %	14 %	4 %
Neighbourhood noise	36 %	29 %	19 %	11 %	5 %
Entertainment facilities noise	63 %	14 %	13 %	6 %	4 %
Railway noise	74 %	11 %	8 %	5 %	2 %
Aircraft noise	74 %	14 %	9 %	3 %	0 %

% HA = 18 (14 (very annoys) + 4 (extremely annoys))

as an important indicator of noise exposure in relation to non-auditory health effects (especially concerning cardiovascular system). The level of noise annoyance is assessed by a questionnaire, in which respondents subjectively describe on various scales (from three to twelve grades) the extent of noise annoyance. The standard five grade scale was suggested by Fields and collaborates (Fields et al, 1997, 2001).

The aim of our study was to compare two noise annoyance surveys and two noise annoyance scales (the new and standardly suggested five – grade scale and three – grade scale used in the older studies) in the period of 15 years in selected areas of Slovak capital Bratislava, to calculate risks of community noise annoyance and disturbance (odds ratio, 95 % CI) in the observed sample.

Material and methods

In our study three and five grade scales were used in the samples from selected population groups. In the sample from the year 1989 (764 respondents, 36 % males, 64 % females; 71% in the age group from 20–40 years) three-grade scale (3 – annoys; 2 – slightly annoys; 1 – not at all, never) validated noise annoyance questionnaire was used (Radulov a Rolný, 1988; Aghova et al, 1990; Sobotová et al, 2001). On the sample from the year 2004 (244 respondents, 36 % males, 64 % females; 80 % in the age group from 20–30 years) the same questionnaire was used adjusted according to Fields et al (1997; 2001) on five grade scale (5 – annoys extremely, always; 4 – substantially, often; 3 – rather, sometimes; 2 – a little, seldom; 1 – not at all, never). The questionnaire items referred to annoyance (global item), disturbance of concentration, conversation, or listening to radio/TV, being nervous or tense, disturbance in going to sleep, and waking up at night. Localization of a flat in quite and noisy area was assessed subjectively and objectively by equivalent noise level measurements (L_{Aeq}) in particular measuring stations in Bratislava (2 meters from the building facades). The questionnaire was evaluated using statistical programmes EPI Info 6.04 and SPlus 6.0. Noise annoyance risks were calculated by bivariate and stratified analysis in the form of odds ratio and Mantel–Haenszel weighted odds ratio from 2x2 and 2xn tables. The level of significance was assessed by 95 % confidence interval (CI).

Results and discussion

Objective measurements proved the subjective evaluation of the situation concerning community noise annoyance, the significant increase of road traffic noise L_{Aeq} in the period of 15 years ($L_{Aeq,24h}$ = 64.7±2 dB vs $L_{Aeq,24h}$ = 67±2 dB; $p<0.001$) for the exposed area.

The results of subjective community noise annoyance evaluation in five grade scale (year 2004) and three grade scale (year 1989) are in the Tables 1 and 2. The higher percentage of road traffic noise annoyance has been observed comparing two noise annoyance scales in the 15 year period. The percentage of subjects moderately and more annoyed by road traffic noise was 40 % in the year 2004, 22 % respondents were annoyed moderately, 14 % of respondents were very annoyed and 4 % were extremely annoyed. The percentage of highly annoyed (% HA) subjects was 18 %. The percentage of subjects annoyed by road traffic noise was 22 % in the year 1989.

The use of validated five-grade scale of noise annoyance assessment gives higher possibilities for more detailed analysis, allows to calculate the indicator of percentages of highly annoyed subjects (% HA), the rate of highly annoyed individuals. The percentage of highly annoyed subjects for the year 2004 in our sample was 18 %. In other recently published studies % HA respondents was 15 % (Babisch et al, 2003). The percentage of respondents that were not at all annoyed by road traffic noise has been decreased during the 15 year period by 10 % (42 % vs 32 %).

Tab. 2. Subjective community noise annoyance evaluation (distribution in three grade scale, year 1989).

Type of noise	Category in three grade scale Annoys		
	Not at all	Slightly	Annoyed
Road traffic noise	42 %	38 %	22 %
Neighbourhood noise	41 %	40 %	19 %
Entertainment facilities noise	89 %	7 %	4 %
Railway noise	84 %	11 %	5 %
Aircraft noise	33 %	35 %	32 %

Tab. 3. Current and previous risks of different noise exposures in noisy vs control area (years 1989 and 2004).

Noise annoyance (type of noise)	Risks in the year 1989			Risks in the year 2004		
	OR (95 % CI)	χ^2	p	OR (95 % CI)	χ^2	p
Industrial noise	1.62 (1.14–2.35)**	7.23	<0.05	2.10 (2.48–4.21)***	13.53	<0.001
Aircraft noise	0.46 (0.22–0.92)*	5.55	<0.05	1.06 (0.64–1.75)	0.02	0.90
Road traffic noise	+2.56 (1.93–3.42)***	44.80	<0.001	3.55 (2.44–5.46)***	43.65	<0.00
Neighbourhood noise	+1.71 (1.29–2.27)***	14.51	<0.001	2.10 (1.52–2.91)***	21.26	<0.00
Entertainment facilities noise	1.51 (0.90–2.52)	2.34	0.126	4.47 (2.75–7.33)***	42.22	<0.00
Railways noise	0.56 (0.31–0.98)*	4.62	<0.05	1.62 (0.98–2.69)	3.44	0.064
House equipment noise	+0.57 (0.40–0.80)*	10.72	<0.05	1.26 (0.80–1.99)	0.84	0.358

*** statistically very highly significant, p<0.001, ** statistically highly significant, p<0.01, * statistically significant, p<0.05, + Mantel–Haenszel weighted odds ratio

The increase of subjective community noise annoyance risks (odds ratio, 95 % CI) has been observed after 15 years as well. The sample from the year 2004 has been more annoyed by road traffic noise, neighbourhood noise, noise from entertainment facilities, noise from industry and railway noise (Tab. 3). The highest risk increase has been observed in entertainment facilities noise annoyance. This could be due to socioeconomic transformations and many other changes in traffic during this 15 year period.

Conclusions

Using of standard five-grade noise annoyance questionnaire gives higher possibilities for data analysis in the studies investigating the influence of environmental noise annoyance on selected population groups. Our results provided the creation of indicator % HA, that was relatively high. This indicator enables the comparison of results from other European and world studies, it facilitates the expanding of the world database on human reactions to noise in different countries. Since noise annoyance is a subjective indicator of exposure, the results must be viewed with caution regarding to recall bias and objective measurements are also needed.

References

Ághová Ľ., Voleková J., Jurkovičová J. Problems of noise in the urban environment. Acta Hyg Epidemiol Microbiol 1990; 3: 6—8.

Babisch W, Ising H, Gallacher JEJ. Health status as a potential effect modifier of the relation between noise annoyance and incidence of ischaemic heart disease. Occup Environ Med 2003; 60: 739—745.

Fields JM, de Jong RG, Brown AL, Flindell IH, Gjestland T, Job RFS, Kurra S, Lercher P, Schuemer-Kohrs A, Vallet M, Yano T. Guidelines for reporting core information from community noise reaction surveys. J Sound Vib 1997; 206: 685—695.

Fields JM, de Jong RG, Gjestland T, Flindell IH, Job RFS, Kurra S, Lercher P, Vallet M, Yano T, Guski R, Felscher-Suhr U, Schumer R. Standardized general-purpose noise reaction questions for community noise surveys: Research and recommendation. J Sound Vib 2001; 242: 641—679.

Miedema HME, Oudshoorn CGM. Annoyance from transportation noise: relationships with exposure metrics DNL and DENL and their confidence intervals. Environ Health Persp 2001; 109: 409—416.

Radulov Š, Rolný D. Noise in the environment of some Slovak towns and community noise annoyance. Acta Hyg Epidemiol Microbiol 1988; Suppl 3: 120—127.

Sobotová L, Jurkovičová J, Voleková J, Aghová L. Community noise annoyance risk in two surveys. Intern J Occup Med Environ Health 2001; 14: 197—200.

Received March 8, 2006.
Accepted March 24, 2006.